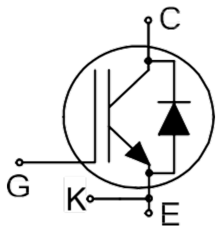
英飞凌短路坚固的 1200 V TRENCHSTOP™ IGBT 7 技术与软、快速恢复发射极控制 7 二极管

特性

- V_{CE} = 1200 V
- I_C = 40 A
- IGBT与全电流，软的及快恢复二极管合封
- 低饱和电压 V_{CEsat}= 2 V 在 T_{vj}= 175°C
- 针对硬开关拓扑进行了优化（2-L 逆变器、3-L NPC T 型……）
- 短路耐受性 8 µs
- 广泛的 dv/dt 可控性
- 完整的产品品类和 PSpice 模型： http://www.infineon.com/igbt/

潜在应用

- 工业驱动
- 工业供电
- 太阳能逆变器



Halogen-free
Lead-free
Green
RoHS

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
IKZA40N120CS7	PG-TO247-4-STD-NT3.7	K40MCS7

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 Min.	Values Typ.	Values Max.	Unit
Internal emitter inductance measured 5 mm (0.197 in.) from case	L_E			13		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	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
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.3	0.42	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.55	0.75	K/W

2 IGBT

表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25$ °C		1200	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25$ °C	82	A
			$T_c = 100$ °C	56	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			120	A
Turn-off safe operating area		$V_{CE} \leq 1200$ V, $T_{vj} \leq 175$ °C		120	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 0.5$ µs, $D < 0.001$		±25	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 600$ V, $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 150$ °C		8	µs
Power dissipation	P_{tot}	$T_{vj} \leq 175$ °C	$T_c = 25$ °C	357	W
			$T_c = 100$ °C	179	

表3　特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 40$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.65	2	V
			$T_{vj} = 175$ °C		2		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.78$ mA, $V_{CE} = V_{GE}$		5.1	5.7	6.5	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 1200$ V, $V_{GE} = 0$ V	$T_{vj} = 25$ °C			40	µA
			$T_{vj} = 175$ °C		3500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = 20$ V				100	nA
Transconductance	g_{fs}	$I_C = 40$ A, $V_{CE} = 20$ V, $T_{vj} = 175$ °C			17		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 600$ V, $V_{GE} = 15$ V, $t_{SC} \leq 8$ µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 150$ °C			240		A
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			5.5		nF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			120		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			27		pF
Gate charge	Q_G	$I_C = 40$ A, $V_{GE} = 15$ V, $V_{CC} = 960$ V			230		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4\ \Omega$, $R_{G(off)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_C = 40$ A		28		ns
			$T_{vj} = 175$ °C, $I_C = 40$ A		29		
Rise time (inductive load)	t_r	$V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4\ \Omega$, $R_{G(off)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_C = 40$ A		15		ns
			$T_{vj} = 175$ °C, $I_C = 40$ A		19		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4\ \Omega$, $R_{G(off)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_C = 40$ A		176		ns
			$T_{vj} = 175$ °C, $I_C = 40$ A		258		
Fall time (inductive load)	t_f	$V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4\ \Omega$, $R_{G(off)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_C = 40$ A		110		ns
			$T_{vj} = 175$ °C, $I_C = 40$ A		260		
Turn-on energy	E_{on}	$V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4\ \Omega$, $R_{G(off)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_C = 40$ A		1.23		mJ
			$T_{vj} = 175$ °C, $I_C = 40$ A		2.1		

（表格续下页......）

表 3 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy	E_{off}	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4 Ω, $R_{G(off)}$ = 4 Ω	T_{vj} = 25 °C, I_C = 40 A		1.78		mJ
Total switching energy	E_{ts}	V_{CC} = 600 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 4 Ω, $R_{G(off)}$ = 4 Ω	T_{vj} = 25 °C, I_C = 40 A		3.01		mJ
			T_{vj} = 175 °C, I_C = 40 A		5.8		
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
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	69	A
			T_c = 100 °C	46	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			120	A
Power dissipation	P_{tot}		T_c = 25 °C	208	W
			T_c = 100 °C	104	

表5 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 40 A	T_{vj} = 25 °C		1.65	2.15	V
			T_{vj} = 175 °C		1.6		
Diode reverse recovery time	t_{rr}	V_R = 600 V, $R_{G(on)}$ = 4 Ω	T_{vj} = 25 °C, I_F = 40 A		110		ns
			T_{vj} = 175 °C, I_F = 40 A		220		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V, $R_{G(on)}$ = 4 Ω	T_{vj} = 25 °C, I_F = 40 A		2.5		µC
			T_{vj} = 175 °C, I_F = 40 A		6.3		

（表格续下页……）

表 5 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	$V_R = 600$ V, $R_{G(on)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_F = 40$ A		63		A
			$T_{vj} = 175$ °C, $I_F = 40$ A		88		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 600$ V, $R_{G(on)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_F = 40$ A		-1020		A/µs
			$T_{vj} = 175$ °C, $I_F = 40$ A		-1430		
Reverse recovery energy	E_{rec}	$V_R = 600$ V, $R_{G(on)} = 4\ \Omega$	$T_{vj} = 25$ °C, $I_F = 40$ A		0.89		mJ
			$T_{vj} = 175$ °C, $I_F = 40$ A		2.54		
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%。

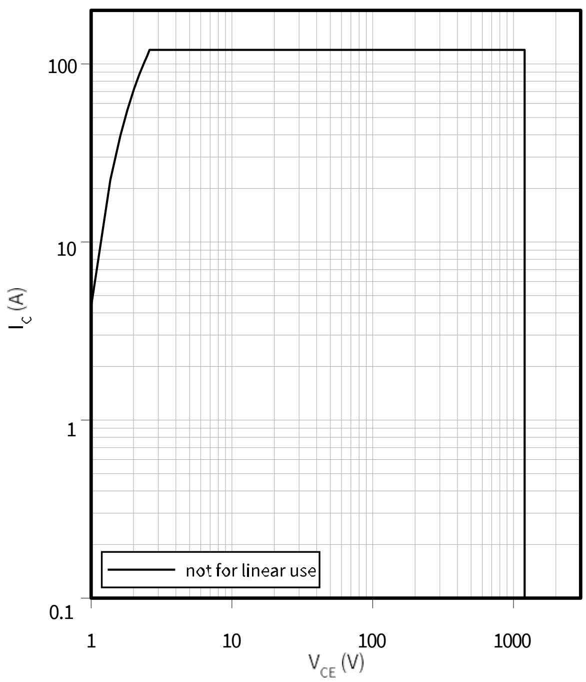
动态测试电路，寄生电感 $L_\sigma = 30$ nH, $C_\sigma = 18$ pF

4 特性图

Reverse bias safe operating area

$I_C = f(V_{CE})$

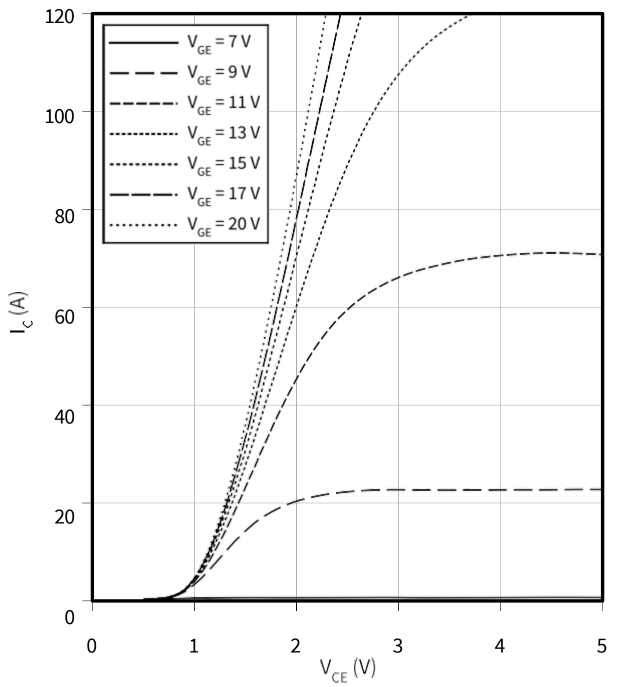
$T_{vj} \leq 175$ °C, $V_{CE} \leq 1200$ V



Typical output characteristic

$I_C = f(V_{CE})$

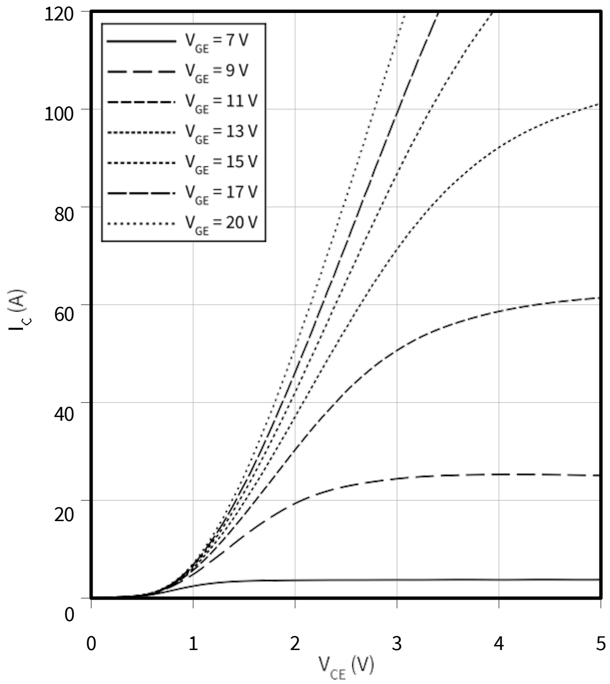
$T_{vj} = 25$ °C



Typical output characteristic

$I_C = f(V_{CE})$

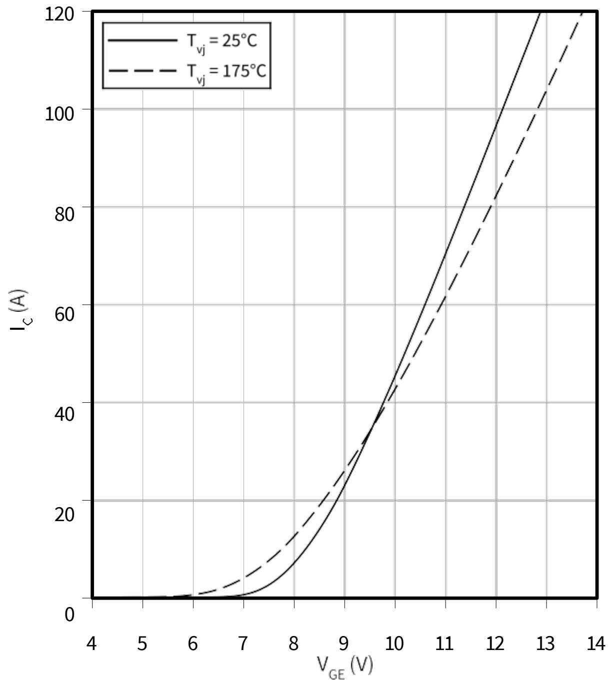
$T_{vj} = 175$ °C



Typical transfer characteristic

$I_C = f(V_{GE})$

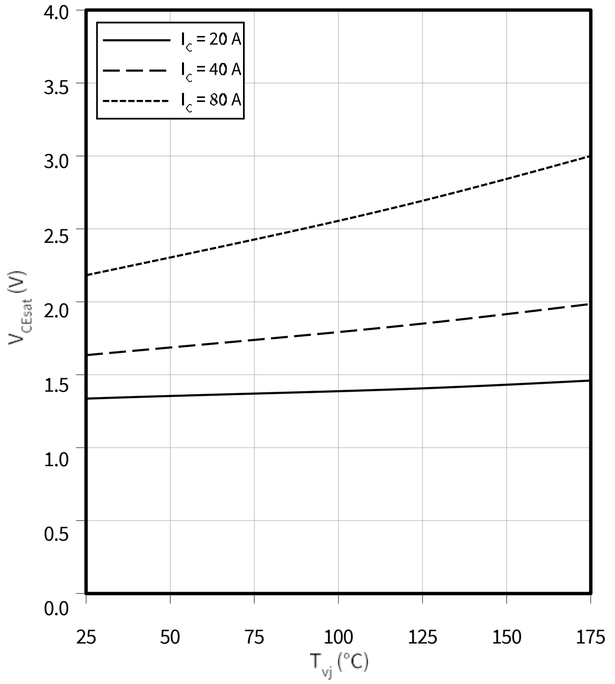
$V_{CE} = 20$ V



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

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

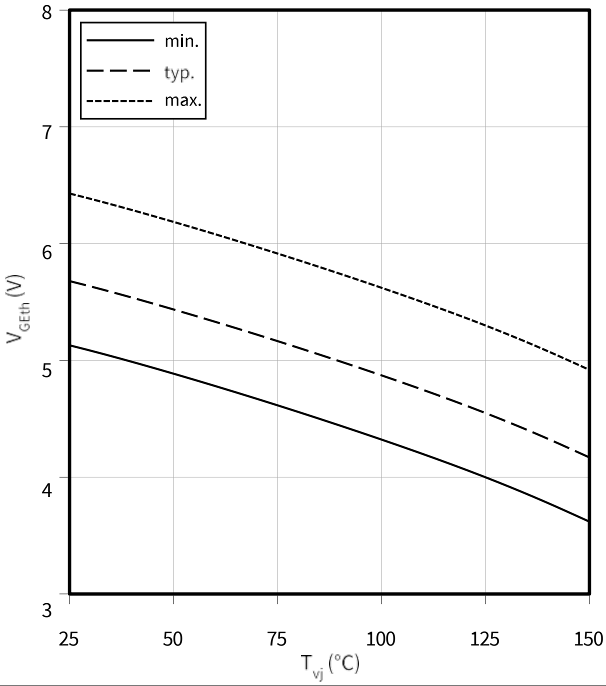
$V_{GE} = 15\ V$



Gate-emitter threshold voltage as a function of junction temperature

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

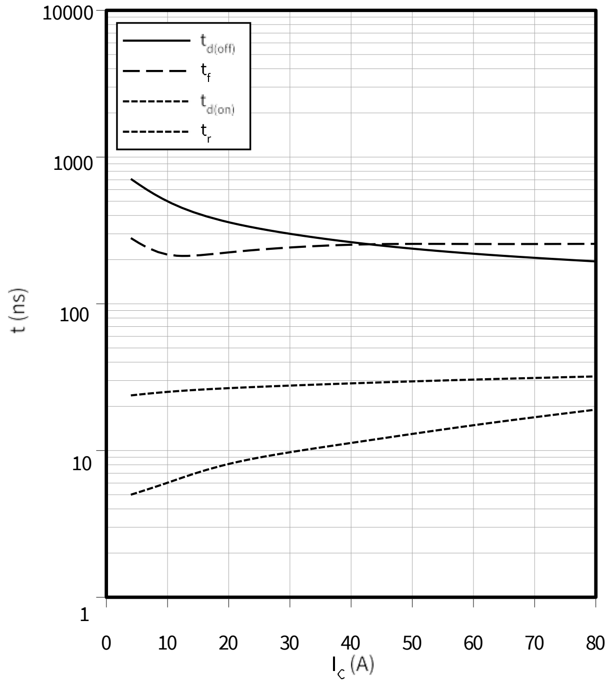
$I_C = 0.78\ mA$



Typical switching times as a function of collector current

$t = f(I_C)$

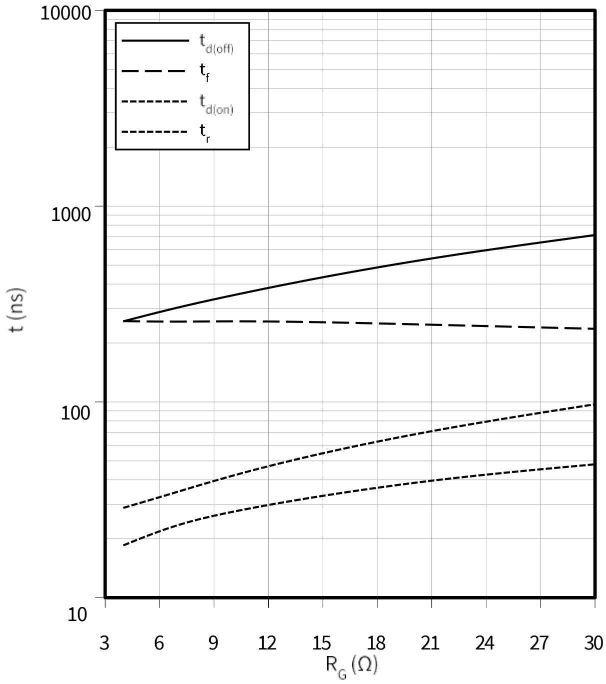
$V_{CC} = 600\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 4\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

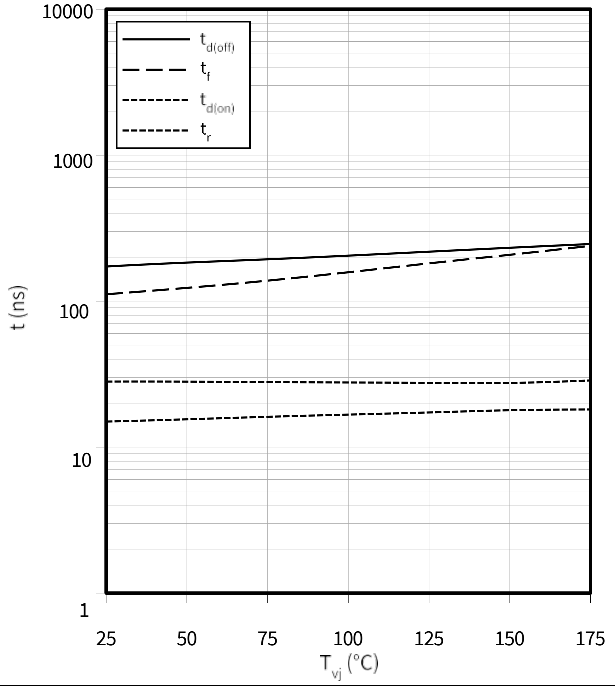
$I_C = 40\ A$, $V_{CC} = 600\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

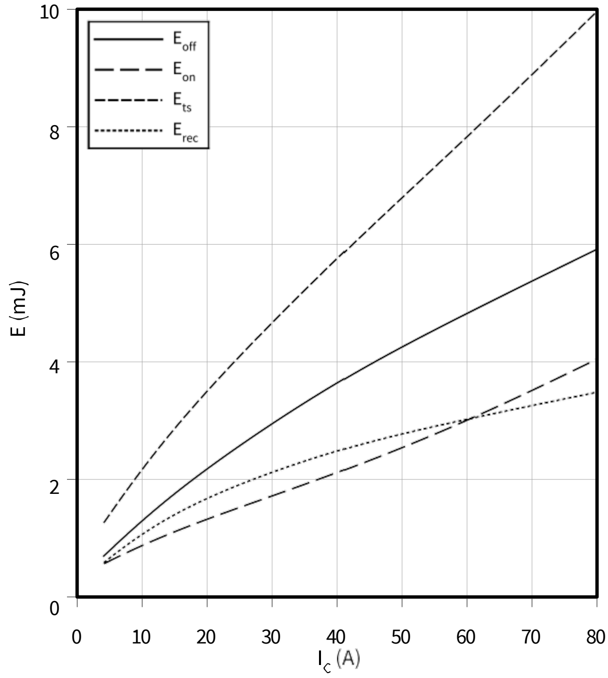
$I_C = 40$ A, $V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 4\ \Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

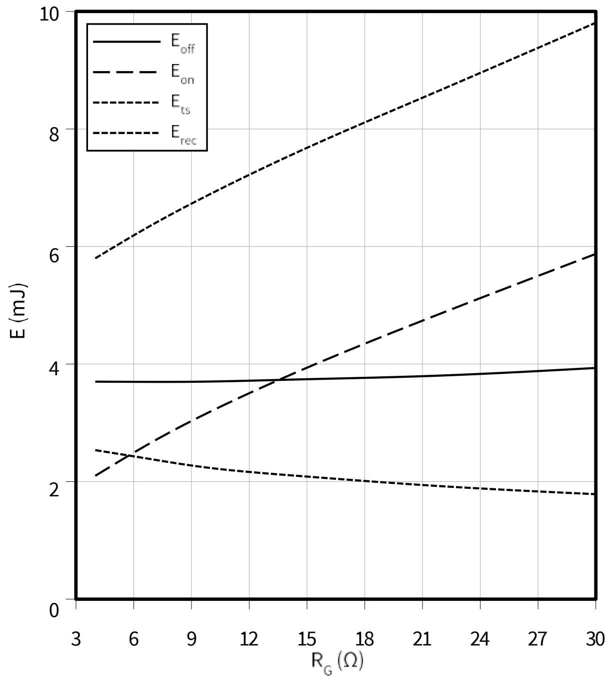
$V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4\ \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

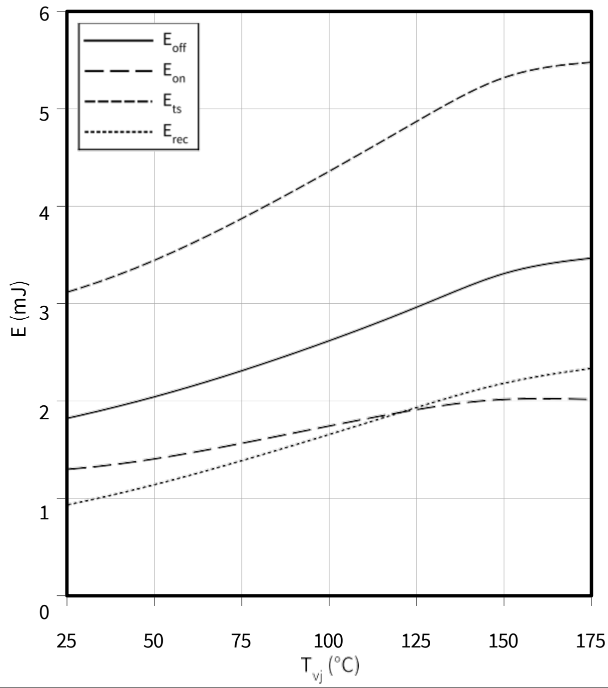
$I_C = 40$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

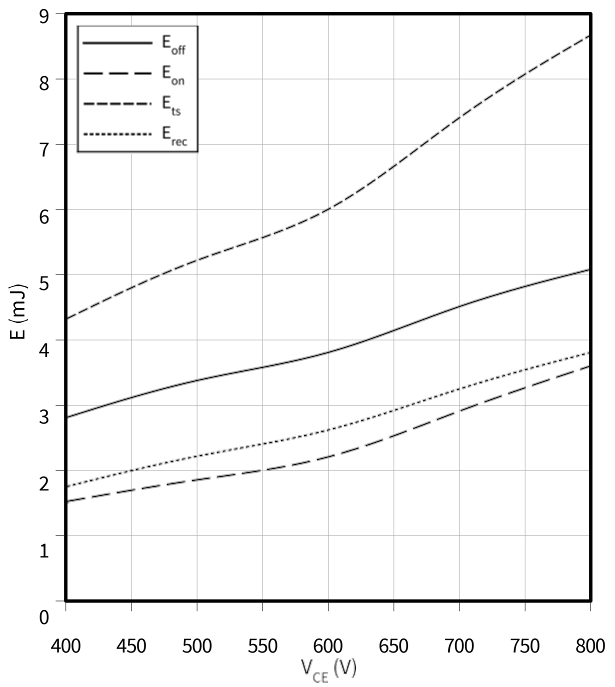
$I_C = 40$ A, $V_{CC} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 4\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

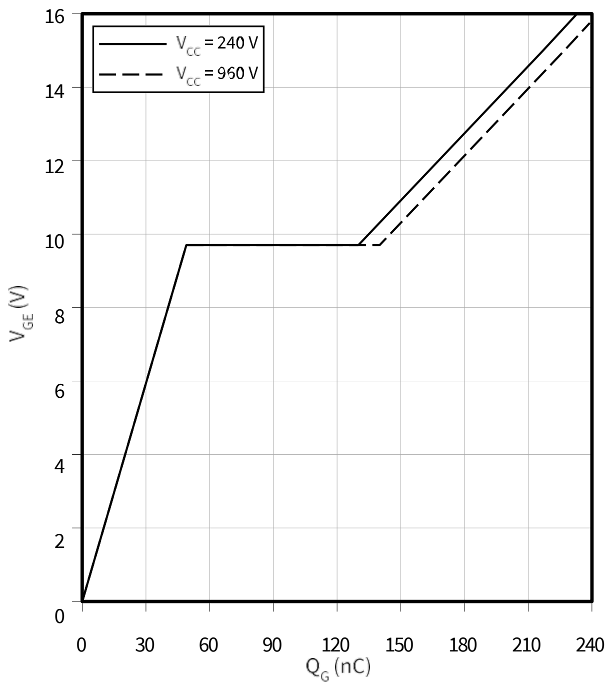
$I_C = 40$ A, $V_{GE} = 0/15$ V, $T_{vj} = 175$ °C, $R_G = 4\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

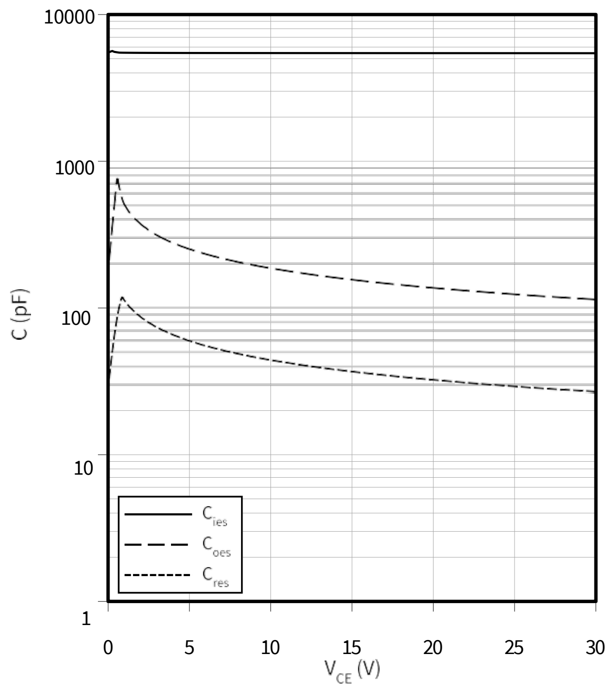
$I_C = 40$ A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

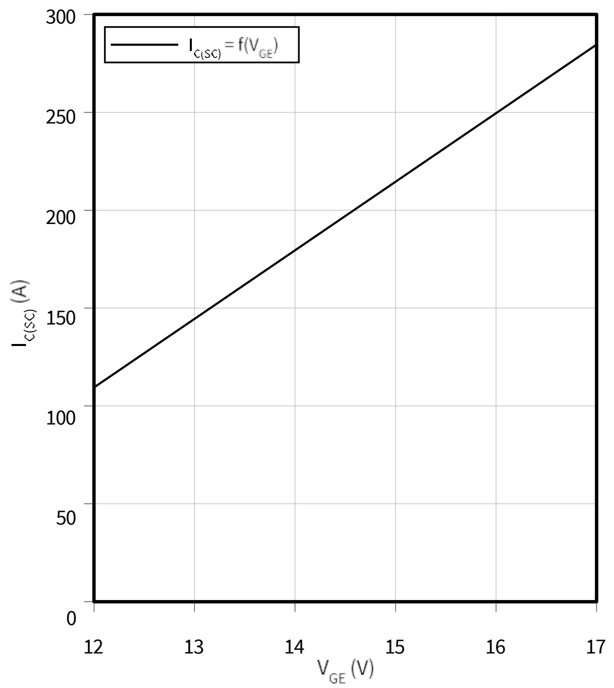
$f = 100$ kHz, $V_{GE} = 0$ V



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

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

$T_{vj} = 150$ °C, $V_{CC} \leq 600$ V

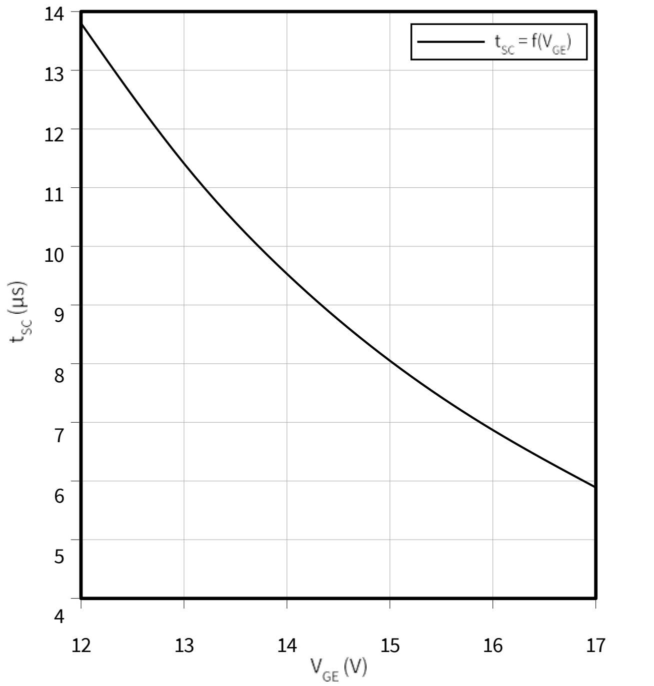


4 特征图

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

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

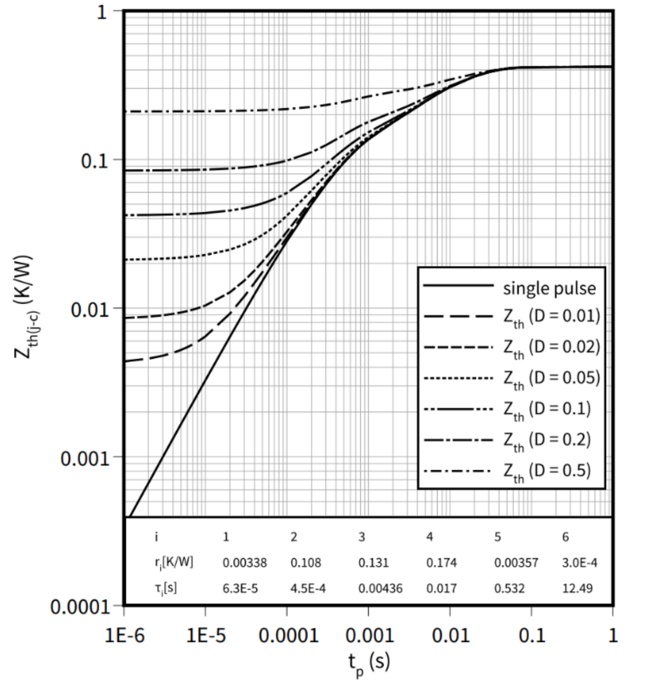
$T_{vj} \le 150$ °C, $V_{CC} \le 600$ V



IGBT transient thermal impedance as a function of pulse width

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

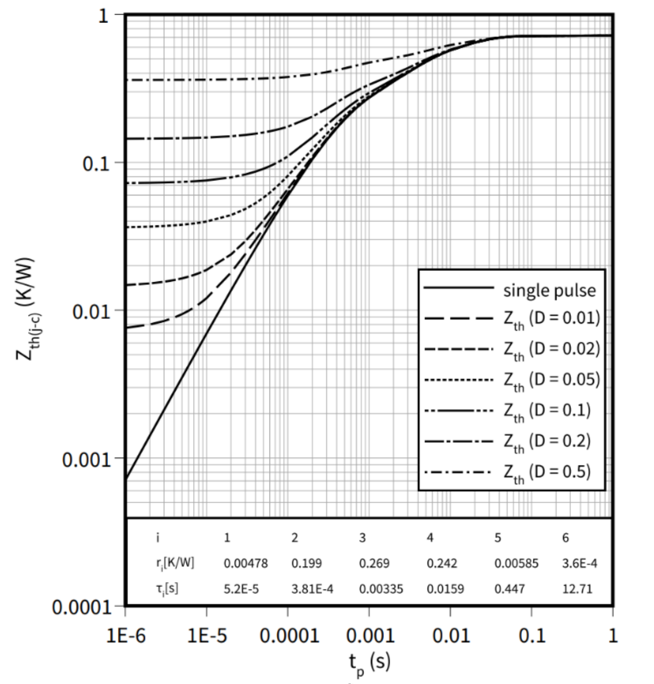
$D = t_p/T$



Diode transient thermal impedance as a function of pulse width

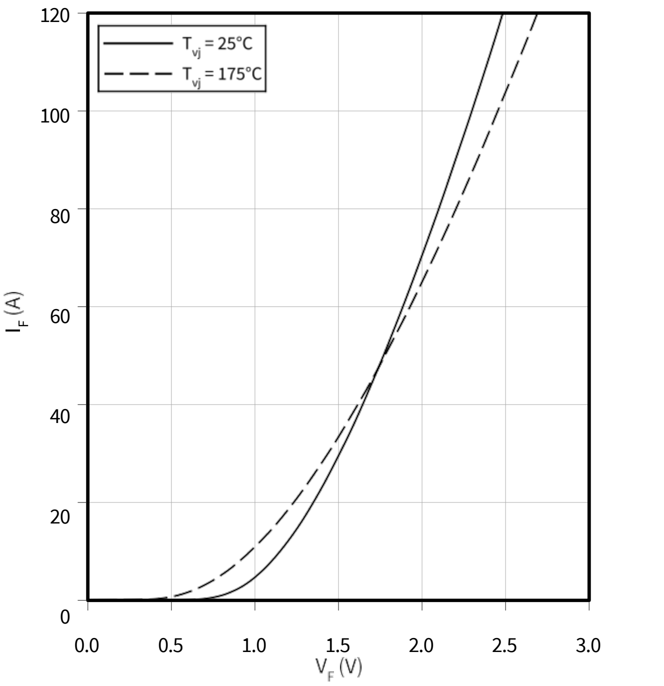
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



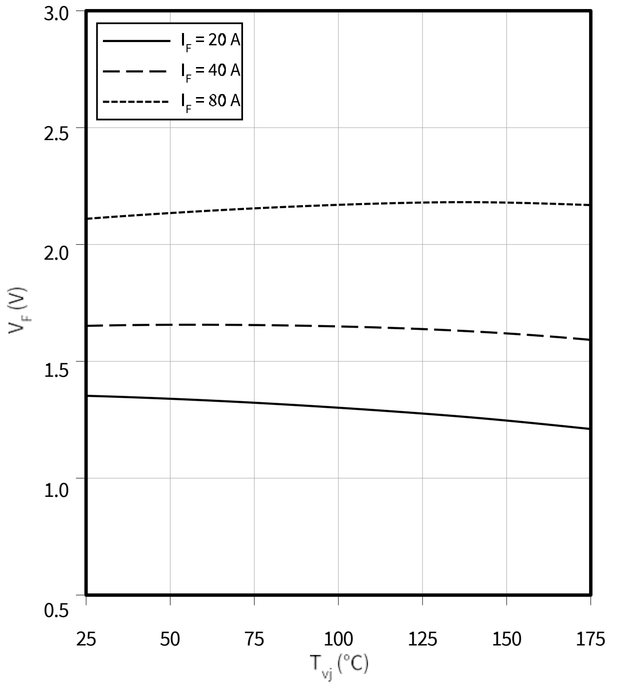
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

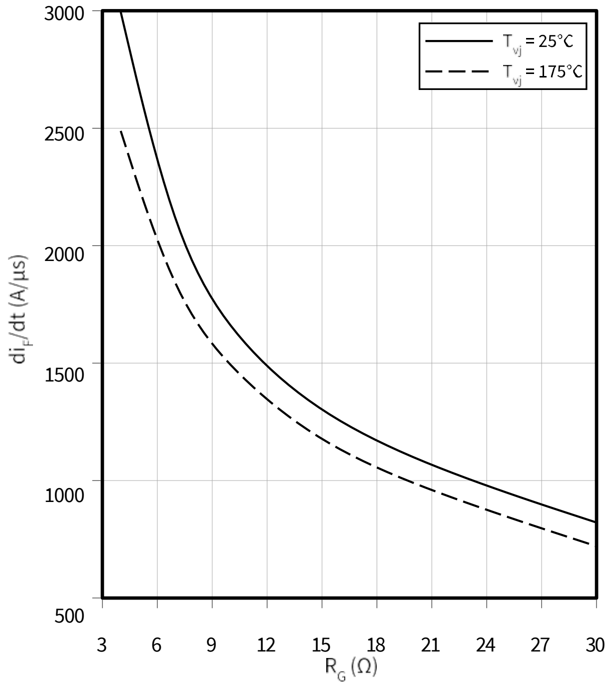
$V_F = f(T_{vj})$



Typical diode current slope as a function of gate resistor

$di_F/dt = f(R_G)$

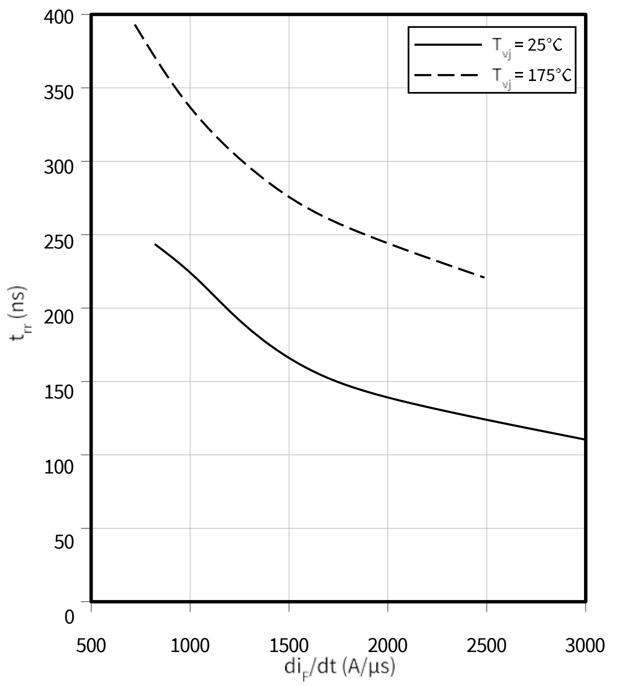
V_R = 600 V, I_F = 40 A



Typical reverse recovery time as a function of diode current slope

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

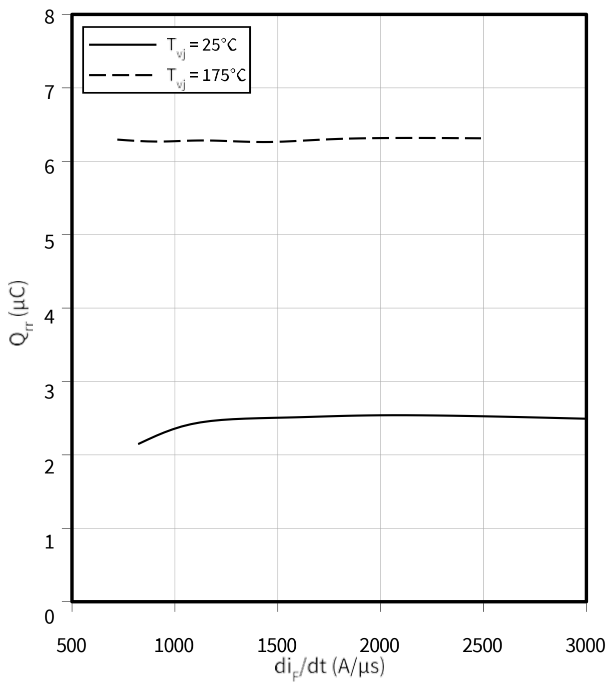
V_R = 600 V, I_F = 40 A



Typical reverse recovery charge as a function of diode current slope

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

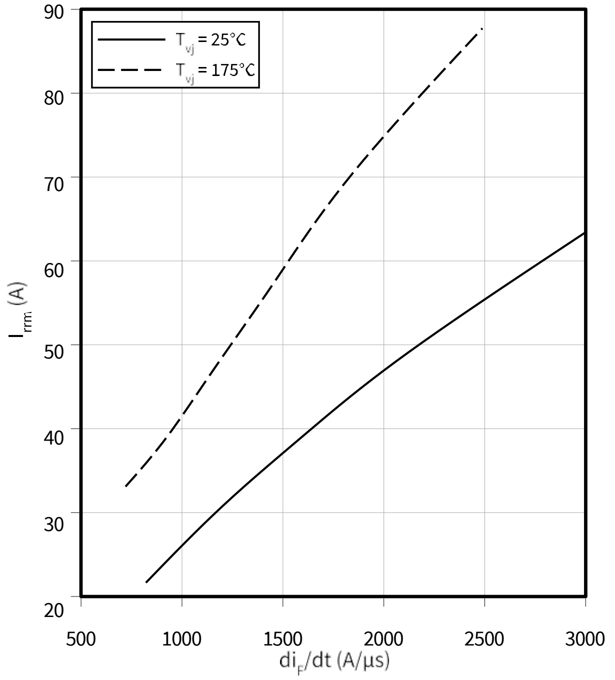
V_R = 600 V, I_F = 40 A



Typical reverse recovery current as a function of diode current slope

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

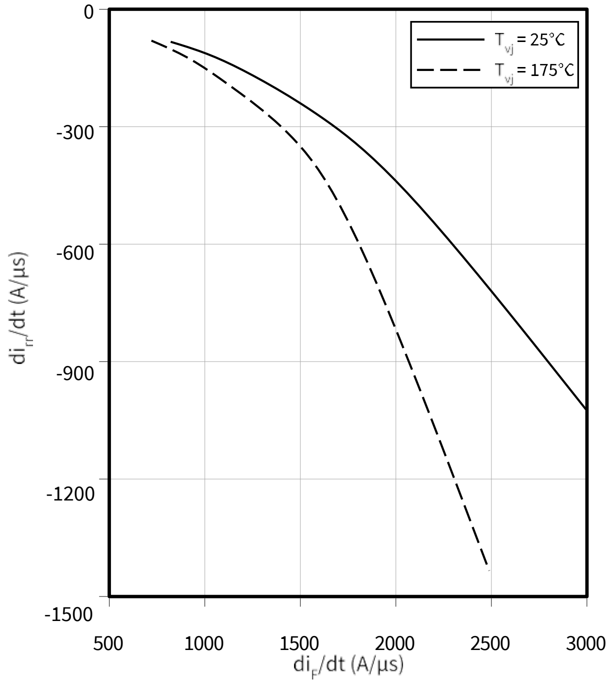
$V_R = 600\ V$, $I_F = 40\ A$



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

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

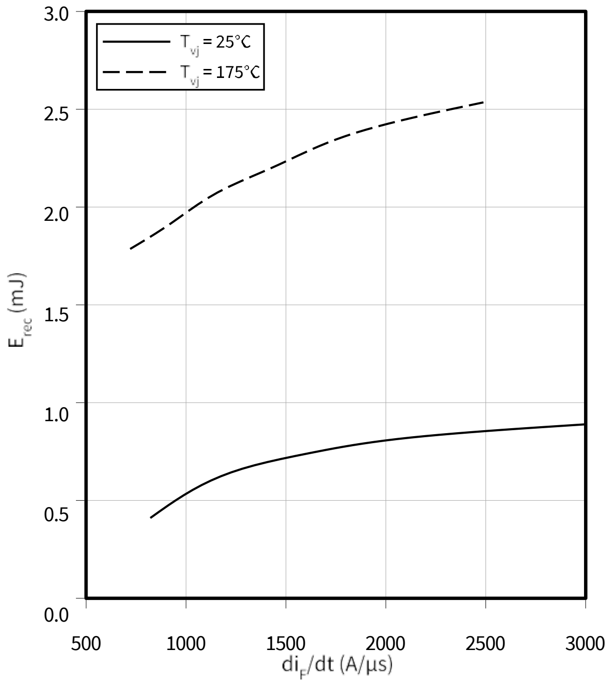
$V_R = 600\ V$, $I_F = 40\ A$



Typical reverse energy losses as a function of diode current slope

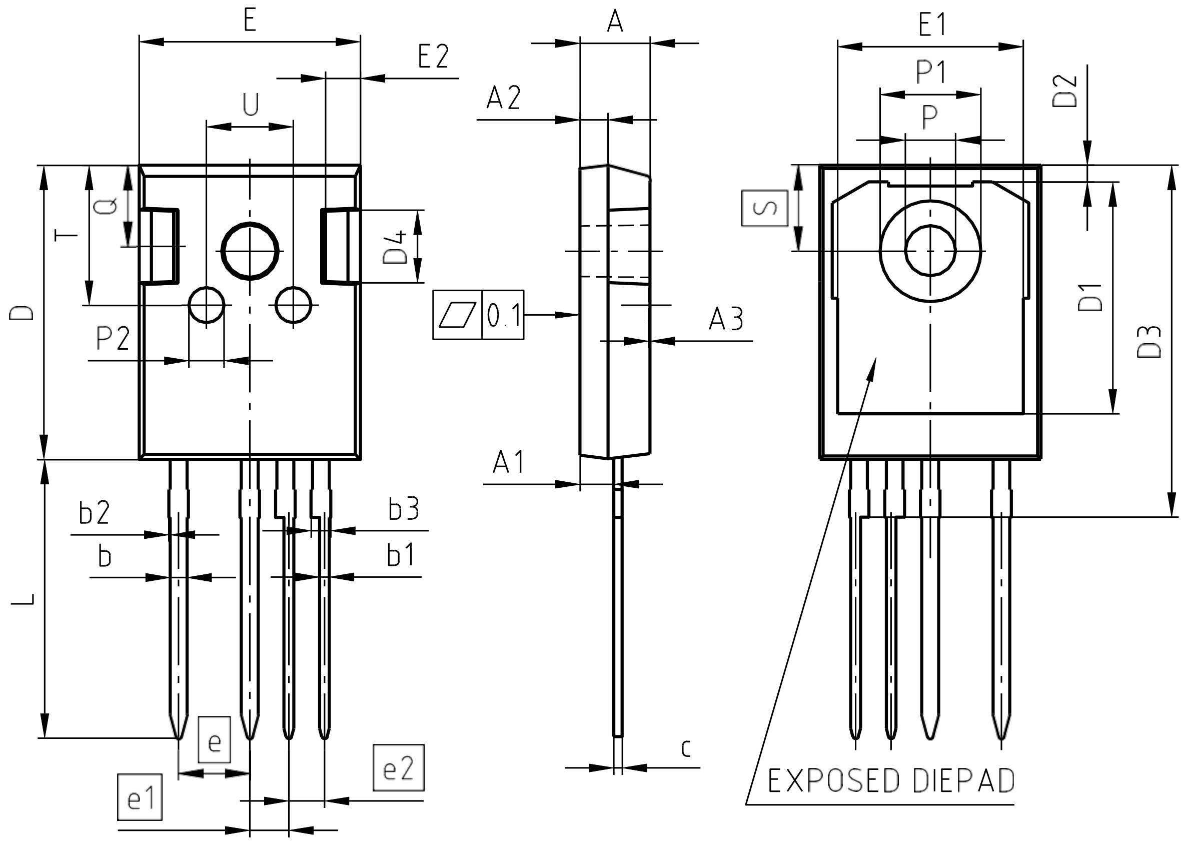
$E_{rec} = f(di_F/dt)$

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



5 封装外形

PG-TO247-4-STD-NT3.7



NOTES:
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH
OR PROTRUSIONS.

PACKAGE - GROUP NUMBER:	PG-TO247-4-U02				
DIMENSIONS	MILLIMETERS		DIMENSIONS	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	4.90	5.10	E	15.70	15.90
A1	2.31	2.51	E1	13.10	13.50
A2	1.90	2.10	E2	2.40	2.60
A3	0.05	0.25	e	5.08	
b	1.10	1.30	e1	2.79	
b1	0.65	0.79	e2	2.54	
b2	---	0.20	N	4	
b3	1.34	1.44	L	19.80	20.10
c	0.58	0.66	øP	3.50	3.70
D	20.90	21.10	øP1	7.00	7.40
D1	16.25	16.85	øP2	2.40	2.60
D2	1.05	1.35	Q	5.60	6.00
D3	24.97	25.27	S	6.15	
D4	4.90	5.10	T	9.80	10.20
			U	6.00	6.40

图 1

6 测试条件

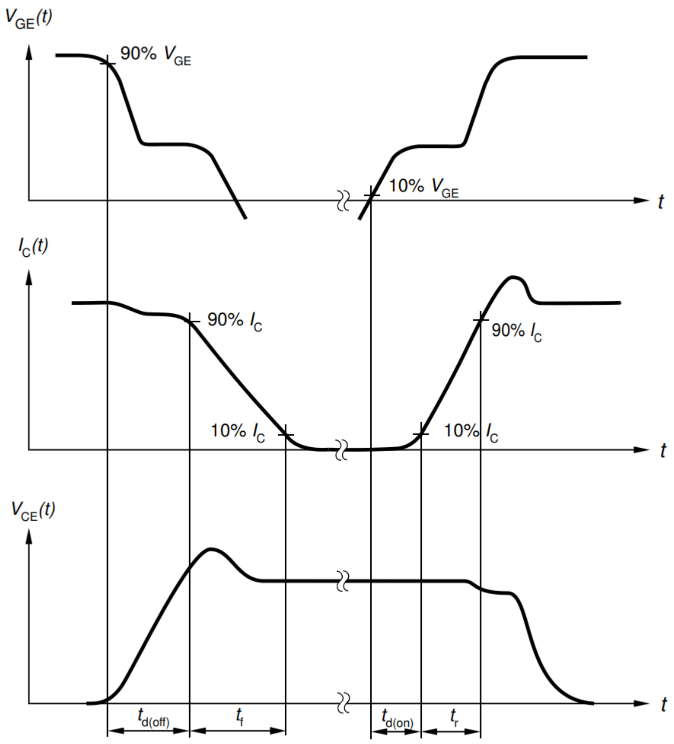


Figure A. **Definition of switching times**

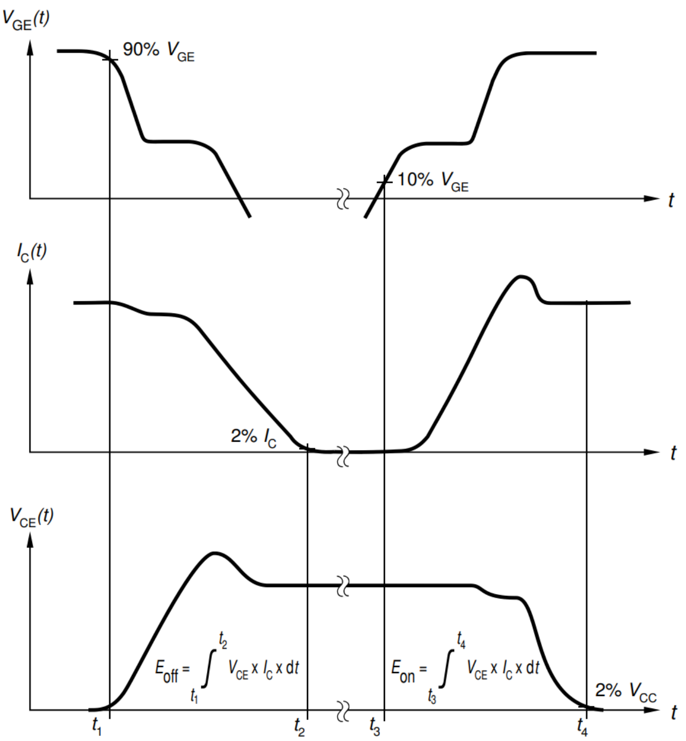


Figure B. **Definition of switching losses**

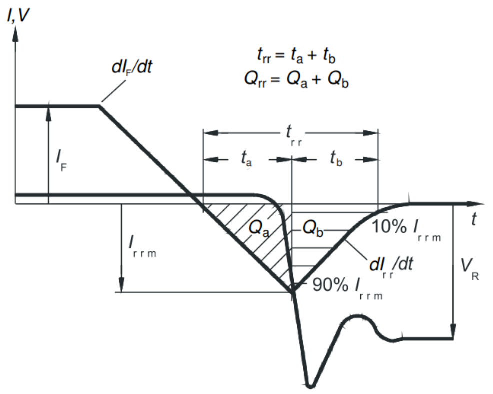


Figure C. **Definition of diode switching characteristics**

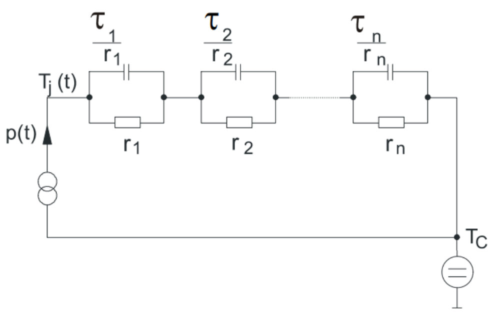


Figure D. **Thermal equivalent circuit**

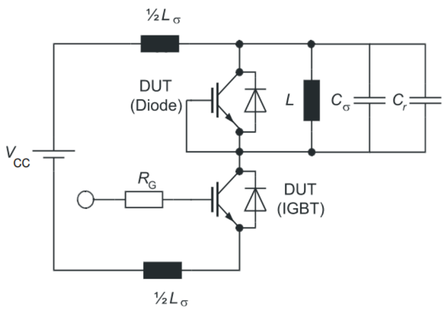


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

图 2

修订记录

Document revision	Date of release	Description of changes
0.10	2022-05-04	Target datasheet
1.00	2022-12-05	Final datasheet
1.10	2023-01-23	Correction of boundary condition of diagrams $I_{C(SC)} = f(V_{GE})$ and $t_{SC} = f(V_{GE})$

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