最终数据手册

英飞凌IKWH50N65EH7高速、低饱和电压 650 V TRENCHSTOP™ IGBT7 技术

与快速软恢复发射极控制 7 二极管共同封装

特性

- V_{CE} = 650 V
- I_C = 50 A
- 低开关损耗
- 极低的集电极-发射极饱和电压 V_{CEsat}
- 非常柔软、快速恢复的反并联二极管
- 平滑切换
- 防潮性
- 针对硬开关、两电平和三电平拓扑进行了优化
- 完整的产品品类和 PSpice 模型： http://www.infineon.com/igbt/

潜在应用

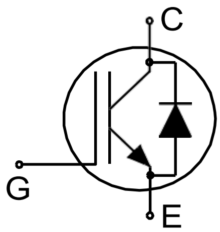
- 工业级不间断电源（UPS）
- 电动汽车充电桩
- 组串式逆变器
- 焊接

产品验证

- 符合JEDEC47/20/22相关测试的工业应用要求

Lead-free
Green
Halogen-free
RoHS

描述



Type	Package	Marking
IKWH50N65EH7	PG-TO247-3-STD-NN4.8	K50EEH7

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		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	$R_{th(j-c)}$			0.46	0.6	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.61	0.8	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		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	80	A
			$T_c = 100$ °C	65	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			200	A
Turn-off safe operating area		$V_{CE} \leq 650$ V, $t_p \leq 1$ µs, $T_{vj} \leq 175$ °C		200	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10$ µs, $D < 0.01$		±30	V
Power dissipation	P_{tot}		$T_c = 25$ °C	249	W
			$T_c = 100$ °C	123	

表 3 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 50$ A, $V_{GE} = 15$ V	$T_{vj} = 25$ °C		1.4	1.65	V
			$T_{vj} = 175$ °C		1.6		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.44$ mA, $V_{CE} = V_{GE}$		2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650$ V, $V_{GE} = 0$ V	$T_{vj} = 25$ °C			15	µA
			$T_{vj} = 175$ °C		1500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = 20$ V				100	nA
Transconductance	g_{fs}	$I_C = 50$ A, $V_{CE} = 20$ V			67		S
Input capacitance	C_{ies}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			2566		pF
Output capacitance	C_{oes}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			84		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz			10.7		pF
Gate charge	Q_G	$V_{CC} = 520$ V, $I_C = 50$ A, $V_{GE} = 15$ V			102		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10$ Ω, $R_{G(off)} = 10$ Ω	$T_{vj} = 25$ °C, $I_C = 50$ A		19		ns
			$T_{vj} = 175$ °C, $I_C = 50$ A		21		
Rise time (inductive load)	t_r	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10$ Ω, $R_{G(off)} = 10$ Ω	$T_{vj} = 25$ °C, $I_C = 50$ A		29		ns
			$T_{vj} = 175$ °C, $I_C = 50$ A		41		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10$ Ω, $R_{G(off)} = 10$ Ω	$T_{vj} = 25$ °C, $I_C = 50$ A		147		ns
			$T_{vj} = 175$ °C, $I_C = 50$ A		172		
Fall time (inductive load)	t_f	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10$ Ω, $R_{G(off)} = 10$ Ω	$T_{vj} = 25$ °C, $I_C = 50$ A		42		ns
			$T_{vj} = 175$ °C, $I_C = 50$ A		59		
Turn-on energy	E_{on}	$V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 10$ Ω, $R_{G(off)} = 10$ Ω	$T_{vj} = 25$ °C, $I_C = 50$ A		1.27		mJ
			$T_{vj} = 175$ °C, $I_C = 50$ 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} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 50 A		0.65		mJ
			T_{vj} = 175 °C, I_C = 50 A		0.95		
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω	T_{vj} = 25 °C, I_C = 50 A		1.92		mJ
			T_{vj} = 175 °C, I_C = 50 A		3.05		
Operating junction temperature	T_{vj}			-40		175	°C

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	limited by bondwire	T_c = 25 °C	80	A
			T_c = 100 °C	59	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			200	A
Power dissipation	P_{tot}		T_c = 25 °C	187	W
			T_c = 100 °C	92	

表 5 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 50 A	T_{vj} = 25 °C		1.65	2	V
			T_{vj} = 175 °C		1.55		
Diode reverse recovery time	t_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		76		ns
			T_{vj} = 175 °C, I_F = 50 A		115		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		1.12		µC
			T_{vj} = 175 °C, I_F = 50 A		2.41		

（表格续下页……）

表 5 （续）特征值

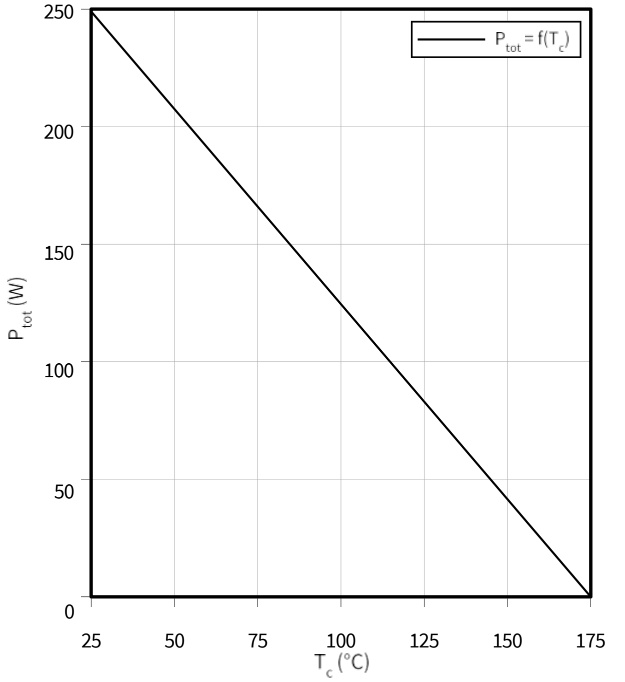
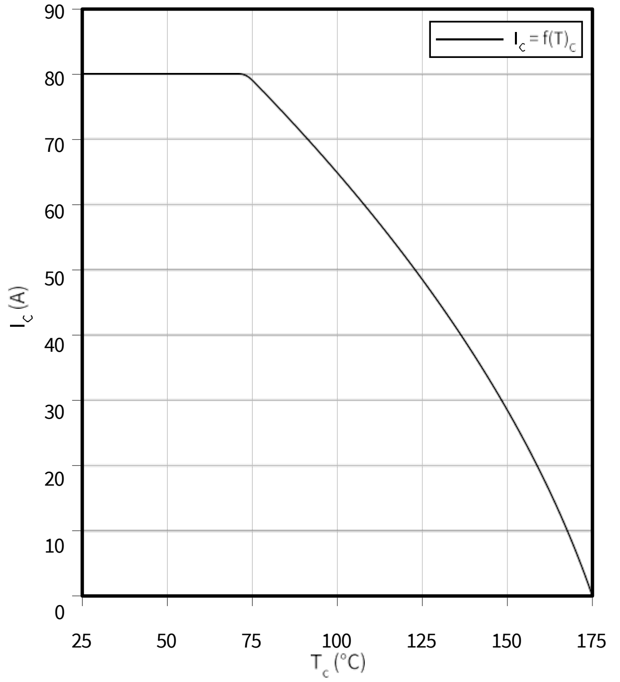
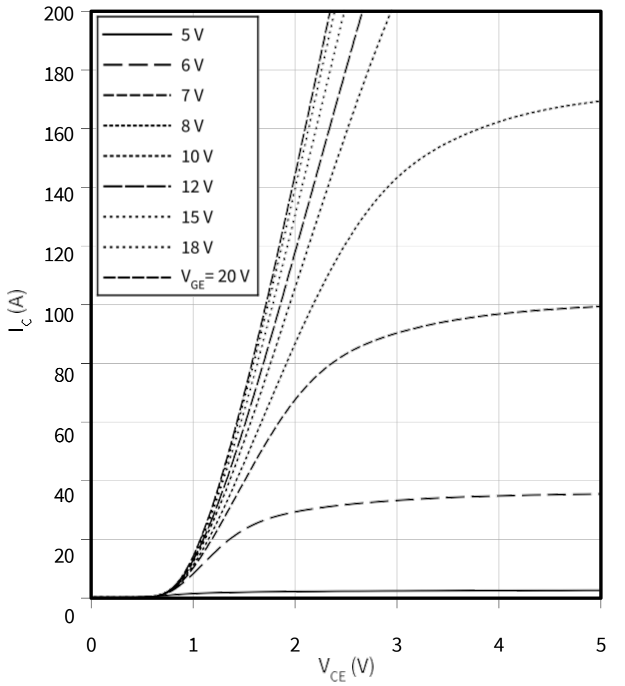
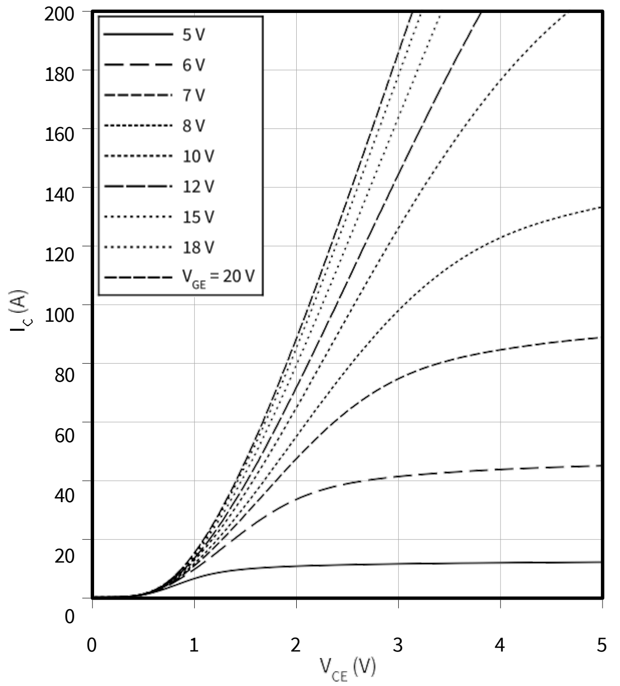
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		24.3		A
			T_{vj} = 175 °C, I_F = 50 A		33.8		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		-1480		A/µs
			T_{vj} = 175 °C, I_F = 50 A		-861		
Reverse recovery energy	E_{rec}	V_R = 400 V, $R_{G(on)}$ = 10 Ω	T_{vj} = 25 °C, I_F = 50 A		0.25		mJ
			T_{vj} = 175 °C, I_F = 50 A		0.51		
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%。

除非另有规定，*电气特性均为 T_{vj} = 25°C。*

动态测试电路，寄生电感 L_σ = 8 nH，寄生电容 C_σ = 30 pF，来自图E。能量损耗包括“拖尾”和二极管反向恢复。

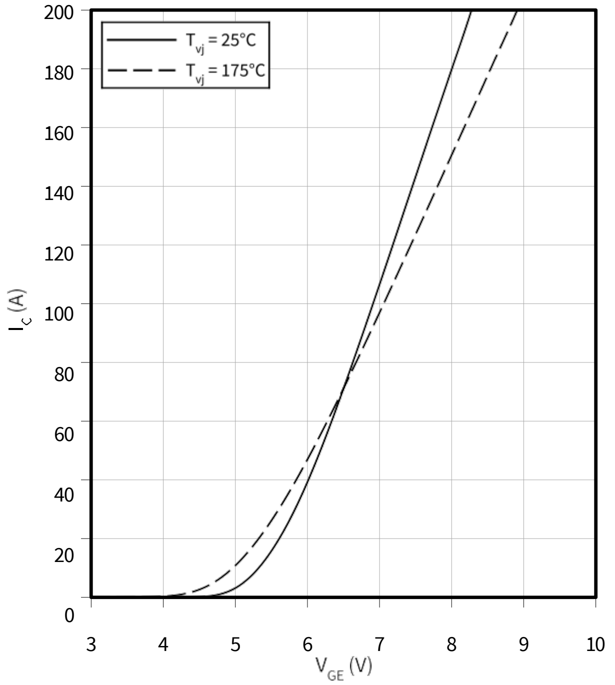
4 特性图

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 transfer characteristic

$I_C = f(V_{GE})$

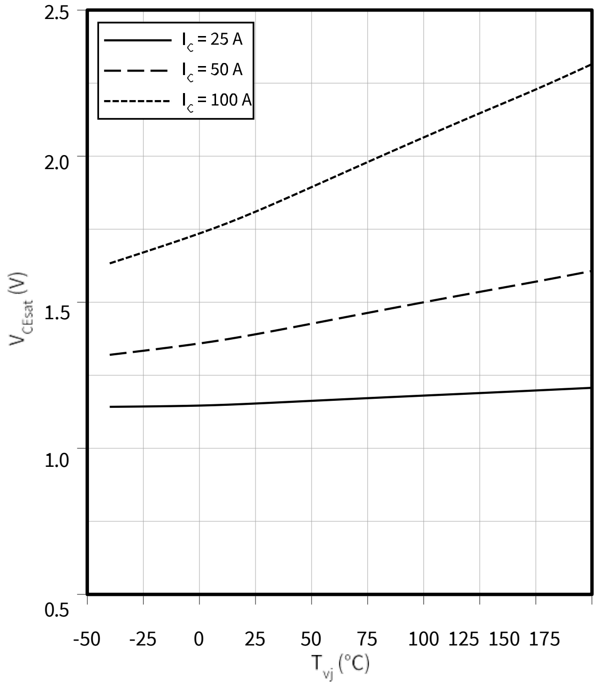
$V_{CE} = 20$ V



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

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

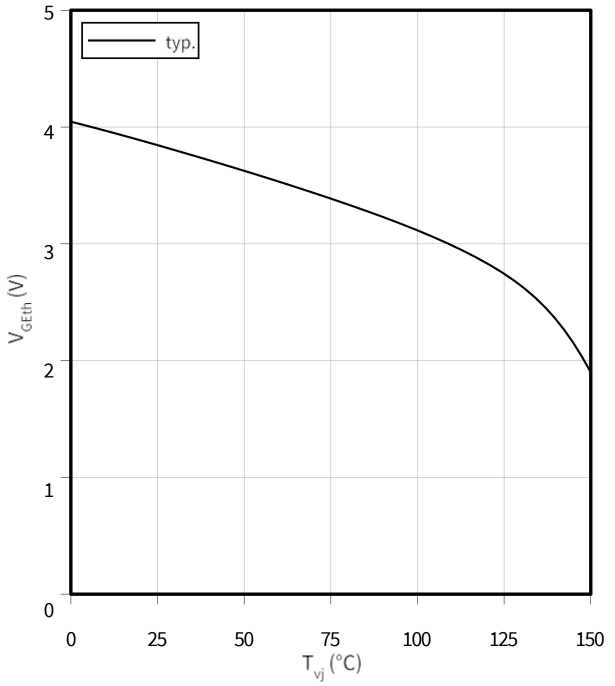
$V_{GE} = 15$ V



Gate-emitter threshold voltage as a function of junction temperature

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

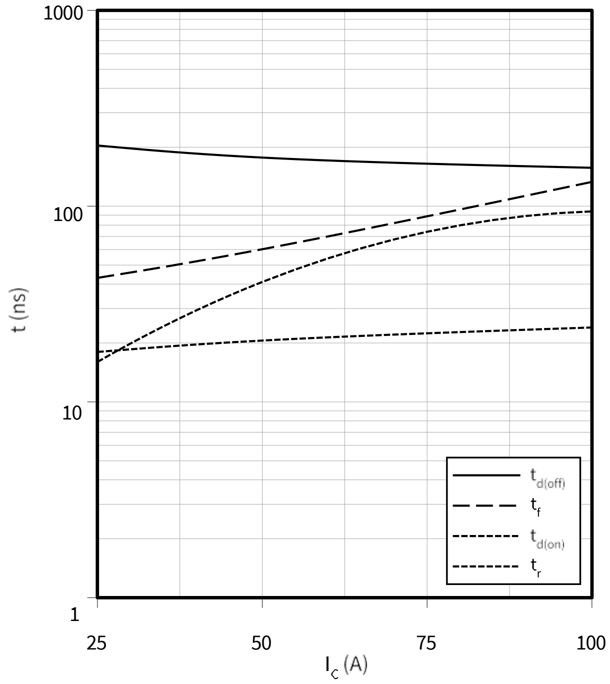
$I_C = 0.44$ mA



Typical switching times as a function of collector current

$t = f(I_C)$

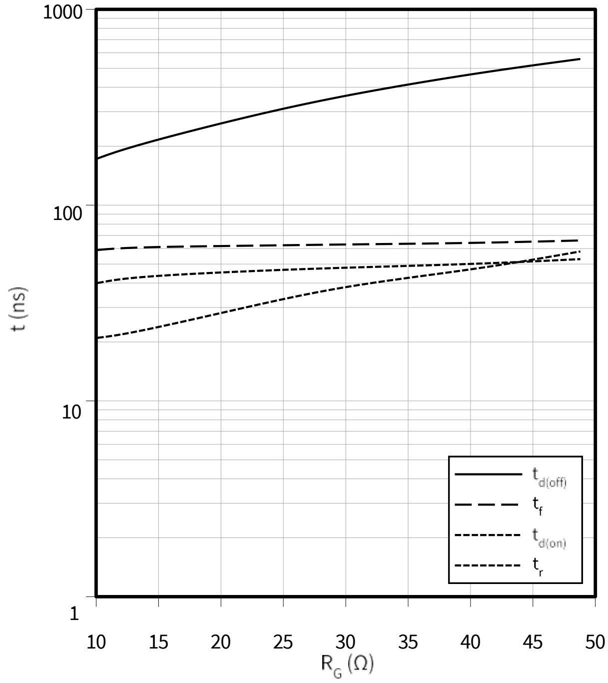
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

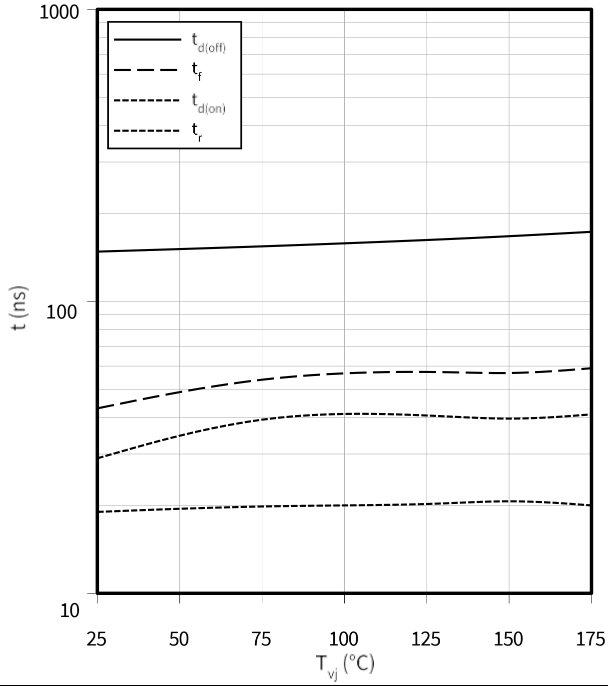
$I_C = 50$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

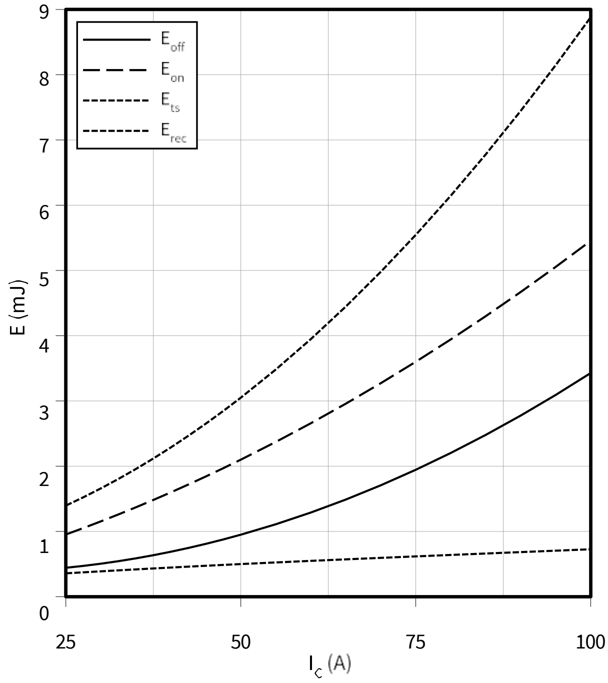
$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 10$ Ω



Typical switching energy losses as a function of collector current

$E = f(I_C)$

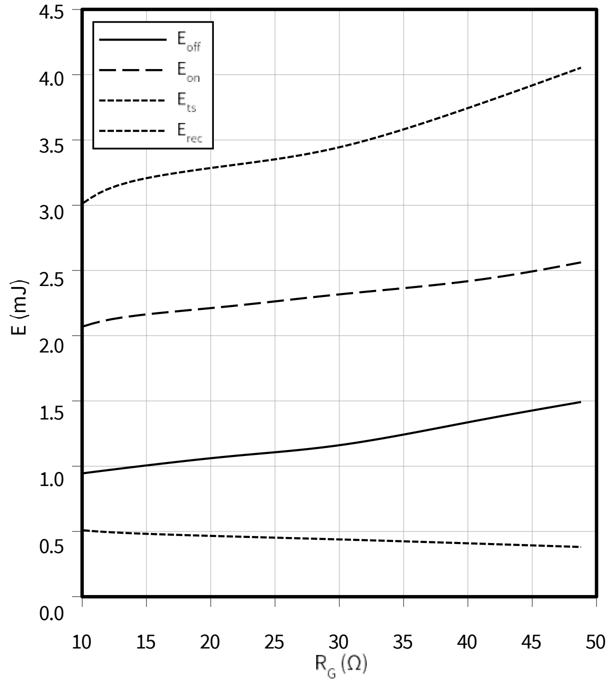
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10$ Ω



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

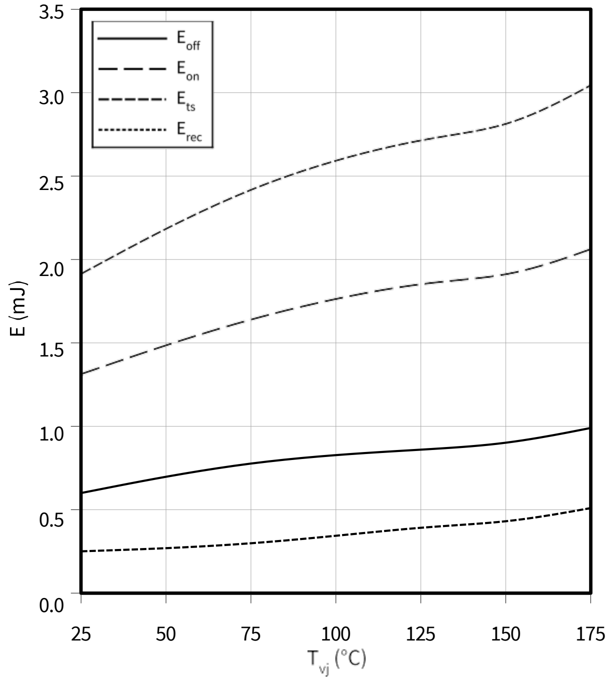
$I_C = 50$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

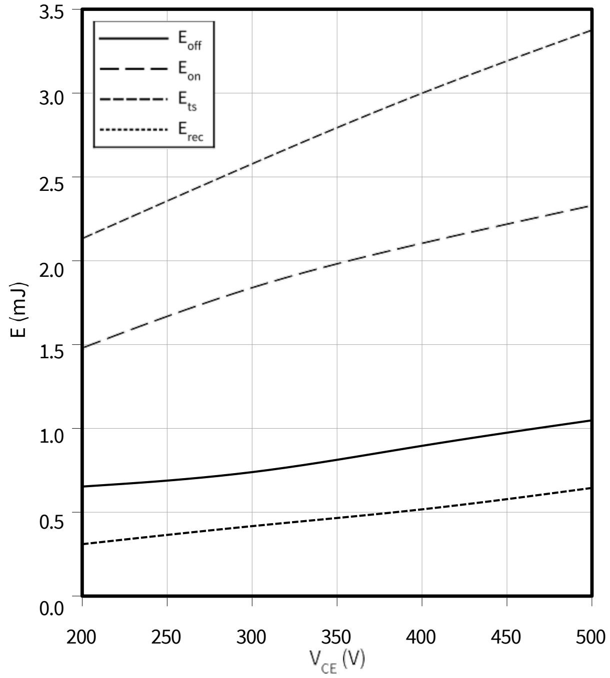
$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

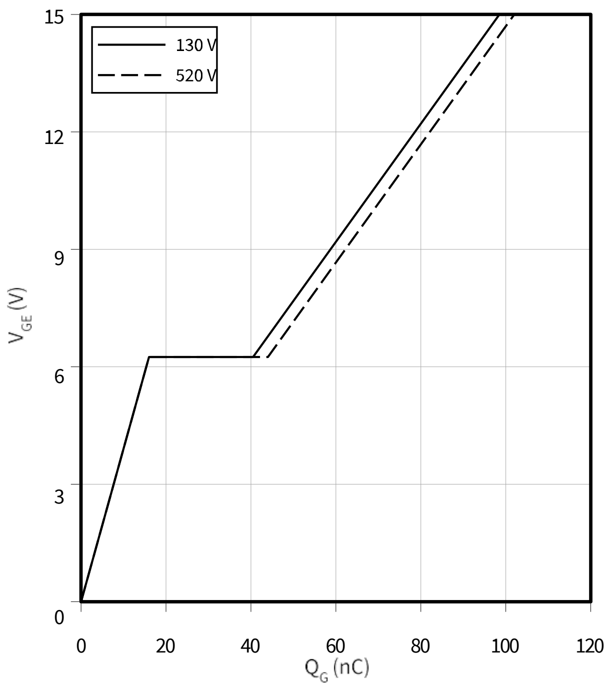
$I_C = 50$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

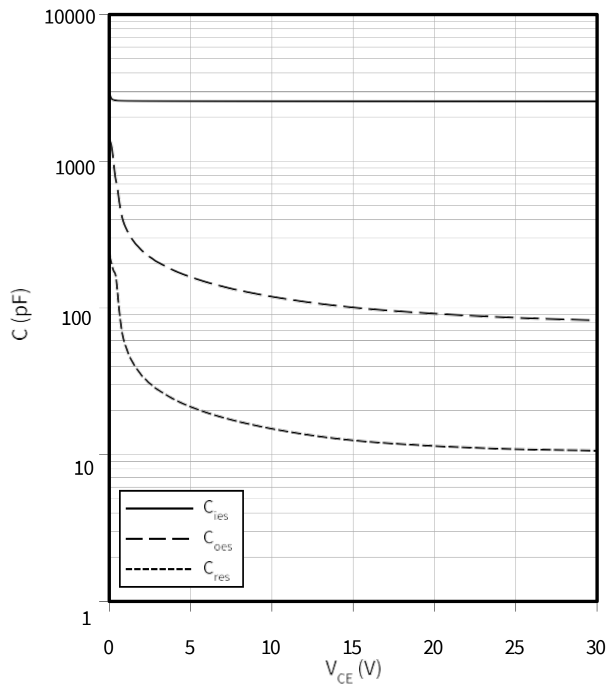
$I_C = 50$ A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

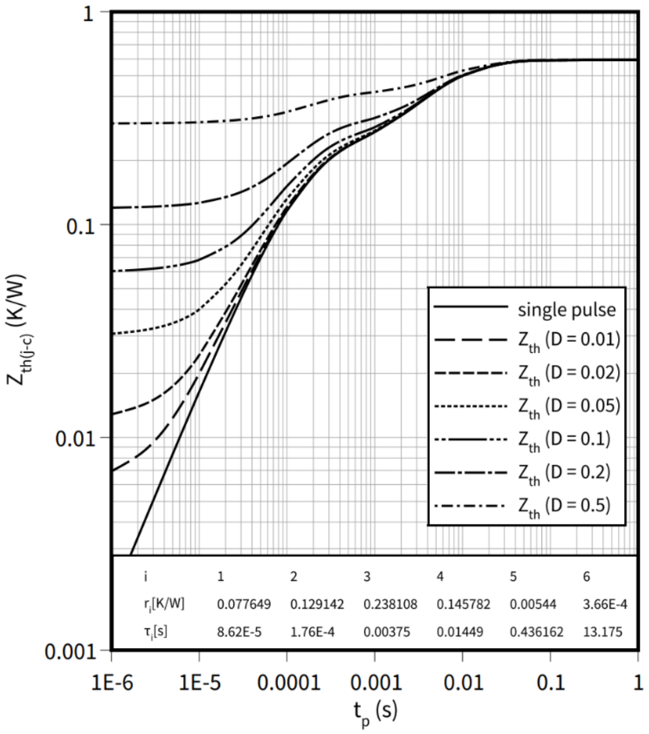
$f = 100$ kHz, $V_{GE} = 0$ V



IGBT transient thermal impedance as a function of pulse width

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

$D = t_p/T$

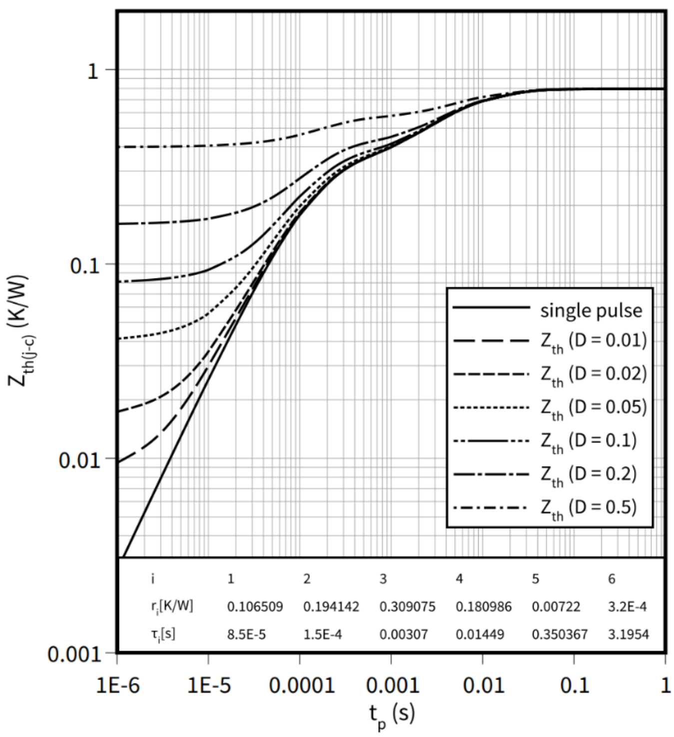


i	1	2	3	4	5	6
r_i[K/W]	0.077649	0.129142	0.238108	0.145782	0.00544	3.66E-4
τ_i[s]	8.62E-5	1.76E-4	0.00375	0.01449	0.436162	13.175

Diode transient thermal impedance as a function of pulse width

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

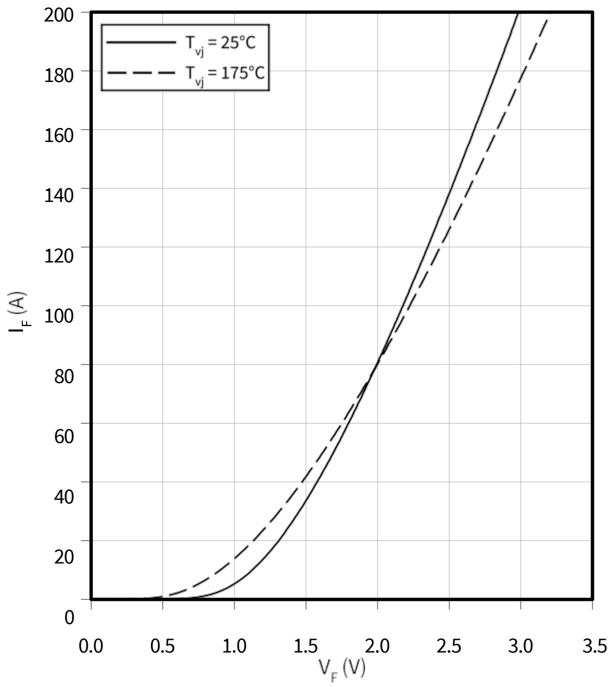
$D = t_p/T$



i	1	2	3	4	5	6
r_i[K/W]	0.106509	0.194142	0.309075	0.180986	0.00722	3.2E-4
τ_i[s]	8.5E-5	1.5E-4	0.00307	0.01449	0.350367	3.1954

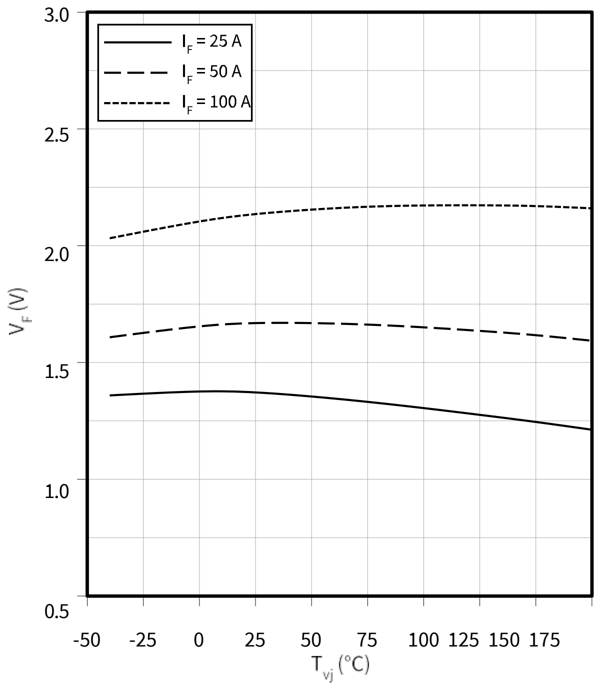
Typical diode forward current as a function of forward voltage

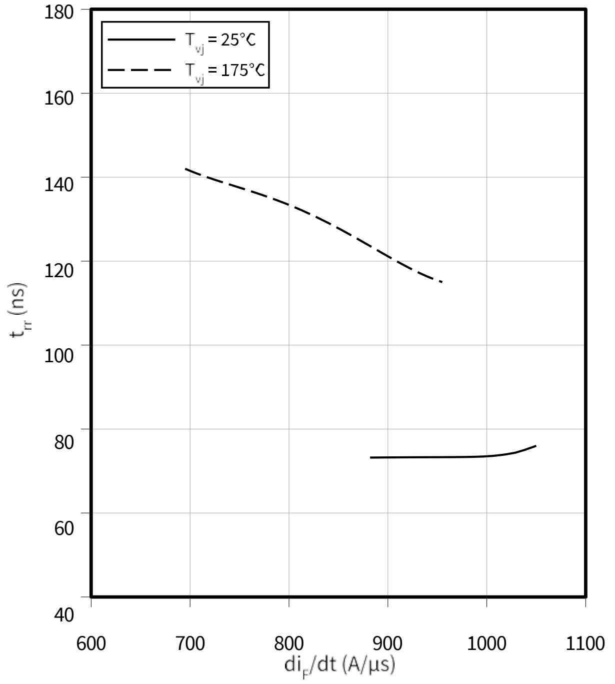
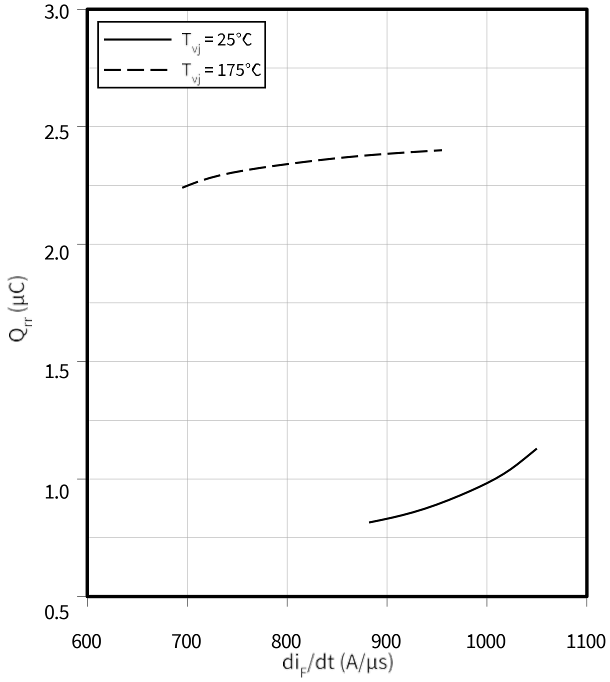
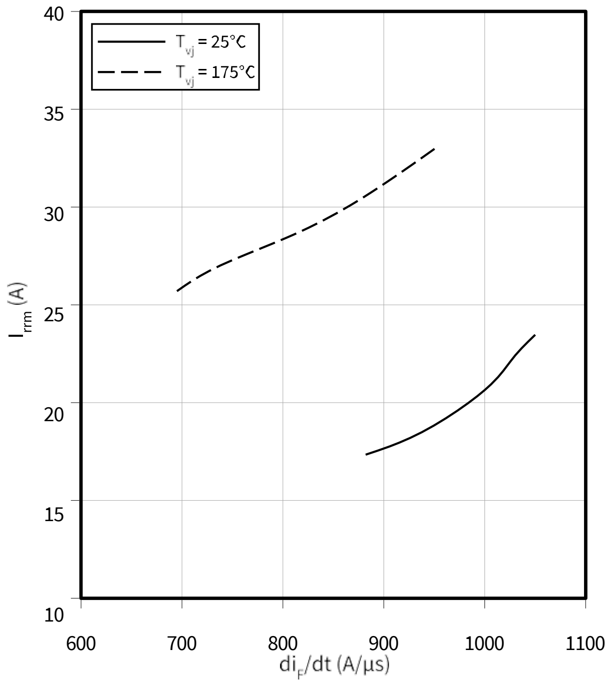
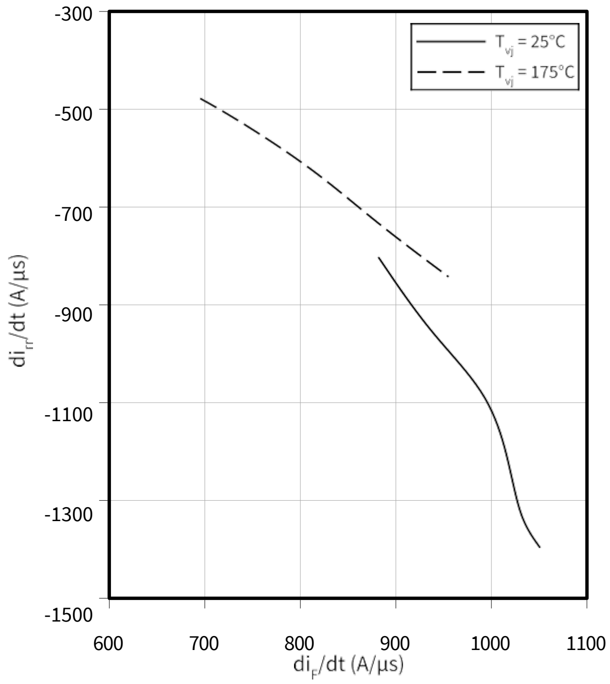
$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$

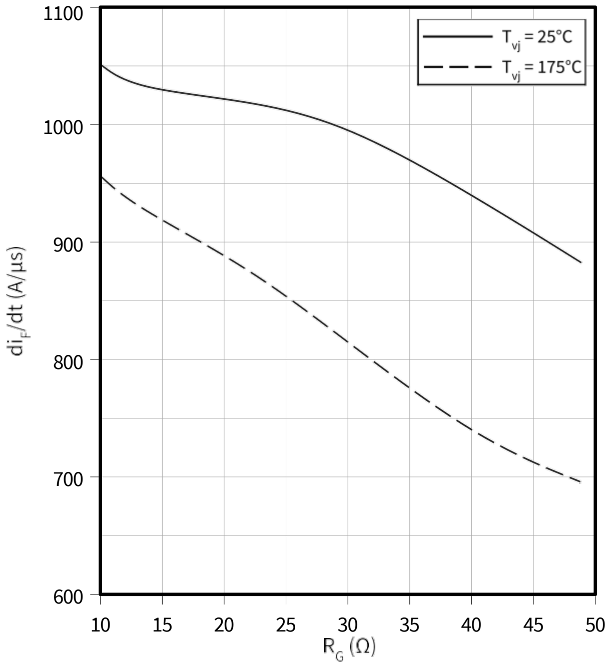


Typical reverse recovery time as a function of diode current slope $t_{rr} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A	**Typical reverse recovery charge as a function of diode current slope** $Q_{rr} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A
	
Typical reverse recovery current as a function of diode current slope $I_{rrm} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A	**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope** $di_{rr}/dt = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A
	

Typical diode current slope as a function of gate resistor

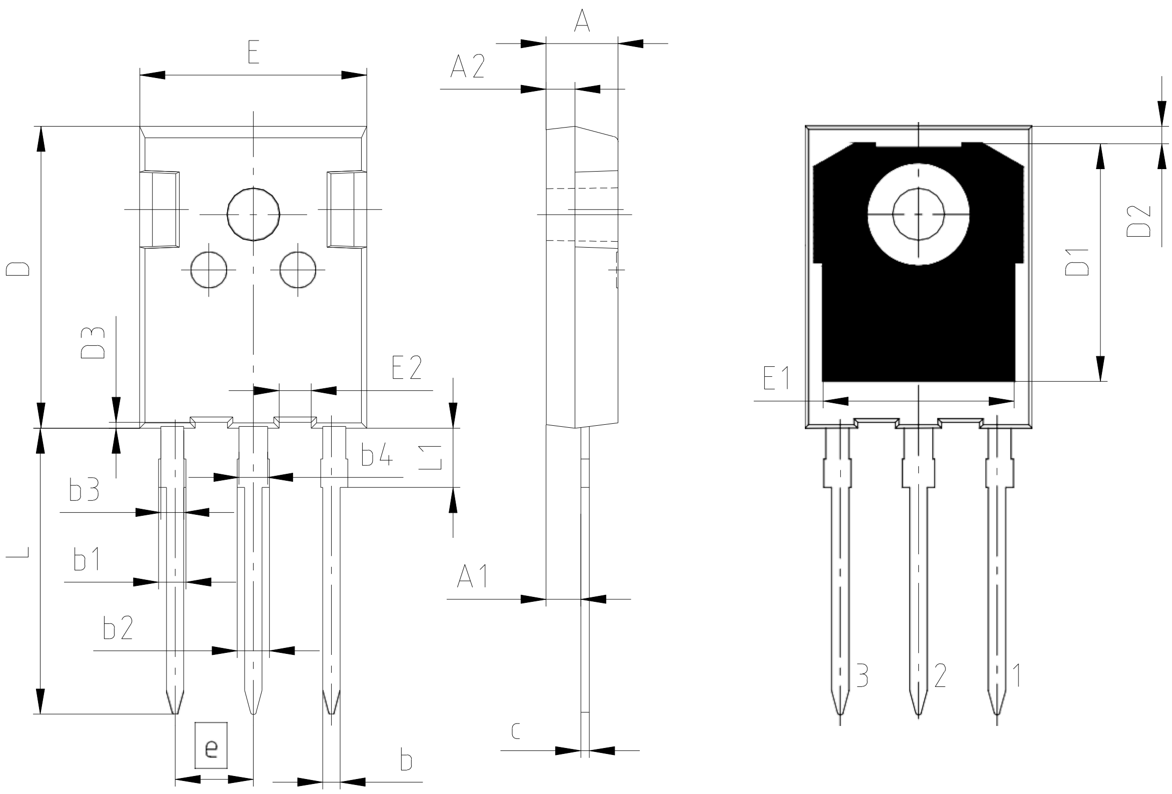
$di_F/dt = f(R_G)$

$V_R = 400$ V, $I_F = 75$ A



5 封装外形

PG-TO247-3-STD-NN4.8



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

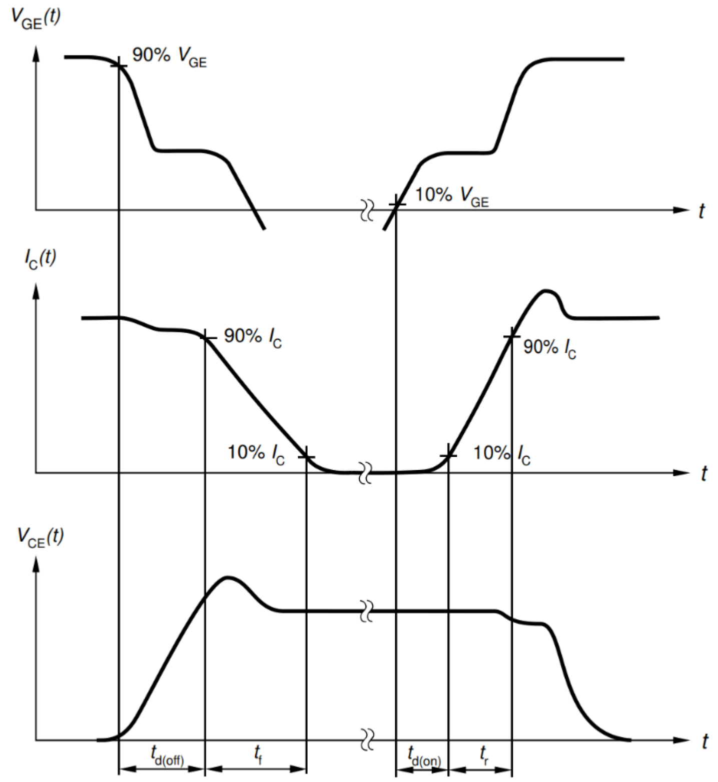


Figure A. **Definition of switching times**

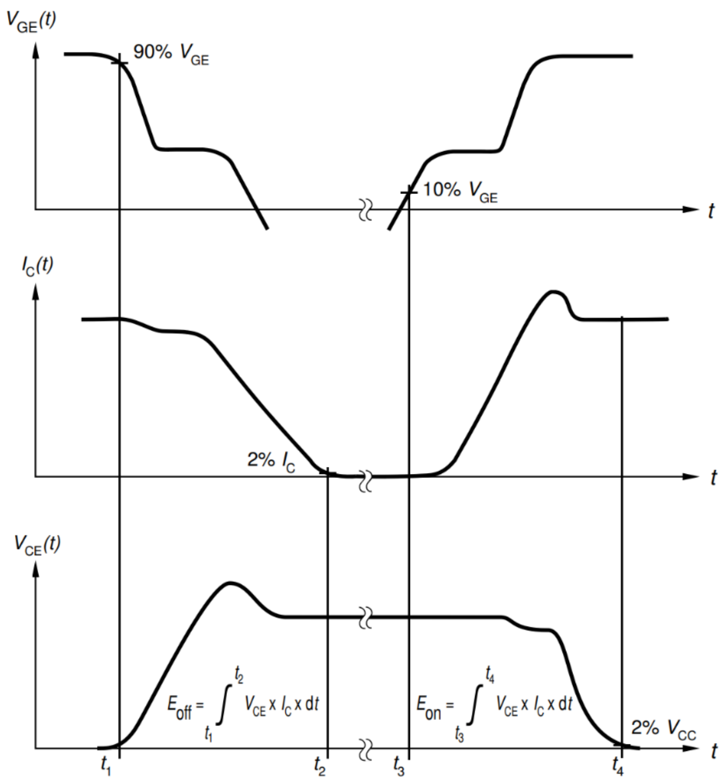


Figure B. **Definition of switching losses**

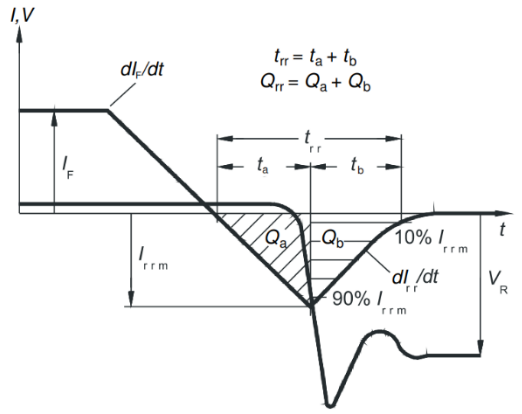


Figure C. **Definition of diode switching characteristics**

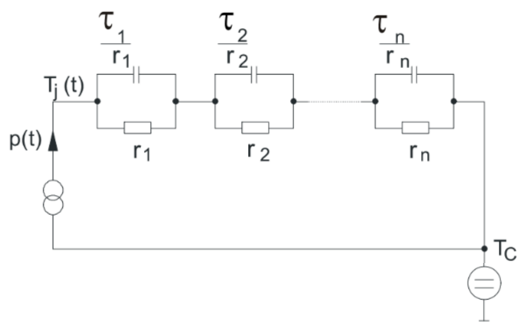


Figure D. **Thermal equivalent circuit**

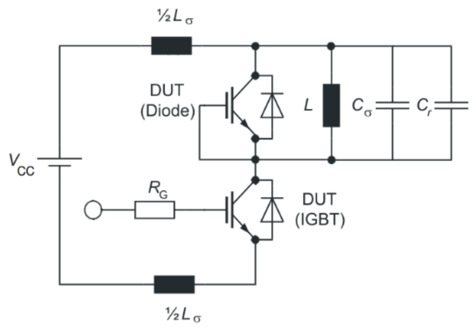


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_r,
(only for ZVT switching)

图 2

修订记录

Document revision	Date of release	Description of changes
1.00	2023-04-27	Final datasheet
1.10	2023-11-15	Update of energy diagrams

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