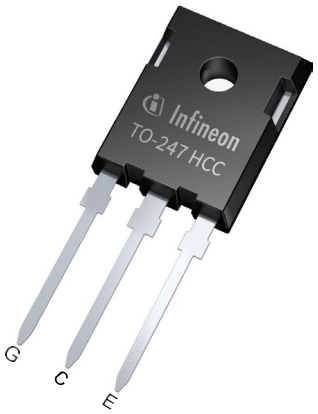
最终数据手册

英飞凌具有短路耐受能力的 1200 V TRENCHSTOP™ IGBT 7 技术，集成软恢复和快恢复二极管

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特性

- V_{CE} = 1200 V
- I_C = 40 A
- 极低V_{CEsat}(C-KE) = 1.7 V（typ.），I_{Cnom}= 40 A，25°C
- 短路耐受时间 t_{sc} = 4 µs（V_{CE} = 800 V、V_{GE} = 15 V）
- 平滑的开关特性
- 广泛的 dv/dt 可控性
- TO247PLUS 封装，配备高爬电距离
- 简单的栅极驱动器设计
- 配备快速软恢复发射极控制7个二极管
- 低EMI特征
- 高可靠性和使用寿命



AEC Qualified

Halogen-free

RoHS

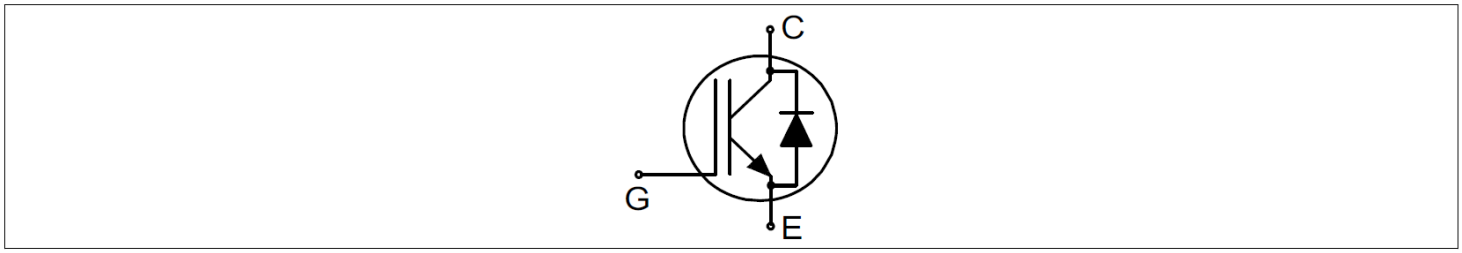
潜在应用

- DC母线放电开关
- 汽车辅助驱动
- 汽车高压加热器

产品验证

- 汽车应用认证。符合AEC-Q101 产品认证

描述



Type	Package	Marking
AIKWH40N120CS7	PG-TO247-3-U04	AW12S7040

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

表 1 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance	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 processes: 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	limited by bondwire	$T_c = 25$ °C	85	A
			$T_c = 100$ °C	65	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			160	A
Turn-off safe operating area		$V_{CE} \leq 1200$ V, $t_p \leq 1$ µs, $T_{vj} \leq 175$ °C		160	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$D = <0.01$		±25	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 800$ V, $V_{GE} = -8/15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 175$ °C		4	µs
Power dissipation	P_{tot}	$T_{vj} = 175$ °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		1.7	2	V
			T_{vj} = 175 °C		2		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.78 mA, V_{CE} = V_{GE}		5.15	5.7	6.45	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		1600		
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			20.7		S
Short-circuit collector current	I_{SC}	V_{CC} ≤ 800 V, V_{GE}=15 V, t_{SC} ≤ 4 µs, Allowed number of short circuits < 1000 , Time between short circuits ≥ 1.0 s	T_{vj} = 25 °C		234		A
			T_{vj} = 175 °C		184		
Internal gate resistance	$R_{G,int}$	f = 100 kHz			5.54		Ω
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			118		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz			28		pF
Gate charge	Q_G	V_{CC} = 960 V, I_C = 40 A, V_{GE} = -8/15 V			343		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	T_{vj} = 25 °C, I_C = 40 A		29		ns
			T_{vj} = 175 °C, I_C = 40 A		35		
Rise time (inductive load)	t_r	V_{CC} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	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} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	T_{vj} = 25 °C, I_C = 40 A		147		ns
			T_{vj} = 175 °C, I_C = 40 A		231		
Fall time (inductive load)	t_f	V_{CC} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	T_{vj} = 25 °C, I_C = 40 A		80		ns
			T_{vj} = 175 °C, I_C = 40 A		194		

（表格续下页……）

表 3 （续）特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy[1)]	E_{on}	V_{CC} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	T_{vj} = 25 °C, I_C = 40 A		3.3		mJ
			T_{vj} = 175 °C, I_C = 40 A		5.65		
Turn-off energy	E_{off}	V_{CC} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	T_{vj} = 25 °C, I_C = 40 A		2.33		mJ
			T_{vj} = 175 °C, I_C = 40 A		4.81		
Total switching energy	E_{ts}	V_{CC} = 800 V, V_{GE} = -8/15 V, R_G = 4.5 Ω	T_{vj} = 25 °C, I_C = 40 A		5.63		mJ
			T_{vj} = 175 °C, I_C = 40 A		10.5		
Operating junction temperature	T_{vj}			-40		175	°C

1) 包括反向恢复电流引起的 IGBT 损耗

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	88	A
			T_c = 100 °C	54	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			160	A
Power dissipation	P_{tot}	T_{vj} = 175 °C	T_c = 25 °C	200	W
			T_c = 100 °C	100	

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		1.68	2.15	V
			T_{vj} = 175 °C		1.62		

（表格续下页……）

表 5　　（续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	Q_{rr}		T_{vj} = 25 °C, I_F = 40 A		2.8		µC
			T_{vj} = 175 °C, I_F = 40 A		7.6		
Diode peak reverse recovery current	I_{rrm}		T_{vj} = 25 °C, I_F = 40 A		28.9		A
			T_{vj} = 175 °C, I_F = 40 A		43.2		
Diode reverse recovery energy	E_{rec}		T_{vj} = 25 °C, I_F = 40 A		1.11		mJ
			T_{vj} = 175 °C, I_F = 40 A		3.35		
Operating junction temperature	T_{vj}			-40		175	°C

注： *为了获得最佳的使用寿命和可靠性，英飞凌建议工作条件不超过本数据手册中所述最大额定值的80%。*

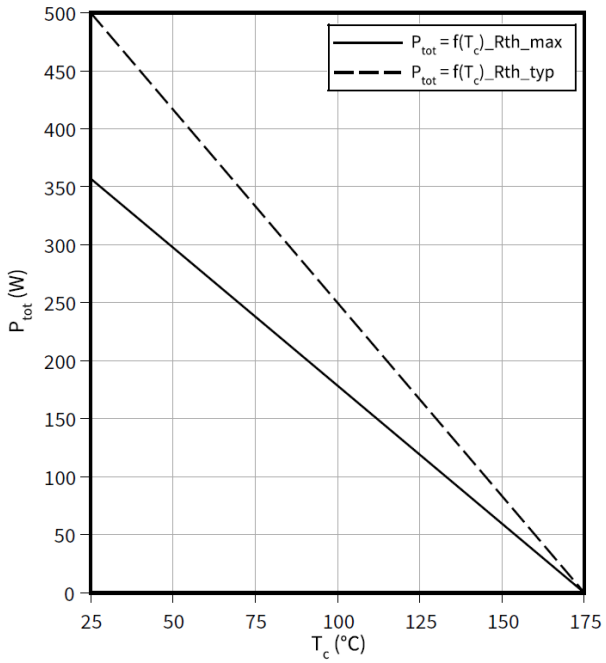
除非另有说明，否则*电气特性均在 T_{vj} = 25°C 条件下测得。动态测试电路，寄生电感 Lσ = 30 nH，$C_σ$ = 8 pF。*

4 特性图

Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$

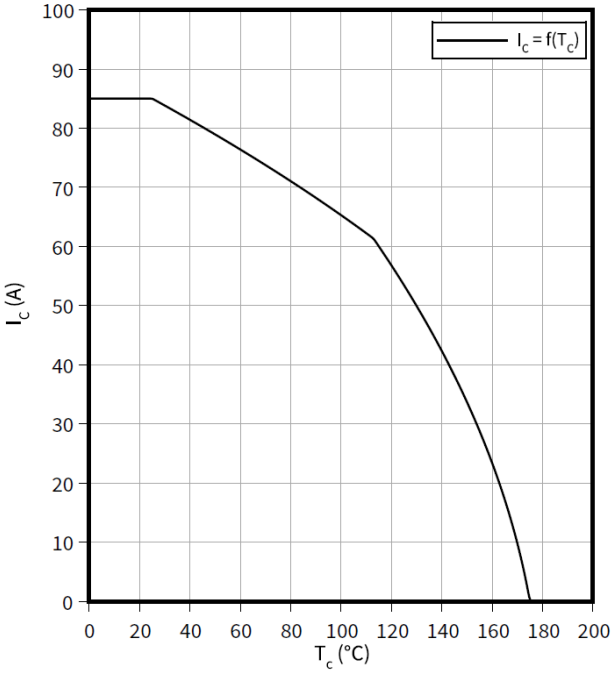
$T_{vj} \leq 175$ °C



Collector current as a function of case temperature

$I_C = f(T_c)$

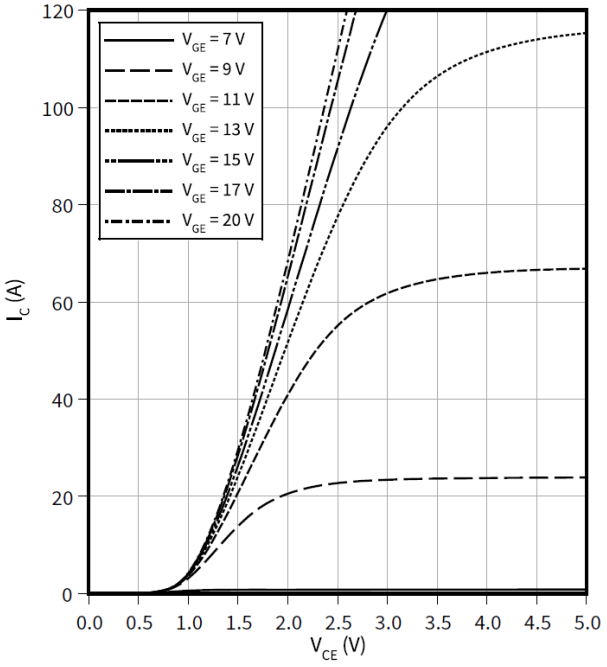
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



Typical output characteristic

$I_C = f(V_{CE})$

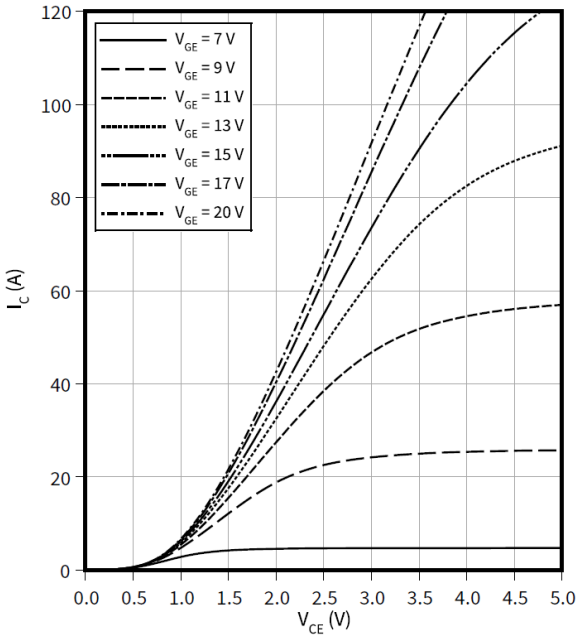
$T_{vj} = 25$ °C



Typical output characteristic

$I_C = f(V_{CE})$

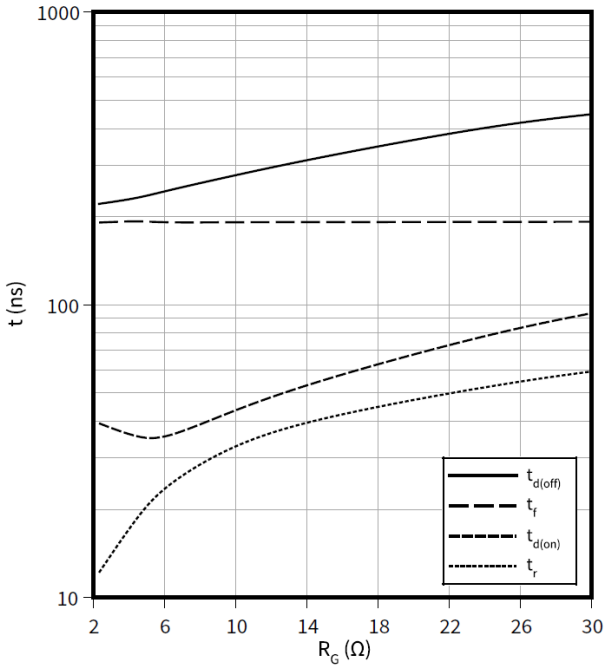
$T_{vj} = 175$ °C



Typical switching times as a function of gate resistor

$t = f(R_G)$

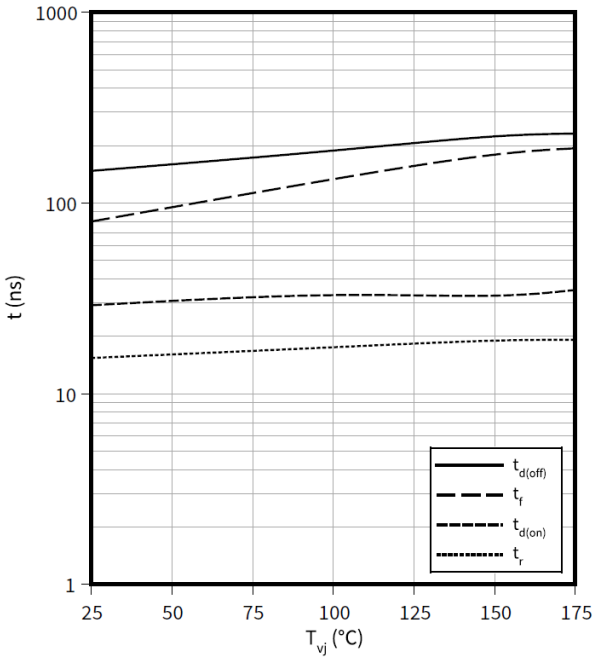
$I_C = 40$ A, $V_{CC} = 800$ V, $T_{vj} = 175$ °C



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

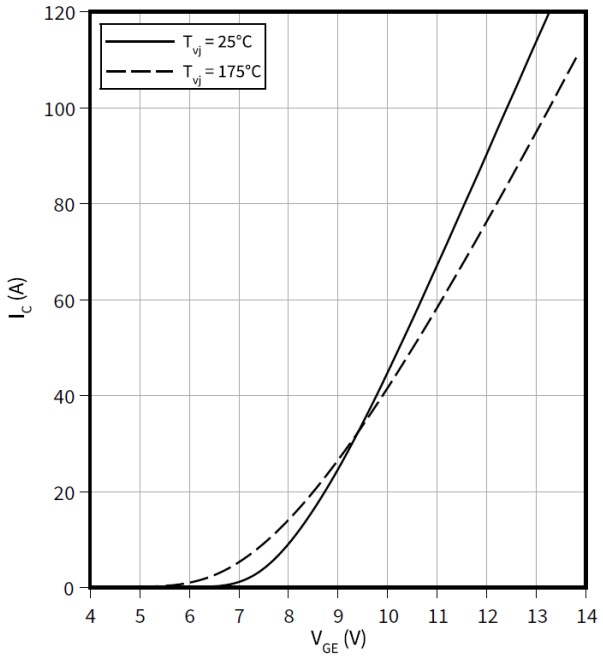
$I_C = 40$ A, $V_{CC} = 800$ V, $R_G = 4.5$ Ω



Typical transfer characteristic

$I_C = f(V_{GE})$

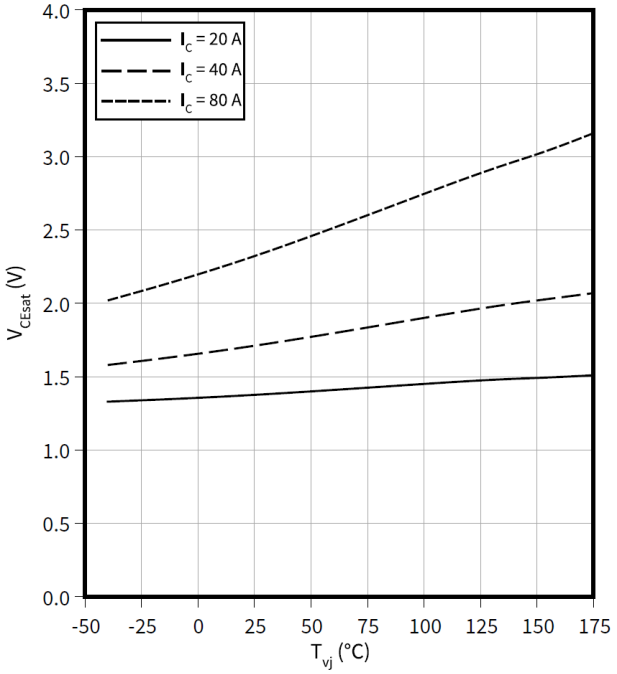
$V_{CE} = 20$ V



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

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

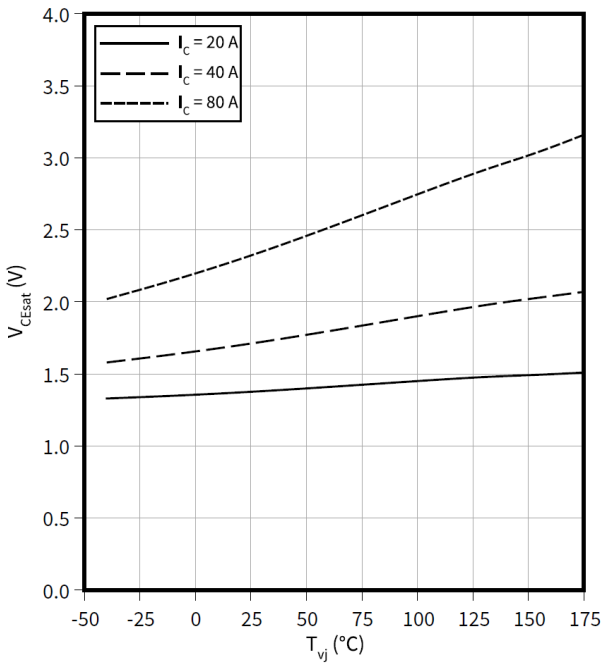
$V_{GE} = 15$ V



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

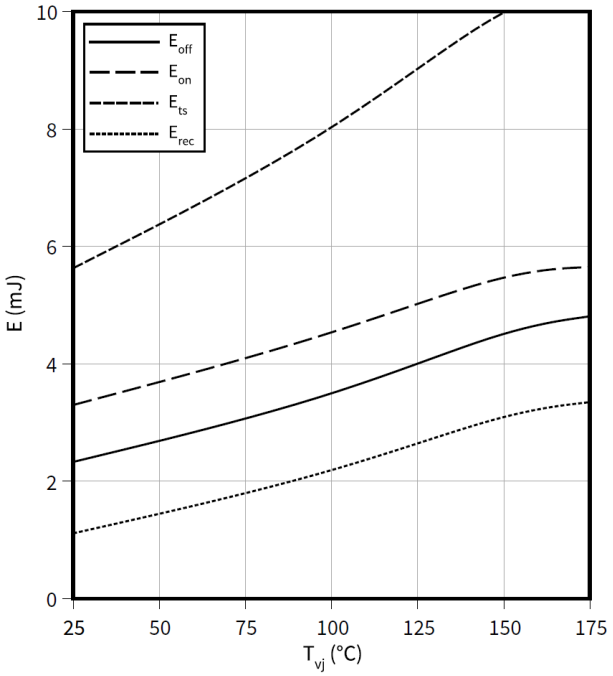
$I_C = 40\ A$, $V_{CC} = 800\ V$, $T_{vj} = 175\ °C$



Typical switching energy losses as a function of junction temperature

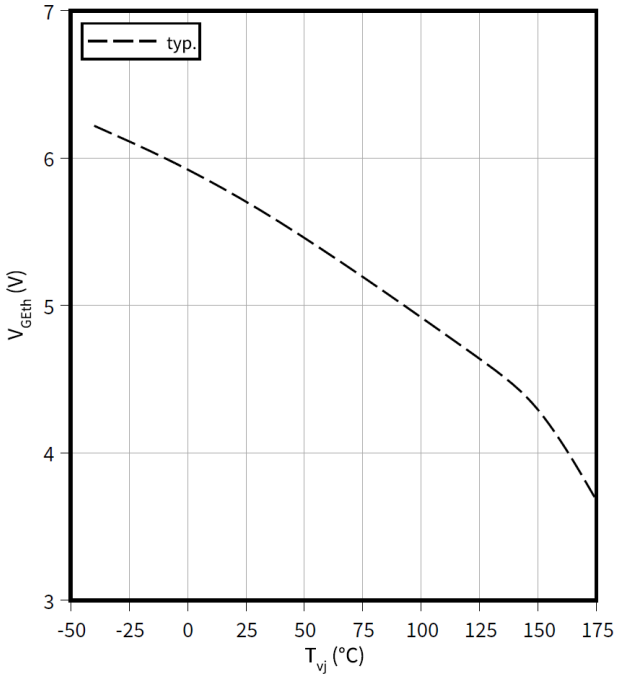
$E = f(T_{vj})$

$I_C = 40\ A$, $V_{CC} = 800\ V$, $R_G = 4.5\ \Omega$



Gate-emitter threshold voltage as a function of junction temperature

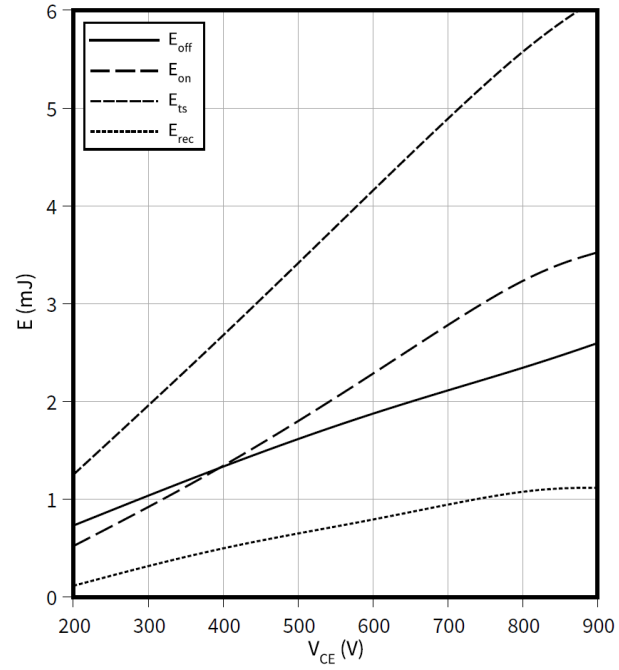
$V_{GEth} = f(T_{vj})$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

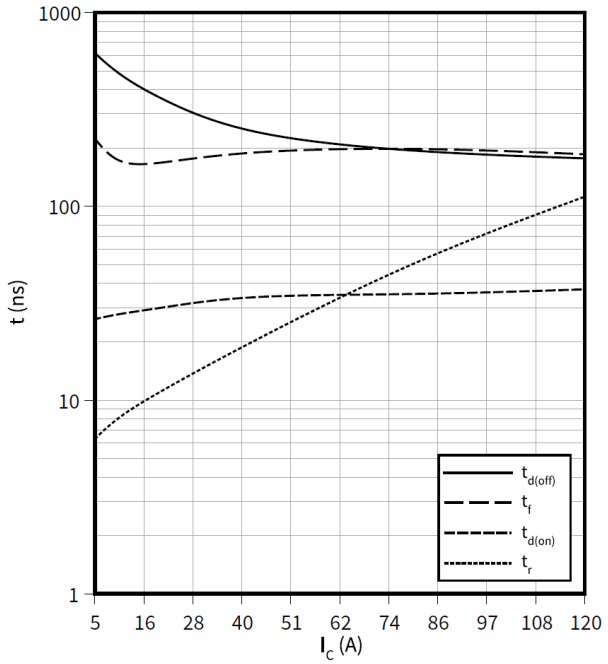
$I_C = 40\ A$, $T_{vj} = 175\ °C$, $R_G = 4.5\ \Omega$



Typical switching times as a function of collector current

$t = f(I_C)$

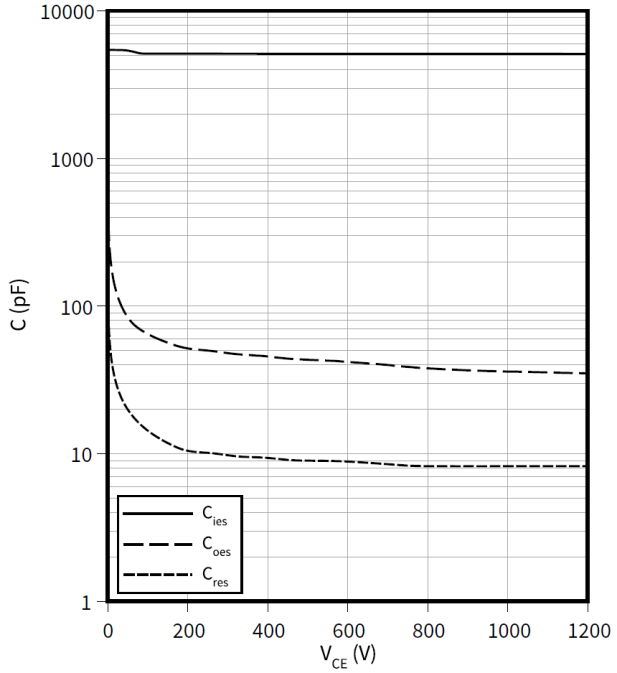
$V_{CC} = 0$ V, $T_{vj} = 175$ °C, $R_G = 4.5$ Ω



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

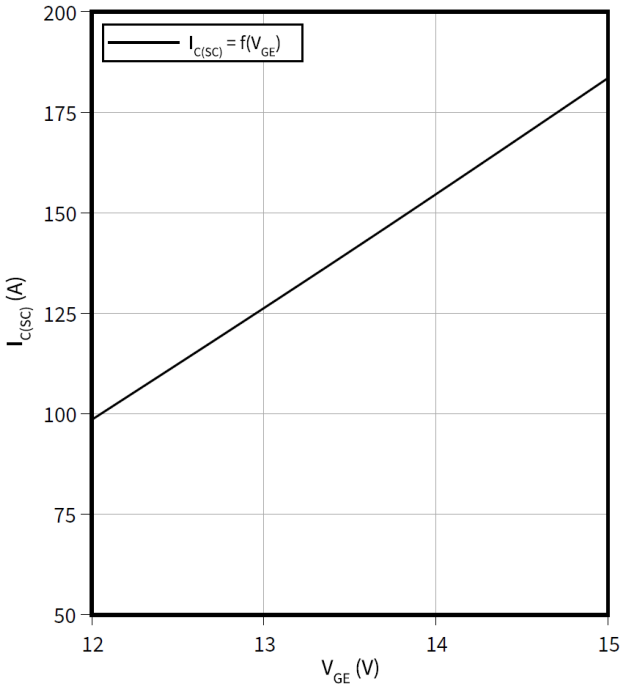
$f = 0$ kHz, $V_{GE} = 0$ V



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

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

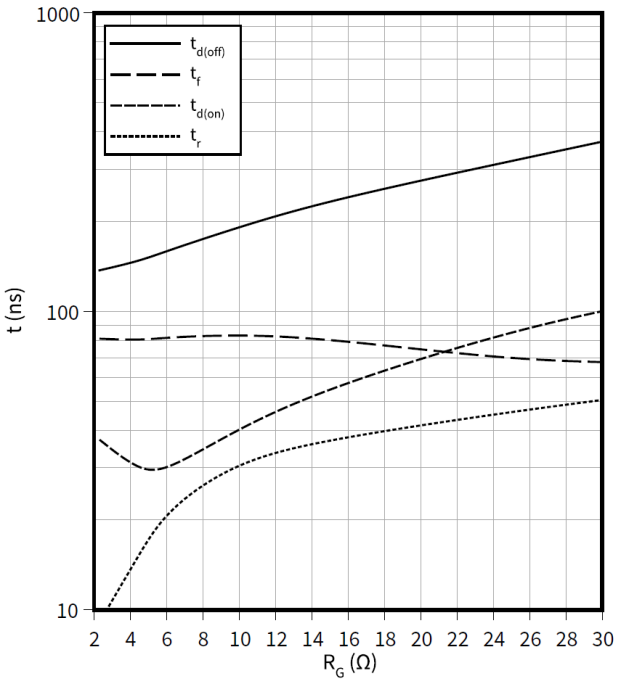
$T_{vj} = 175$ °C, $V_{CC} = 800$ V



Typical switching times as a function of gate resistor

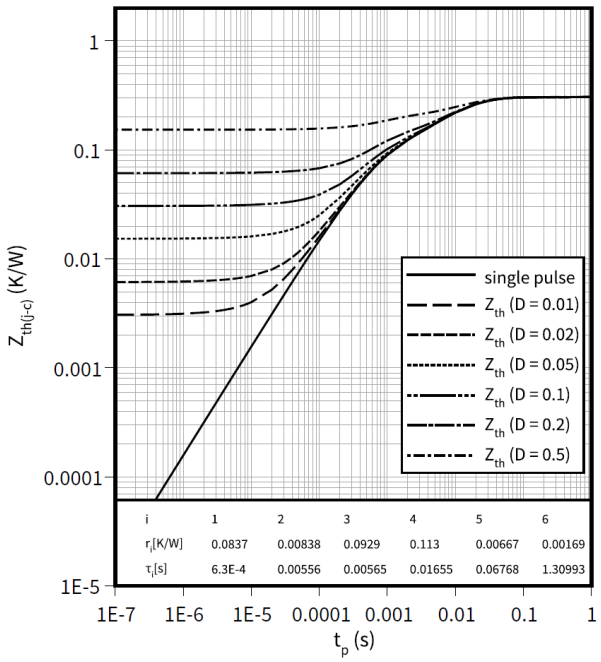
$t = f(R_G)$

$I_C = 40$ A, $V_{CC} = 800$ V, $T_{vj} = 25$ °C



IGBT typical transient thermal impedance as a function of pulse width

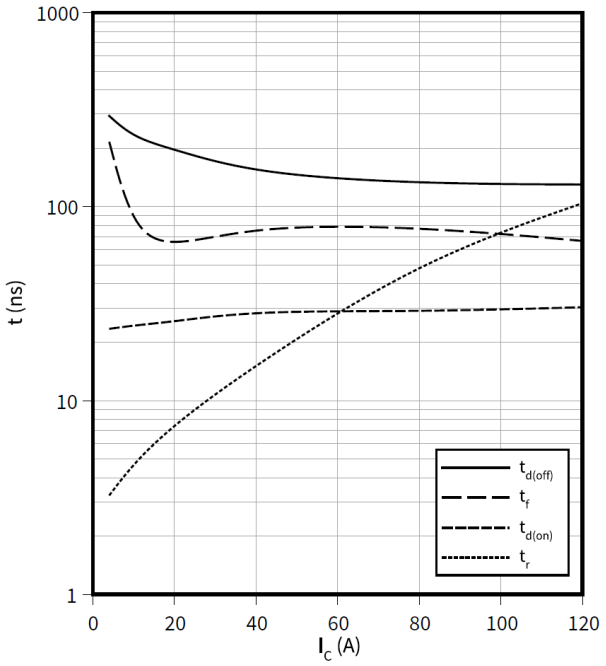
$Z_{th(j-c)} = f(t_p)$



Typical switching times as a function of collector current

$t = f(I_C)$

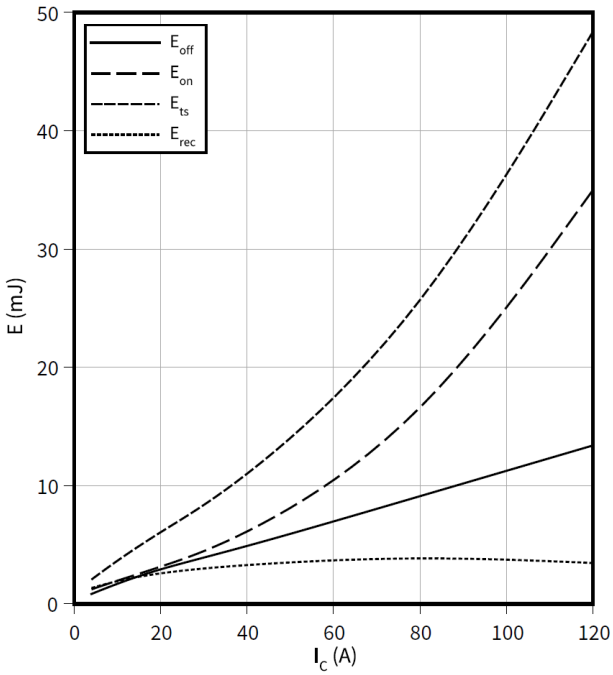
$R_G = 4.5\ \Omega$, $V_{CC} = 800$ V, $T_{vj} = 25$ °C



Typical switching energy losses as a function of collector current

$E = f(I_C)$

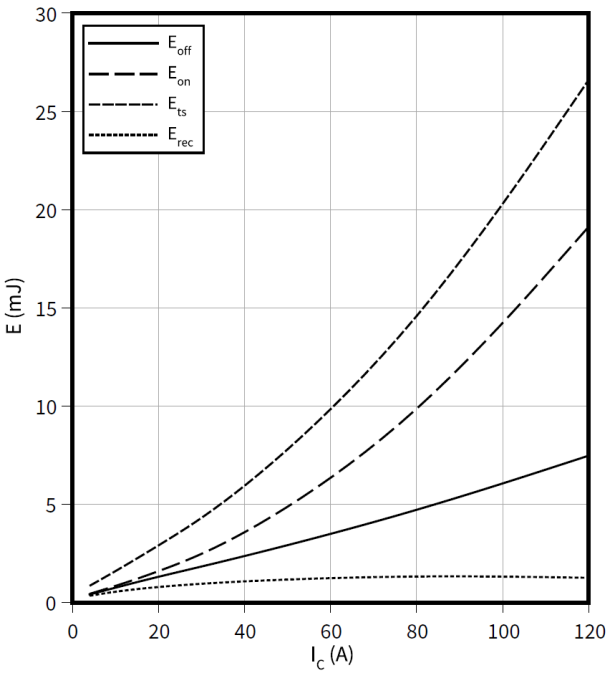
$V_{CC} = 800$ V, $T_{vj} = 175$ °C, $R_G = 4.5\ \Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

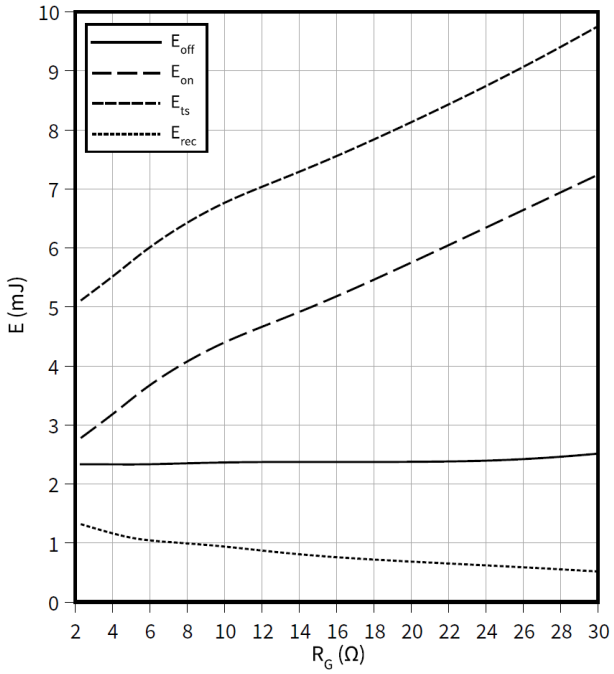
$V_{CC} = 800$ V, $T_{vj} = 25$ °C, $R_G = 4.5\ \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

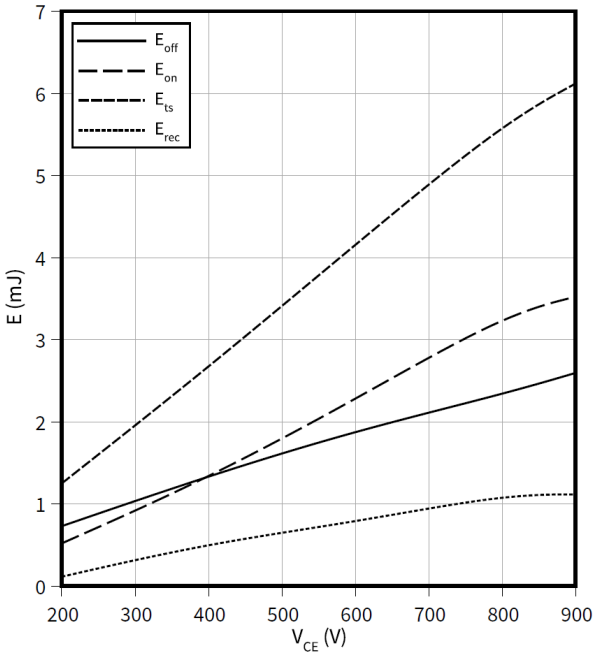
$I_C = 40\ A$, $V_{CC} = 800\ V$, $T_{vj} = 25\ °C$



Typical switching energy losses as a function of collector emitter voltage

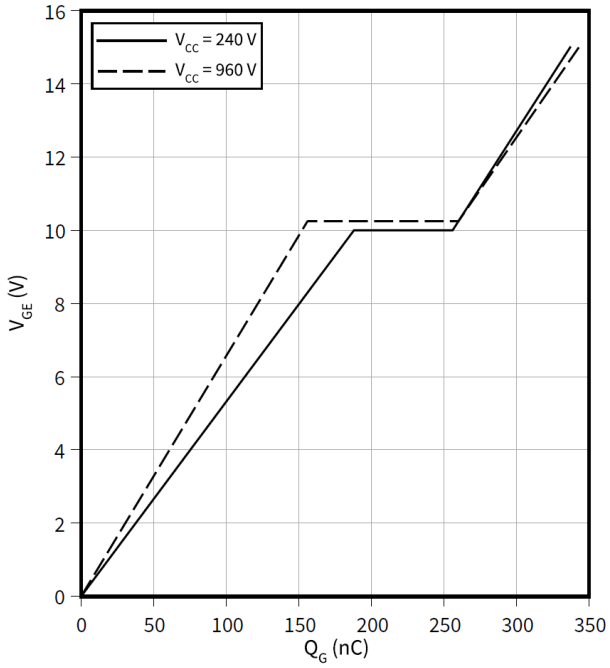
$E = f(V_{CE})$

$I_C = 40\ A$, $T_{vj} = 25\ °C$, $R_G = 4.5\ Ω$



Typical gate charge

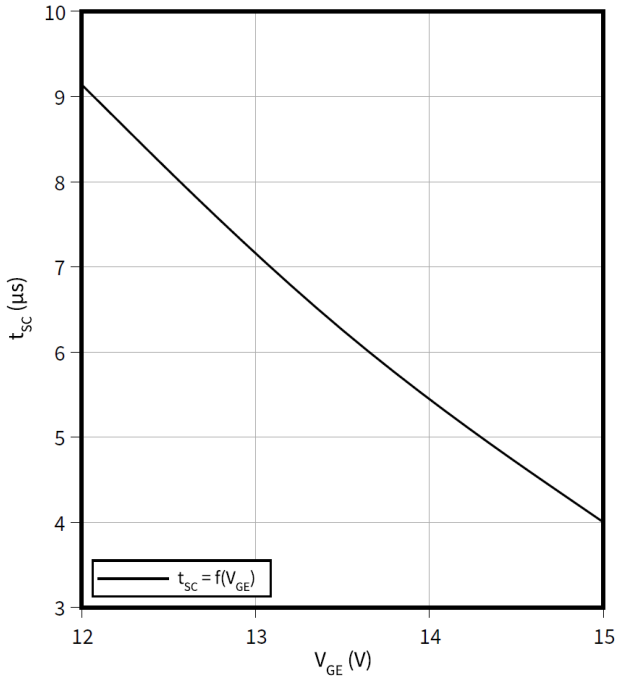
$V_{GE} = f(Q_G)$



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

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

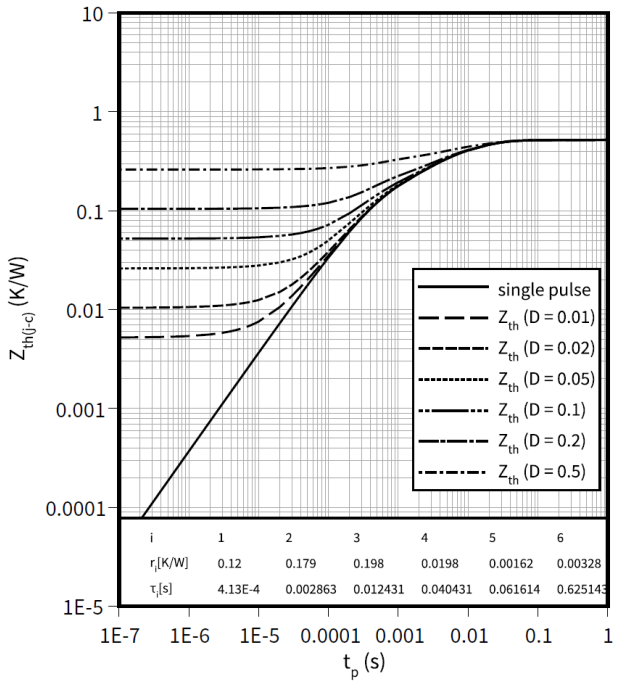
$T_{vj} = 175\ °C$, $V_{CC} = 800\ V$



Diode typical transient thermal impedance as a function of pulse width

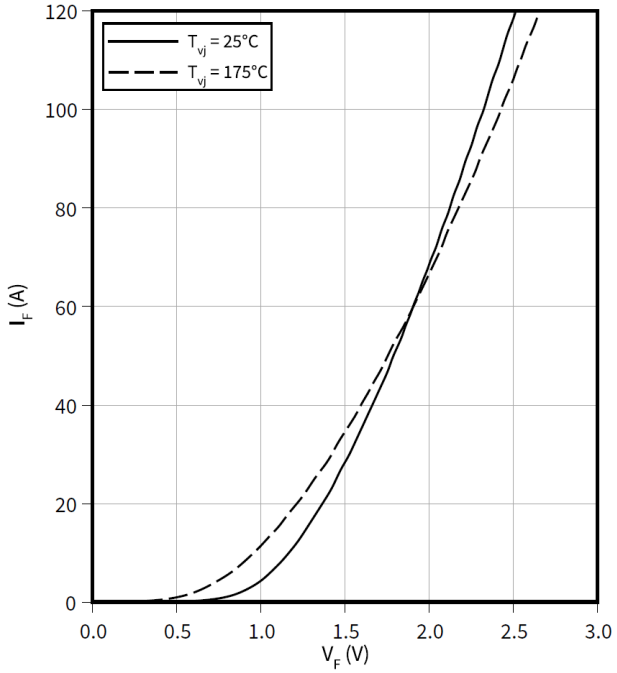
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



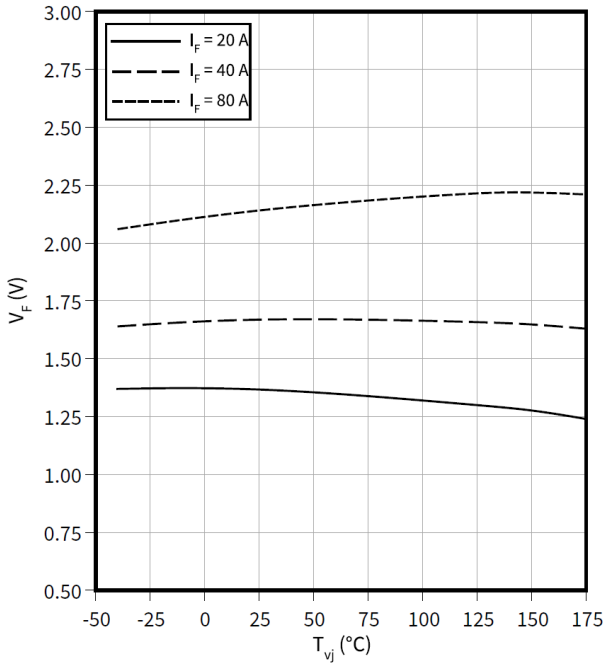
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

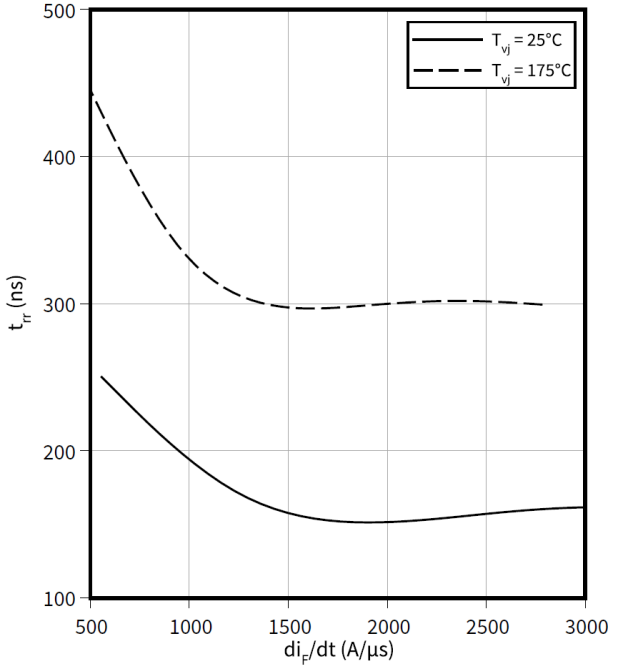
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

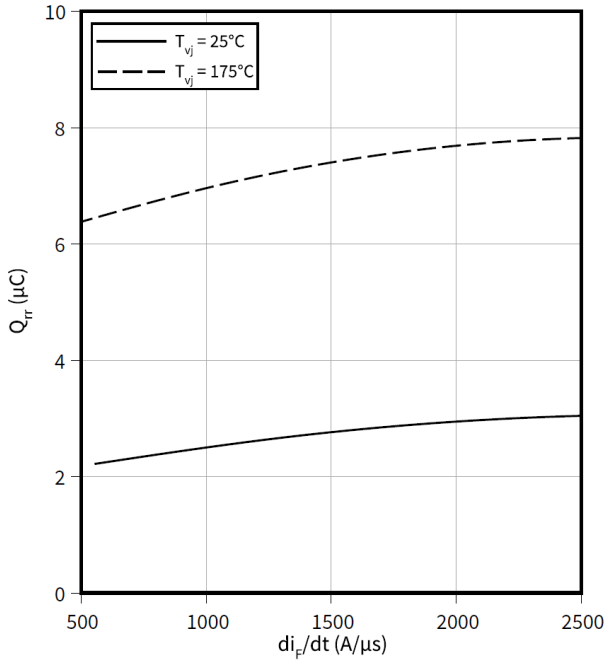
$I_F = 40$ A, $V_R = 800$ V



Typical reverse recovery charge as a function of diode current slope

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

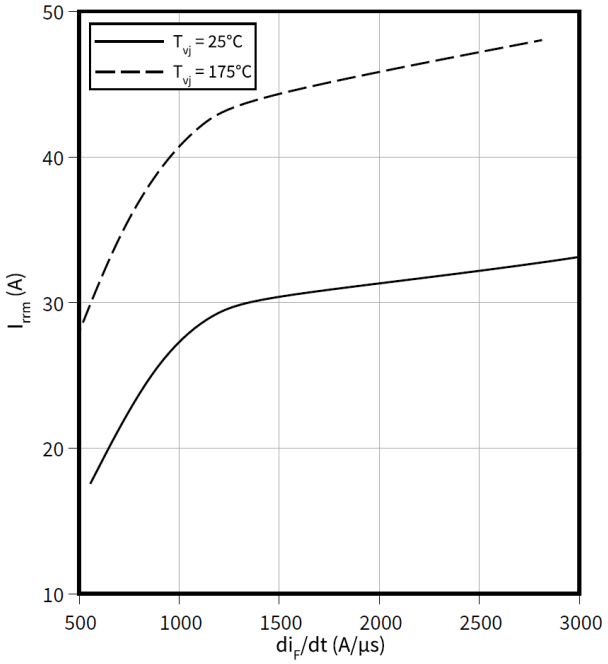
$V_R = 800$ V, $I_F = 40$ A



Typical reverse recovery current as a function of diode current slope

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

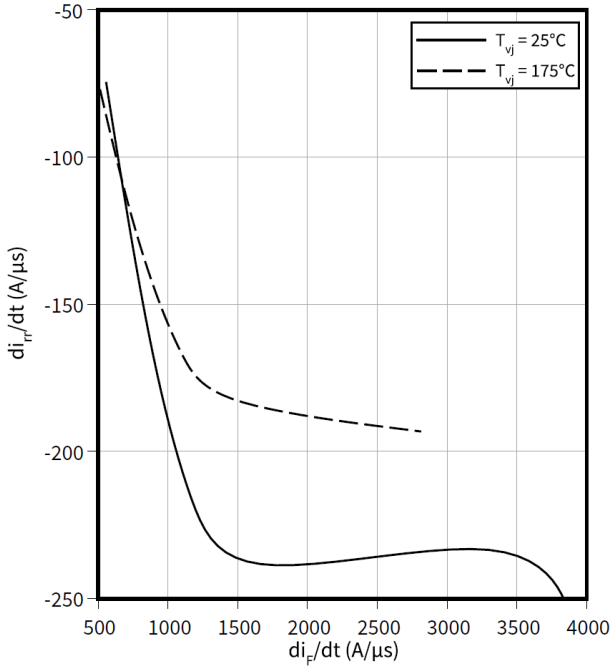
$V_R = 800$ V, $I_F = 40$ A



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

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

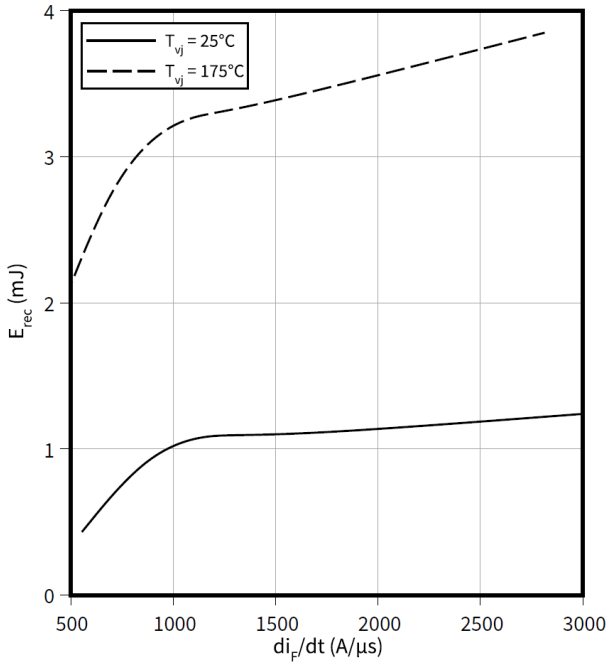
$V_R = 800$ V, $I_F = 40$ A



Typical reverse energy losses as a function of diode current slope

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

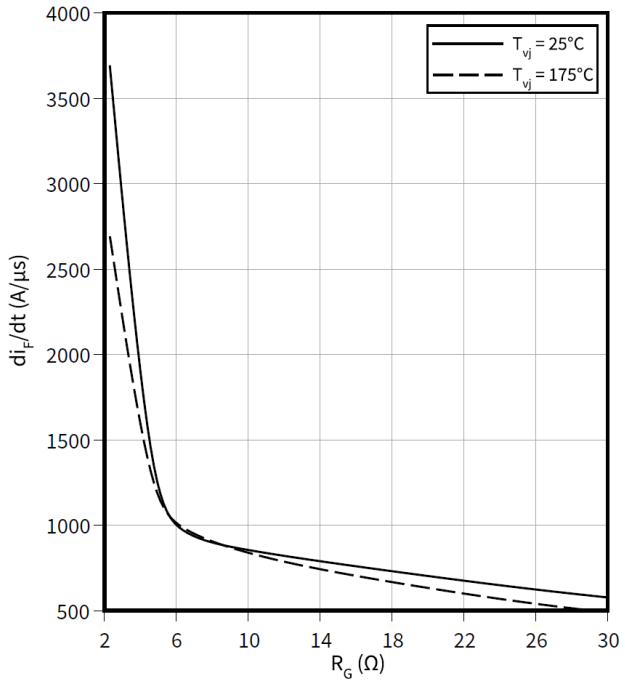
$V_R = 800$ V, $I_F = 40$ A



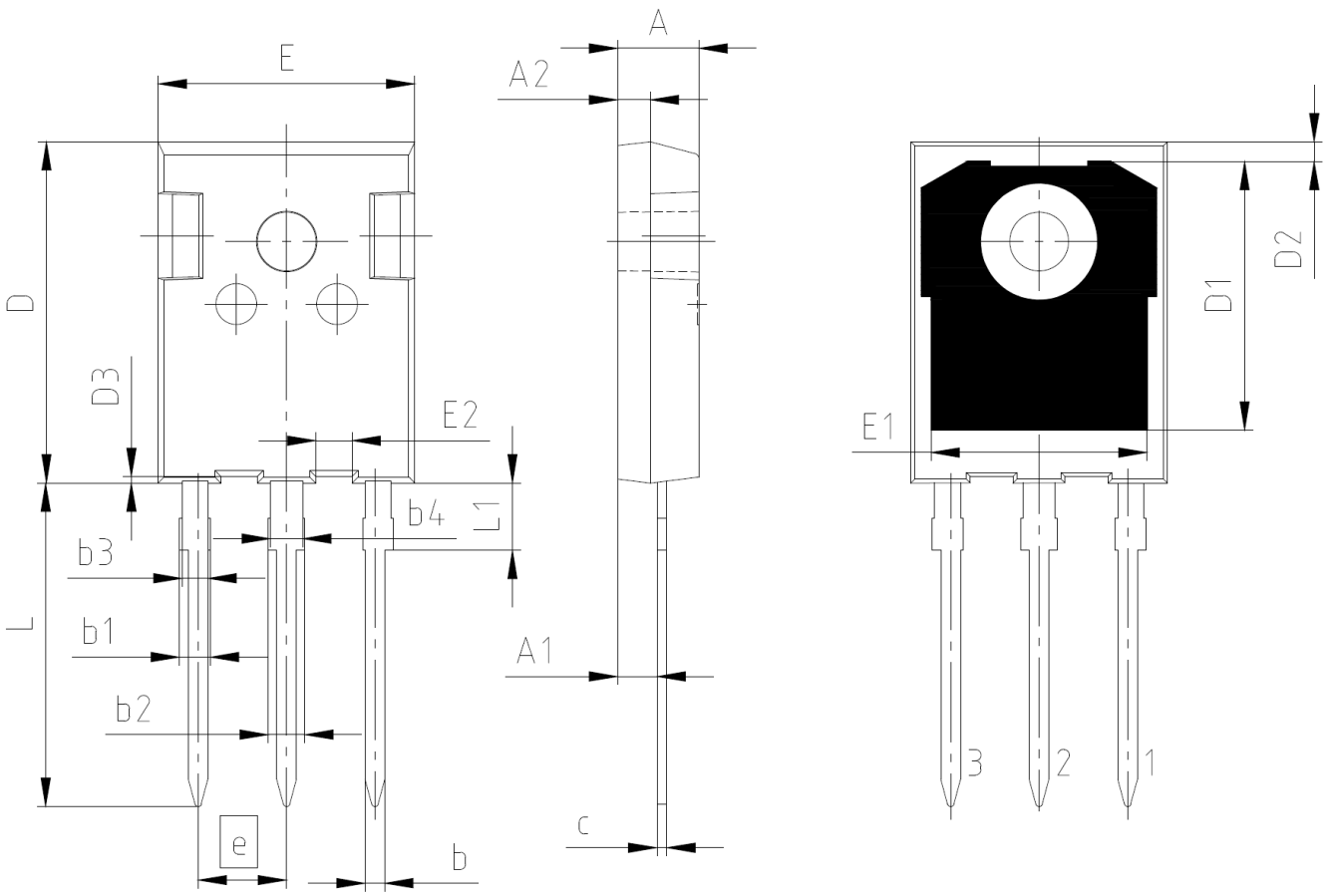
Typical diode current slope as a function of gate resistor

$di_F/dt = f(R_G)$

$V_R = 800$ V, $I_F = 40$ A



5 封装外形



PACKAGE - GROUP NUMBER:	PG-TO247-3-U04	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.90	5.10
A1	2.31	2.51
A2	1.90	2.10
b	1.16	1.26
b1		1.90
b2		2.30
b3	1.55	1.65
b4	1.96	2.06
c	0.59	0.66
D	20.90	21.10
D1	16.25	16.85
D2	1.05	1.35
D3	0.55	0.65
E	15.70	15.90
E1	13.10	13.50
E2	2.14	2.34
e	5.44	
N	3	
L	19.80	20.10
L1	3.95	4.30

图 1

6 测试条件

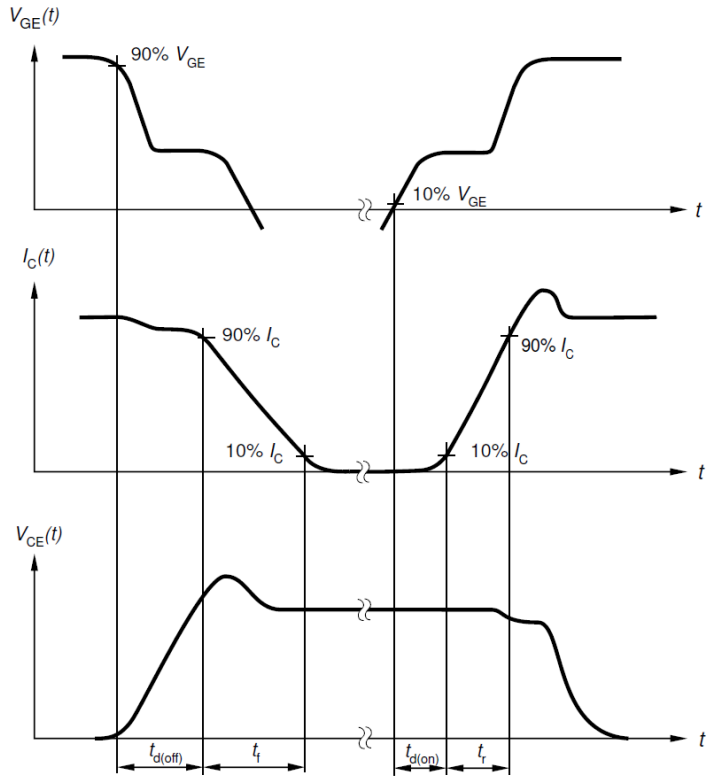


Figure A. **Definition of switching times**

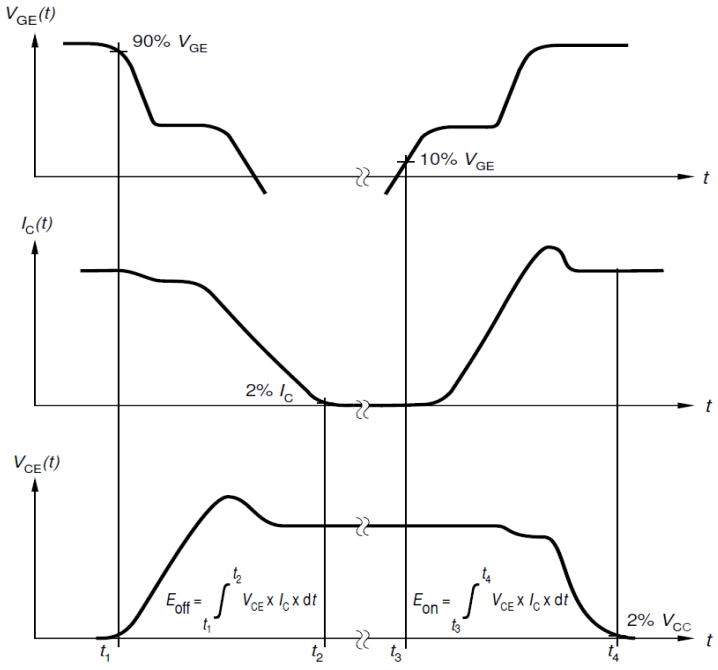


Figure B. **Definition of switching losses**

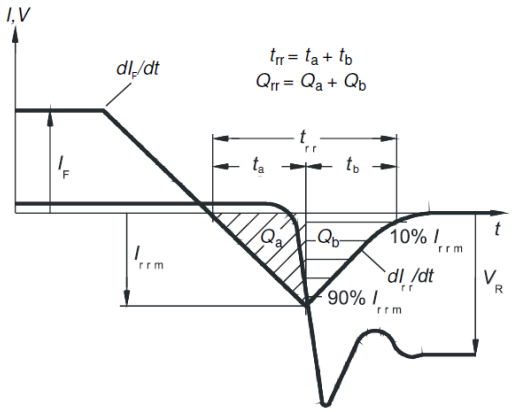


Figure C. **Definition of diode switching characteristics**

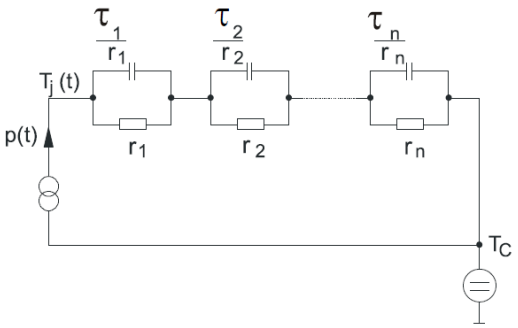


Figure D. **Thermal equivalent circuit**

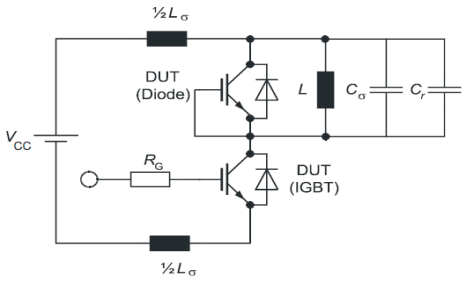


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

图 2

修订记录

Document revision	Date of release	Description of changes
0.10	2025-02-07	Target datasheet
0.20	2026-02-16	Preliminary datasheet
1.00	2026-04-01	Final datasheet

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Edition 2026-04-01

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-ABM806-003

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版本 **2026-11-04**

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