

最终数据手册

英飞凌工业用CoolSiC™ 1700 V SiC 沟槽 MOSFET：碳化硅MOSFET

特性

- $V_{DS} = 1700\text{ V}$ at $T_{vj} = 25^{\circ}\text{C}$
- $I_{DC} = 7.5\text{ A}$ at $T_c = 25^{\circ}\text{C}$
- $R_{DS(on)} = 650\text{ m}\Omega$ at $V_{GS} = 12\text{ V}$, $T_{vj} = 25^{\circ}\text{C}$
- 针对反激式拓扑进行了优化
- 12 V / 0 V 栅极源电压与大多数反激式控制器兼容
- 开关损耗非常低
- 基准栅极阈值电压, $V_{GS(th)} = 4.5\text{ V}$
- 完全可控的 dv/dt, 用于 EMI 优化
- 英飞凌.XT 互连技术, 实现、行业领先的热性能

潜在应用

- 通用驱动器 (GPD)
- 电动汽车充电
- 储能系统(ESS)
- 组串式逆变器
- UPS (不间断电源)

产品验证

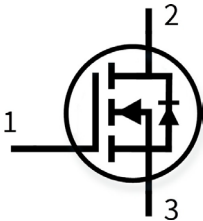
- 符合JEDEC47/20/22相关测试的工业应用要求

描述

- 1 - 栅极
- 2 - 漏极
- 3 - 来源



- Halogen-free
- Green
- Lead-free
- RoHS



Type	Package	Marking
IMWH170R650M1	PG-TO247-3-STD-NN4.8	170M1650

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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2 MOSFET
1 封装

1 封装

表1 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal source inductance measured 5 mm (0.197 in.) from case	L_s			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	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			1.3	1.69	K/W

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表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25\text{ °C}$		1700	V
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS} = 12\text{ V}$	$T_c = 25\text{ °C}$	7.5	A
			$T_c = 100\text{ °C}$	5.3	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 12\text{ V}$		19	A
Gate-source voltage, max. transient voltage ¹⁾	V_{GS}	$t_p \leq 0.5\text{ }\mu\text{s}$, $D < 0.01$		-10/20	V
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25\text{ °C}$	88	W
			$T_c = 100\text{ °C}$	44	

1) 重要提示：正、负栅极源电压的选择会影响器件的长期行为。为了确保器件在计划使用寿命内的正常运行，必须考虑应用说明 AN2018-09中描述的设计指南。

表3 建议值

Parameter	Symbol	Note or test condition	Values	Unit
Recommended turn-on gate voltage	$V_{GS(on)}$		12...15	V
Recommended turn-off gate voltage	$V_{GS(off)}$		0	V

表4 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 1.5 \text{ A}$	$T_{vj} = 25 \text{ °C}, V_{GS(on)} = 12 \text{ V}$		650		mΩ
			$T_{vj} = 100 \text{ °C}, V_{GS(on)} = 12 \text{ V}$		921		
			$T_{vj} = 175 \text{ °C}, V_{GS(on)} = 12 \text{ V}$		1324		
			$T_{vj} = 25 \text{ °C}, V_{GS(on)} = 15 \text{ V}$		526	580	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 1.7 \text{ mA}, V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20 \text{ V}$)	$T_{vj} = 25 \text{ °C}$	3.5	4.5	5.7	V
			$T_{vj} = 175 \text{ °C}$		3.6		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1700 \text{ V}, V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		0.6	11	μA
			$T_{vj} = 175 \text{ °C}$		8		
Gate leakage current	I_{GSS}	$V_{DS} = 0 \text{ V}$	$V_{GS} = 20 \text{ V}$			100	nA
			$V_{GS} = -10 \text{ V}$			-100	
Forward transconductance	g_{fs}	$I_D = 1.5 \text{ A}, V_{DS} = 20 \text{ V}$			0.65		S
Internal gate resistance	$R_{G,int}$	$f = 1 \text{ MHz}, V_{AC} = 25 \text{ mV}$			25.4		Ω
Input capacitance	C_{iss}	$V_{DD} = 1000 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$			337		pF
Output capacitance	C_{oss}	$V_{DD} = 1000 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$			15		pF
Reverse transfer capacitance	C_{rss}	$V_{DD} = 1000 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$			1		pF
C_{oss} stored energy	E_{oss}	$V_{DD} = 1000 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$			2.5		μJ
Total gate charge	Q_G	$V_{DD} = 1000 \text{ V}, I_D = 1.5 \text{ A}, V_{GS} = 0/12 \text{ V}, \text{turn-on pulse}$			8.1		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 1000 \text{ V}, I_D = 1.5 \text{ A}, V_{GS} = 0/12 \text{ V}, \text{turn-on pulse}$			2.9		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 1000 \text{ V}, I_D = 1.5 \text{ A}, V_{GS} = 0/12 \text{ V}, \text{turn-on pulse}$			1.8		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 1000 \text{ V}, I_D = 1.5 \text{ A}, V_{GS} = 0/12 \text{ V}, R_{G,ext} = 6.9 \text{ Ω}, L_\sigma = 40 \text{ nH}, \text{diode: body diode at } V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		18		ns
			$T_{vj} = 175 \text{ °C}$		15		

(表格续下页.....)

表 4 (续) 特征值

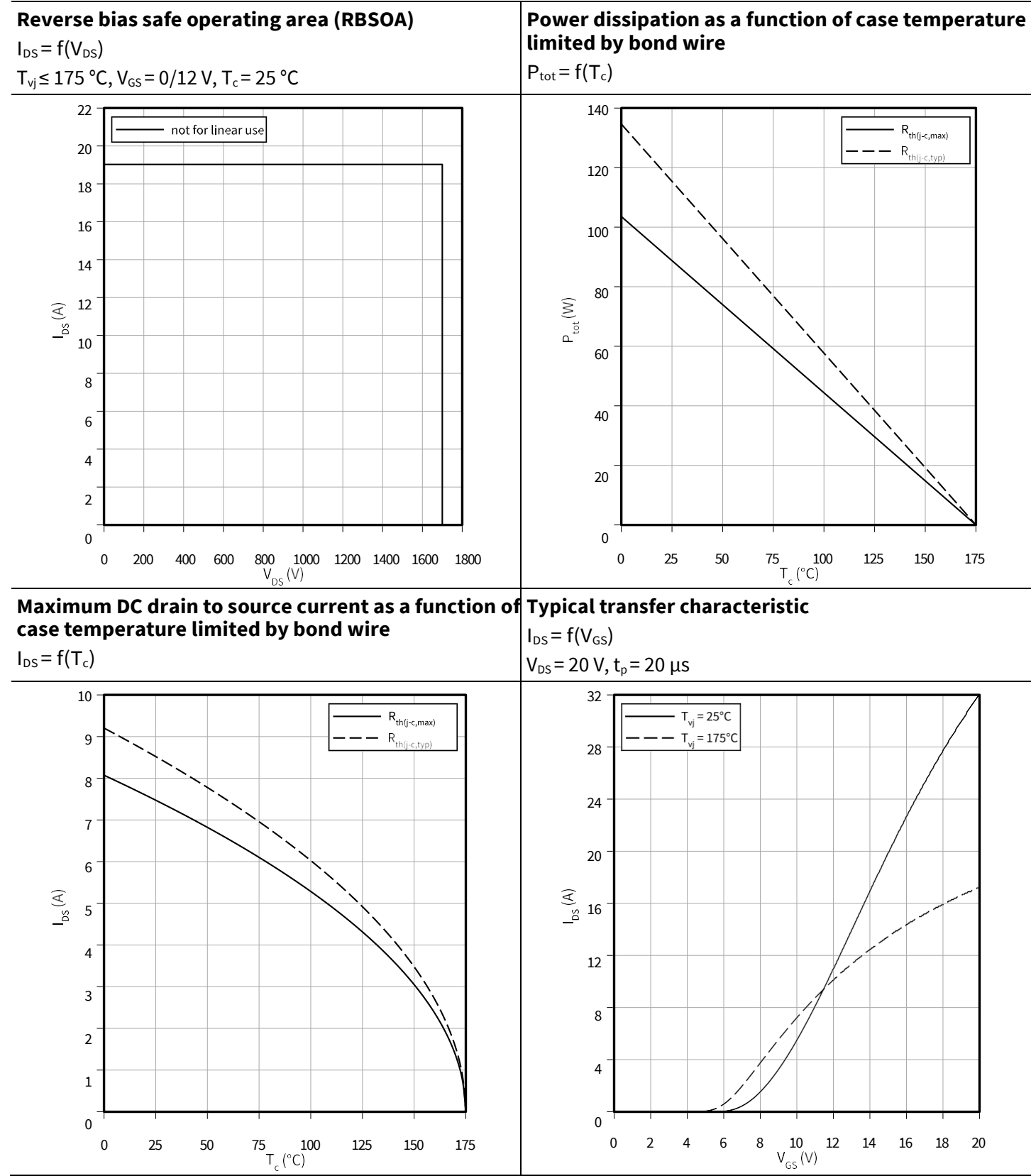
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rise time	t_r	$V_{DD} = 1000 \text{ V}$, $I_D = 1.5 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	11		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	9		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 1000 \text{ V}$, $I_D = 1.5 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	22		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	24		
Fall time	t_f	$V_{DD} = 1000 \text{ V}$, $I_D = 1.5 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	22		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	22		
Turn-on energy	E_{on}	$V_{DD} = 1000 \text{ V}$, $I_D = 1.5 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	76		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	79		
Turn-off energy	E_{off}	$V_{DD} = 1000 \text{ V}$, $I_D = 1.5 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	19		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	21		
Total switching energy	E_{tot}	$V_{DD} = 1000 \text{ V}$, $I_D = 1.5 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	95		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	100		
Virtual junction temperature	T_{vj}		-55		175	$^\circ\text{C}$

注意：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%。

该芯片技术的特征高达 $200 \text{ kV}/\mu\text{s}$ 。测量的 dV/dt 受到测量测试设置和封装的限制。

动态测试电路见图 F。

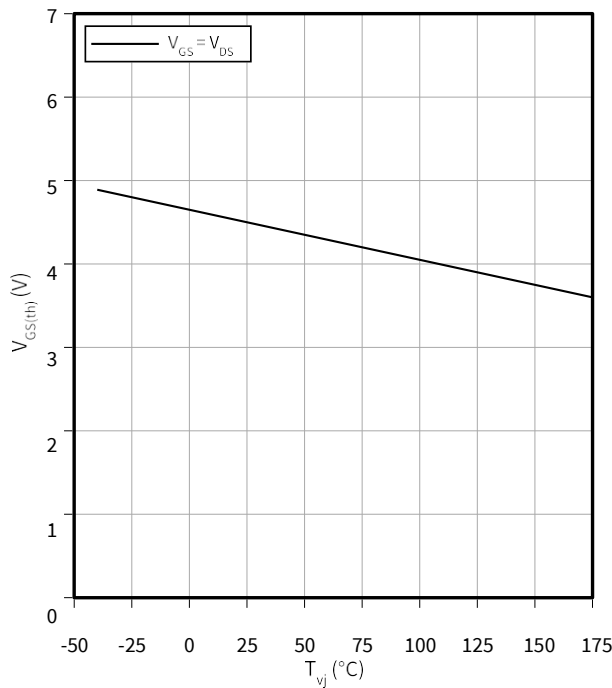
3 特性图



Typical gate-source threshold voltage as a function of junction temperature

$$V_{GS(th)} = f(T_{vj})$$

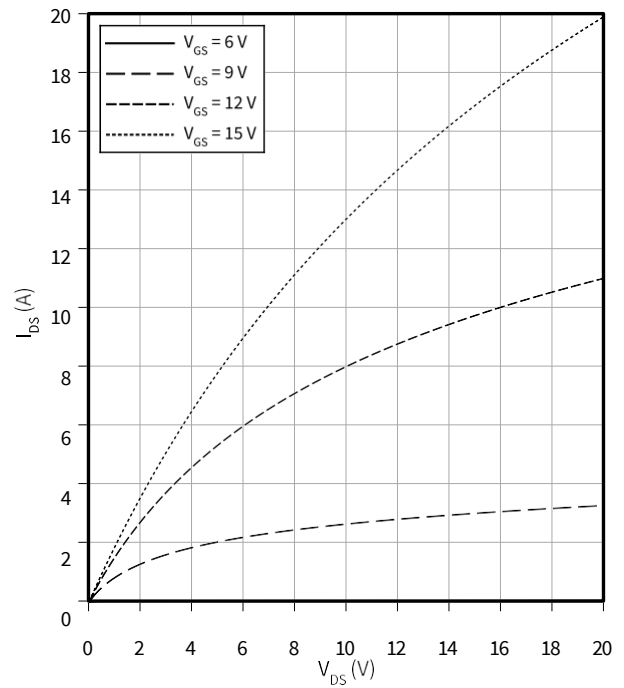
$$I_D = 1.5 \text{ mA}$$



Typical output characteristic, V_{GS} as parameter

$$I_{DS} = f(V_{DS})$$

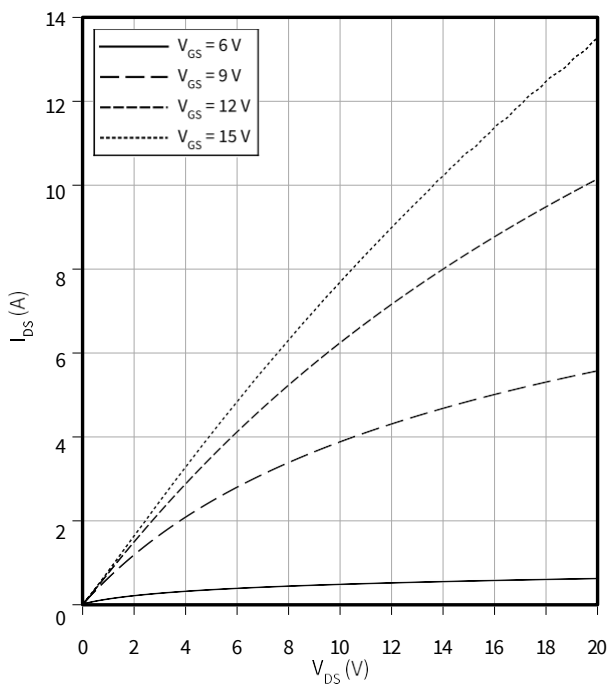
$$T_{vj} = 25 \text{ °C}, t_p = 20 \text{ } \mu\text{s}$$



Typical output characteristic, V_{GS} as parameter

$$I_{DS} = f(V_{DS})$$

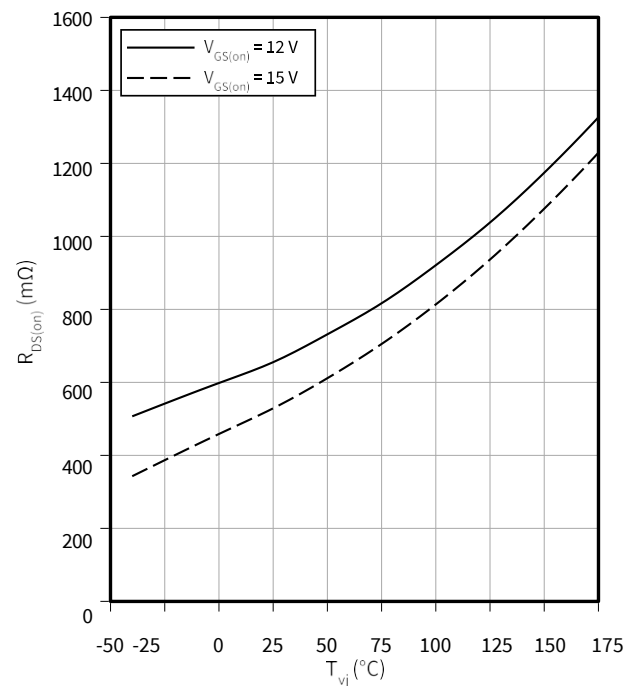
$$T_{vj} = 175 \text{ °C}, t_p = 20 \text{ } \mu\text{s}$$



Typical on-state resistance as a function of junction temperature

$$R_{DS(on)} = f(T_{vj})$$

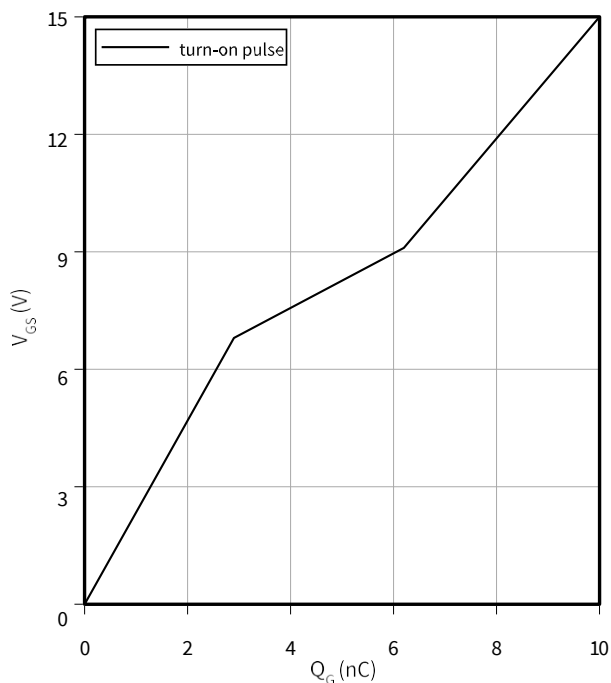
$$I_D = 1.5 \text{ A}$$



Typical gate charge

$$V_{GS} = f(Q_G)$$

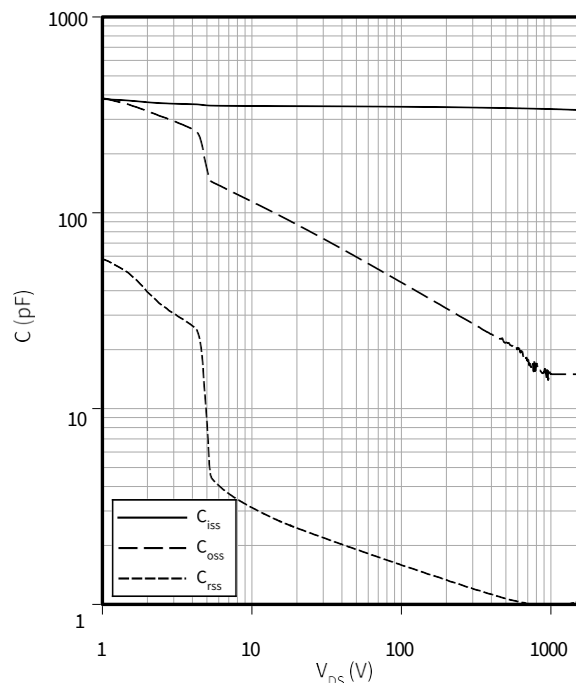
$$I_D = 1.5 \text{ A}, V_{DS} = 1000 \text{ V}$$



Typical capacitance as a function of drain-source voltage

$$C = f(V_{DS})$$

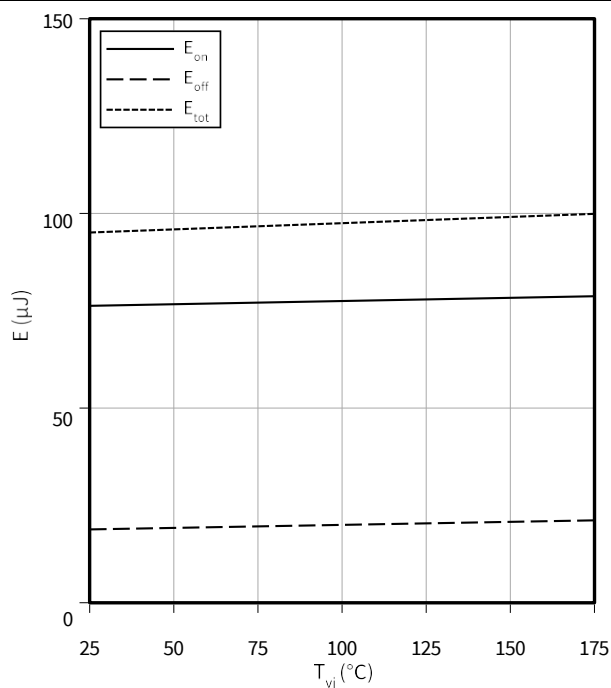
$$f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$$



Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0 \text{ V}$

$$E = f(T_{vj})$$

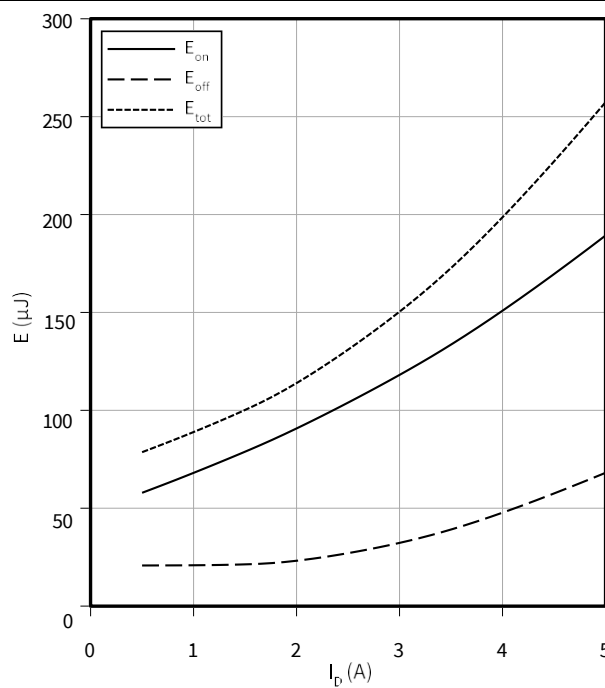
$$V_{GS} = 0/12 \text{ V}, I_D = 1.5 \text{ A}, R_{G,ext} = 6.9 \Omega, V_{DD} = 1000 \text{ V}$$



Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0 \text{ V}$

$$E = f(I_D)$$

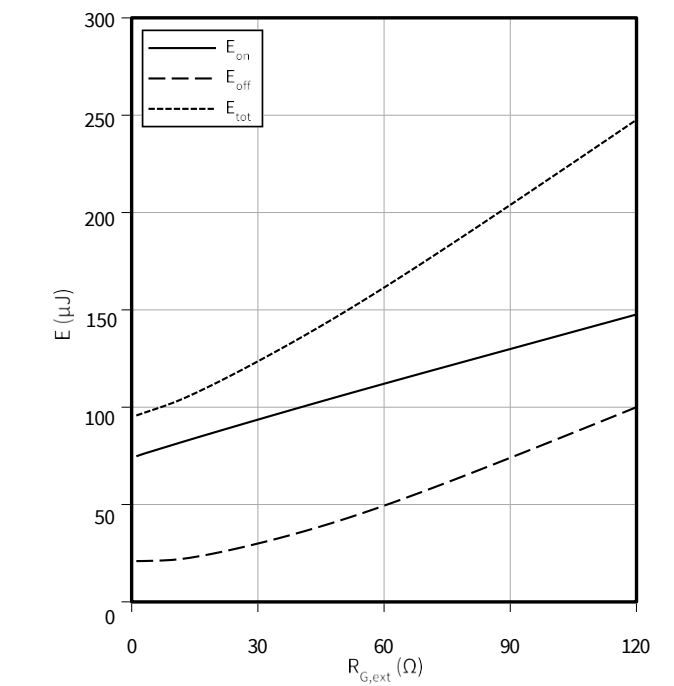
$$V_{GS} = 0/12 \text{ V}, T_{vj} = 175 \text{ °C}, R_{G,ext} = 6.9 \Omega, V_{DD} = 1000 \text{ V}$$



Typical switching energy as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(R_{G,ext})$

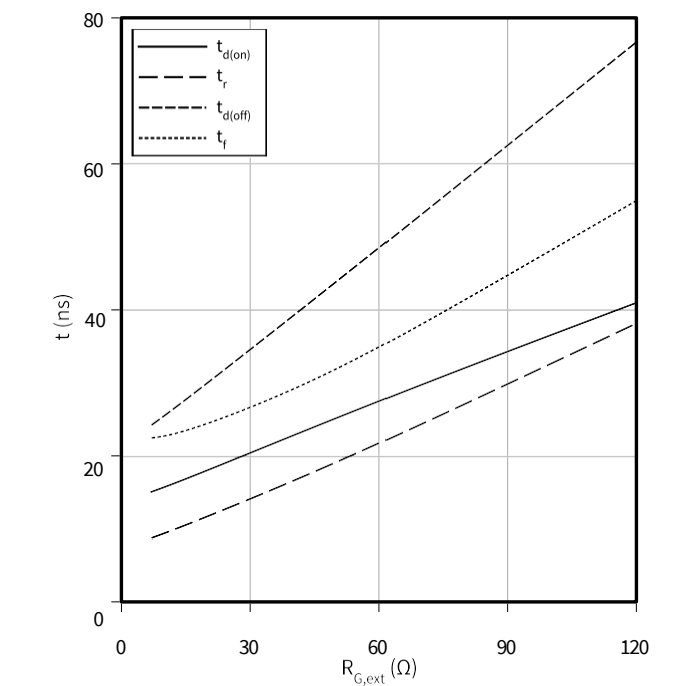
$V_{GS} = 0/12\text{ V}$, $I_D = 1.5\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 1000\text{ V}$



Typical switching times as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$t = f(R_{G,ext})$

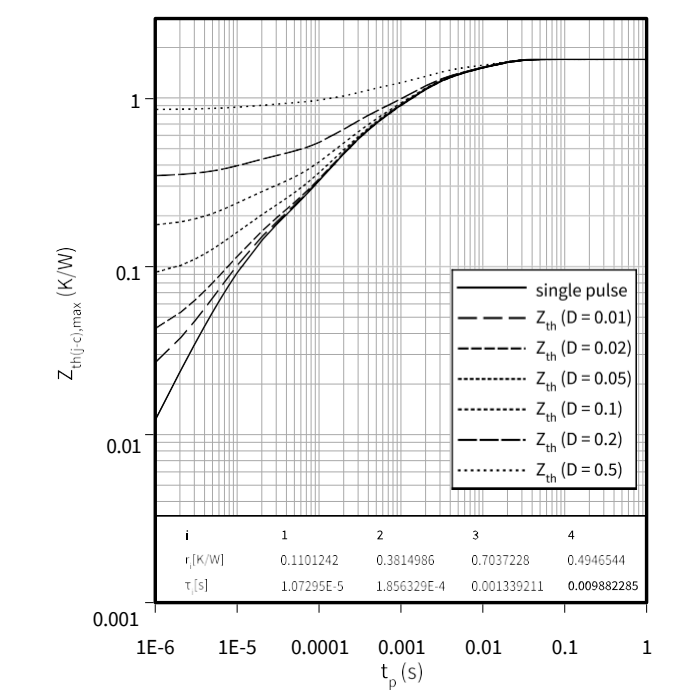
$V_{GS} = 0/12\text{ V}$, $I_D = 1.5\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 1000\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

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

$D = t_p/T$



4 封装外形

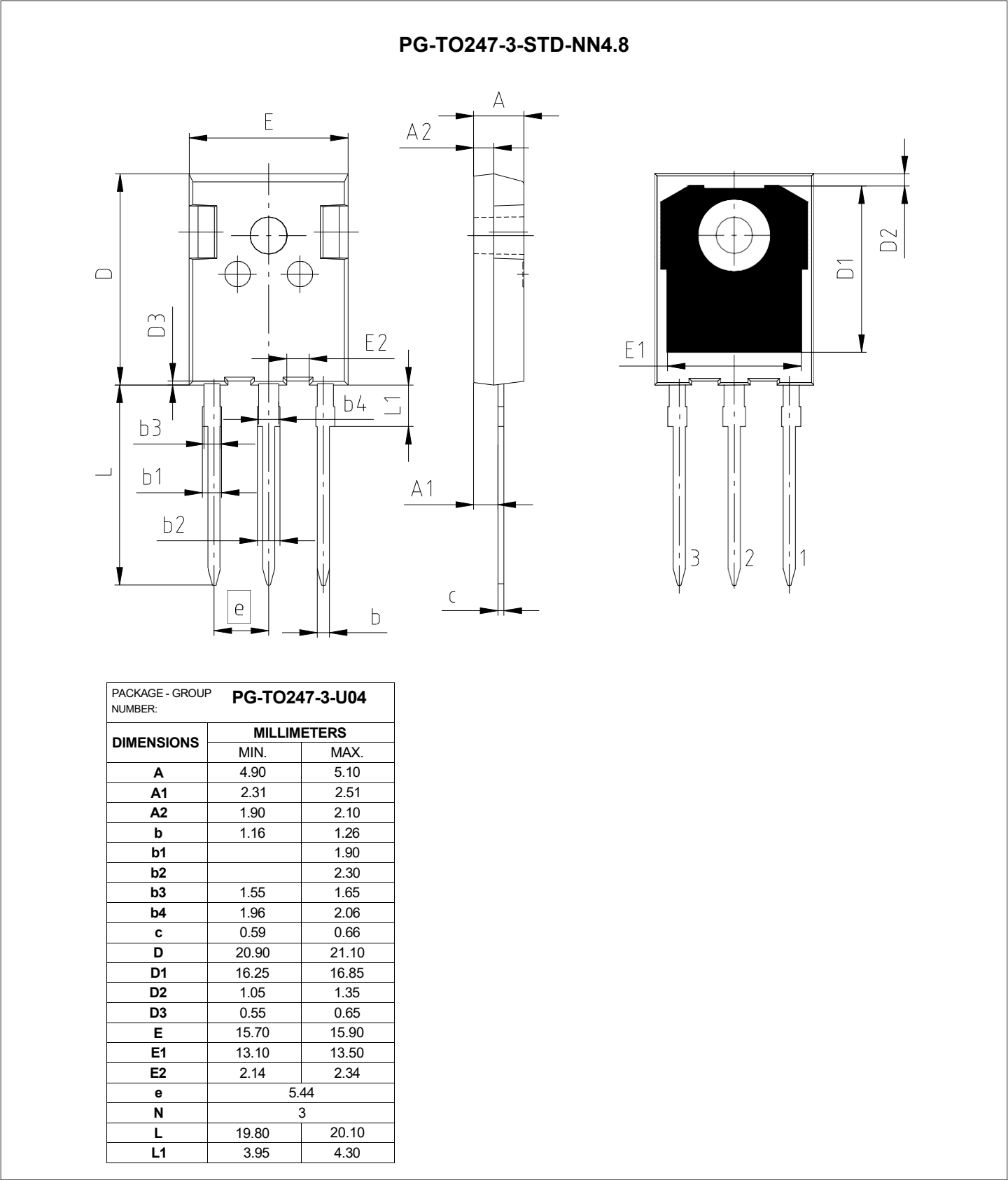


图 1

5 测试条件

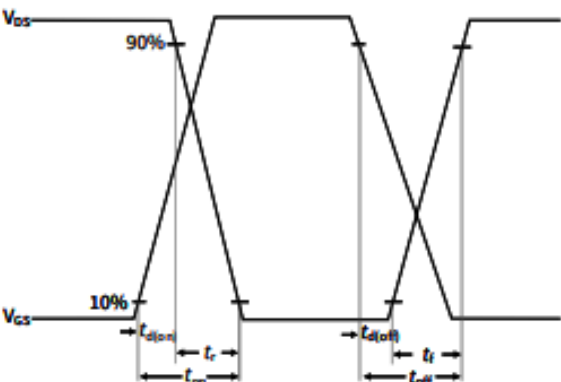


Figure A. Definition of switching times

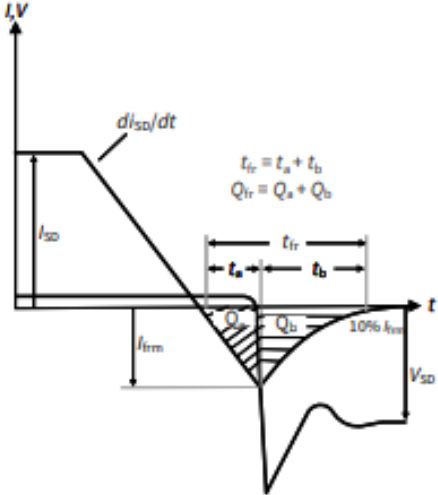


Figure B. Definition of body diode switching characteristics

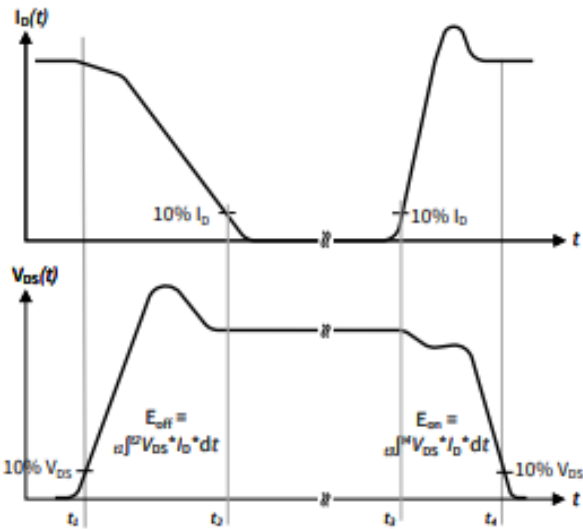


Figure C. Definition of switching losses

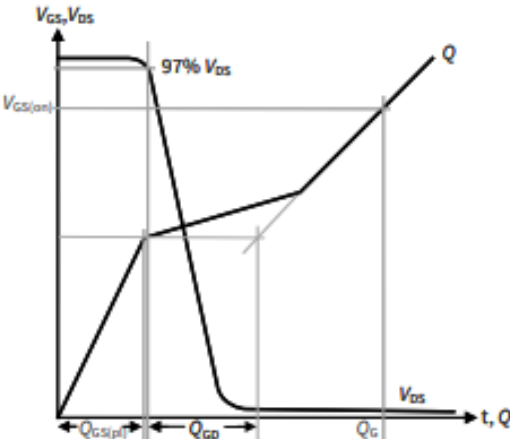


Figure D. Definition of QGD

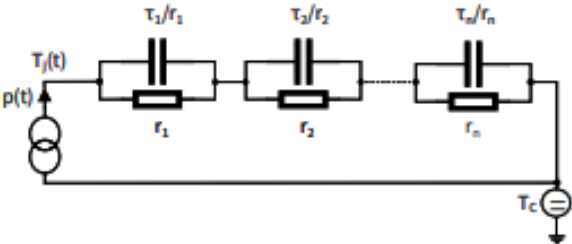


Figure E. Thermal equivalent circuit

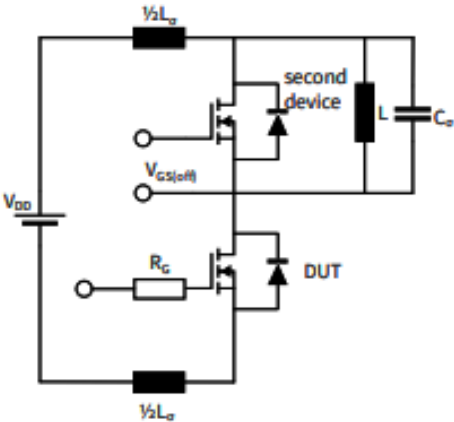


Figure F. Dynamic test circuit
Parasitic inductance L_{σ} ,
Parasitic capacitor C_{σ}



修订记录

Document revision	Date of release	Description of changes
1.00	2024-03-25	Final datasheet



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