

英飞凌 CoolGaN™ G5

英飞凌 CoolGaN™ 晶体管 650 V G5

英飞凌的 CoolGaN™ 是一款高效氮化镓 (GaN) 晶体管，专为 650 V 的功率转换而设计。它可实现更高的功率密度，降低系统 BOM 成本，并有助于实现小型化外形尺寸。采用 200 毫米 (8 英寸) 晶圆技术生产，并完全自动化生产线，生产公差小，产品质量行业领先。这使其适用于从消费电子到工业的广泛应用。

特性

- 增强型晶体管
- 超快速开关
- 无反向恢复电荷
- 能够反向传导
- 低栅极和输出电荷
- 出色的换向耐用性
- 2kV HBM ESD 标准

优点

- 常闭晶体管技术确保安全运行
- 实现快速、精确的电力输送控制
- 提高系统效率和可靠性
- 确保在严苛条件下的稳健表现

这些共性使 CoolGaN™ 成为电源转换领域的游戏规则颠覆者，提供了一个令人叹服的高效、紧凑和可靠的完美组合。

潜在应用

基于半桥硬开关和软开关拓扑 (例如图腾柱 PFC 和 高频 LLC) 的工业、通信、数据中心 SMPS，以及充电器和适配器。

产品验证

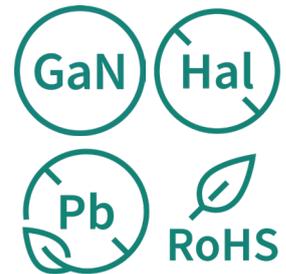
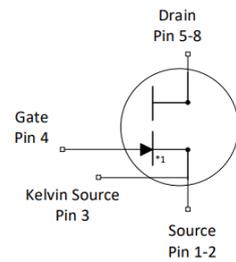
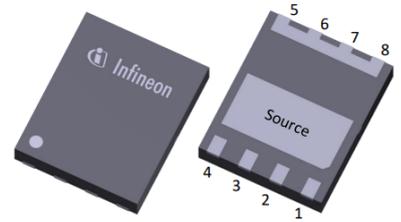
完全符合 JEDEC 工业应用标准

表1 主要性能参数

Parameter	Value	Unit
$V_{DS,max}$	650	V
$V_{DS,trans-max}$	900	V
$R_{DS(on),max}$	170	m Ω
$Q_{g,typ}$	1.8	nC
$I_{D,pulse}$	23	A
$Q_{oss@400V}$	14	nC
Q_{rr}	0	nC

Part number	Package	Marking	Related links
IGLR65R140D2	PG-TSON-8	65R140D	see Appendix A

PG-TSON-8





目录

描述.....	1
最大额定值.....	3
热特性.....	5
电气特性.....	6
电气特性图.....	8
测试电路.....	13
封装外形.....	14
附录 A.....	17
修订记录.....	18
商标.....	19
免责声明.....	19

1 最大额定值

除非另有说明，否则 $T_j = 25^\circ\text{C}$ 。超过最大额定值的应力可能会对器件造成永久性损坏。为获得最佳使用寿命和可靠性，英飞凌建议运行条件不要持续超过所述最大额定值的 80%（除非另有明确说明）。如需更多信息，请联系您当地的英飞凌销售办事处。

表 2 最大额定值

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Drain source voltage, continuous	$V_{DS,max}$	-	-	650	V	$V_{GS} = 0\text{ V}$; derating recommendation according JEDEC JEP198
Leakage current at drain source transient voltage	$I_{DS,trans}$	-	-	4.8	mA	$V_{GS} = 0\text{ V}$; $V_{DS,trans} = 900\text{ V}$
Drain source voltage transient	$V_{DS,trans}$	-	-	900	V	<1% duty cycle; <1 μs ; 1 million pulses
Drain source voltage, pulsed	$V_{DS,pulsed}$	-	-	750	V	$T_j = 25^\circ\text{C}$; $V_{GS} \leq 0\text{ V}$; cumulated stress time $\leq 1\text{ h}$
				650		$T_j = 125^\circ\text{C}$; $V_{GS} \leq 0\text{ V}$; cumulated stress time $\leq 1\text{ h}$
Switching surge voltage, pulsed	$V_{DS,surge}$	-	-	750	V	DC bus voltage = 700 V; turn off $V_{DS,pulse} = 750\text{ V}$; turn on $I_{D,pulse} = 10\text{ A}$; $T_j = 105^\circ\text{C}$; $f \leq 100\text{ kHz}$; $t \leq 100\text{ s}$ (10 million pulses)
Continuous current, drain source ¹⁾	I_D	-	-	13	A	$T_C = 25^\circ\text{C}$; $T_j = T_{j,max}$
Pulsed current, drain source	$I_{D,pulse}$	-23	-	23	A	$T_j = 25^\circ\text{C}$; $I_G = 10\text{ mA}$; See Diagram 3, 5
		-14	-	14		$T_j = 125^\circ\text{C}$; $I_G = 10\text{ mA}$; See Diagram 4, 6
Gate current, continuous ²⁾	$I_{G,avg}$	-	-	7.7	mA	$T_j = -55^\circ\text{C}$ to $T_j = 150^\circ\text{C}$; See Table 9
Gate current, pulsed ²⁾	$I_{G,pulsed}$	-0.77	-	0.77	A	$T_j = -55^\circ\text{C}$ to $T_j = 150^\circ\text{C}$; $t_{pulse} = 50\text{ ns}$; $f = 100\text{ kHz}$; See Table 9
Gate source voltage, continuous ²⁾	V_{GS}	-10	-	-	V	$T_j = -55^\circ\text{C}$ to $T_j = 150^\circ\text{C}$; See Diagram 12
Gate source voltage, pulsed ²⁾	$V_{GS,pulse}$	-25	-	-	V	$T_j = -55^\circ\text{C}$ to $T_j = 150^\circ\text{C}$; $t_{pulse} = 50\text{ ns}$; $f = 100\text{ kHz}$; open drain
Power dissipation	P_{tot}	-	-	47	W	$T_C = 25^\circ\text{C}$
Operating junction temperature	T_j	-55	-	150	$^\circ\text{C}$	-
Storage temperature	T_{stg}	-55	-	150	$^\circ\text{C}$	Max shelf life depends on storage conditions
Drain-source voltage slew-rate	dv/dt	-	-	200	V/ns	-

- 1) 受 T 限制。最大占空比 $D=0.75$
- 2) 我们建议使用先进的驱动技术来优化器件性能。请参阅栅极驱动器应用说明了解更多详细内容。

2 热特性

表 3 热特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	2.7	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	163	°C/W	Device on PCB, minimum footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	74	°C/W	Device on 40 mm*40 mm*1.5 mm epoxy PCB FR4 with 6 cm ² (one layer, 70 μm thickness) copper area for tab (source) connection and cooling. PCB is vertical without air stream cooling.
Soldering temperature	T_{sold}	-	-	260	°C	MSL3, wave & reflow soldering allowed

3 电气特性

除非另有规定, $T_j = 25^\circ\text{C}$

表 4 静态特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate threshold voltage	$V_{GS(th)}$	0.9	1.2	1.6	V	$I_{DS}=1\text{ mA}; V_{DS}=10\text{ V}; T_j=25^\circ\text{C}$
		-	1	-		$I_{DS}=1\text{ mA}; V_{DS}=10\text{ V}; T_j=150^\circ\text{C}$
Gate-Source reverse clamping voltage	$V_{GS, clamp}$	-	-	-8	V	$I_{GS}=-1\text{ mA}$
Drain-Source leakage current	I_{DSS}	-	0.39	39	μA	$V_{DS}=650\text{ V}; V_{GS}=0\text{ V}; T_j=25^\circ\text{C}$
		-	7.8	-		$V_{DS}=650\text{ V}; V_{GS}=0\text{ V}; T_j=150^\circ\text{C}$
Drain-Source on-state resistance	$R_{DS(on)}$	-	0.140	0.170	Ω	$I_G=10\text{ mA}; I_D=3.1\text{ A}; T_j=25^\circ\text{C}$
		-	0.300	-		$I_G=10\text{ mA}; I_D=3.1\text{ A}; T_j=150^\circ\text{C}$
Gate resistance	$R_{G,int}$	-	0.92	-	Ω	LCR impedance measurement; $f=f_{res}$, open drain;

表 5 动态特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance	C_{ISS}	-	155	-	pF	$V_{GS}=0\text{ V}; V_{DS}=400\text{ V}; f=1\text{ MHz}$
Output capacitance	C_{OSS}	-	22	-		
Reverse transfer capacitance	C_{RSS}	-	0.31	-		
Effective output capacitance, time related ³⁾	$C_{o(tr)}$	-	35	-	pF	$V_{GS}=0\text{ V}; V_{DS}=0\text{ to }400\text{ V}; I_D=\text{const}$
Effective output capacitance, energy related ⁴⁾	$C_{o(er)}$	-	26	-	pF	$V_{DS}=0\text{ to }400\text{ V}$
Output charge	Q_{OSS}	-	14	-	nC	
Coss stored energy	E_{OSS}	-	2.1	-	μJ	
Turn-on delay time	$t_{d(on)}$	-	7	-	ns	$I_D=3.1\text{ A}; R_{ON}=12\text{ Ohm}; R_{OFF}=12\text{ Ohm};$ $R_{SS}=820\text{ Ohm}; C_C=1.2\text{ nF};$ $V_{DRV}=12\text{ V};$ see Table 8
Turn-off delay time	$t_{d(off)}$	-	10	-		
Rise time	t_r	-	7	-		
Fall time	t_f	-	23	-		

³⁾ $C_{o(tr)}$ 是一个固定电容, 当 V_{DS} 从 0 升至 400 V 时, 其充电时间与 C_{OSS} 相同

⁴⁾ $C_{o(er)}$ 是固定电容, 当 V_{DS} 从 0 升至 400 V 时, 其存储能量与 C_{OSS} 相同

表 6 栅极电荷特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate charge	Q_G	-	1.8	-	nC	$V_{GS}=0\text{ to }3\text{ V}; V_{DS}=400\text{ V}; I_D=3.1\text{ A}$

表7 反向传导特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Source-Drain reverse voltage	V_{SD}	-	2.0	2.4	V	$V_{GS}=0\text{ V}; I_{SD}=3.1\text{ A}$
Pulsed current, reverse	$I_{SD,pulse}$	-	-	23	A	$I_G=10\text{ mA}$
Reverse recovery charge ⁵⁾	Q_{rr}	-	0	-	nC	$I_{SD}=3.1\text{ A}; V_{DS}=400\text{ V}$

⁵⁾ 不包括 Q_{oss}

4 电气特性图

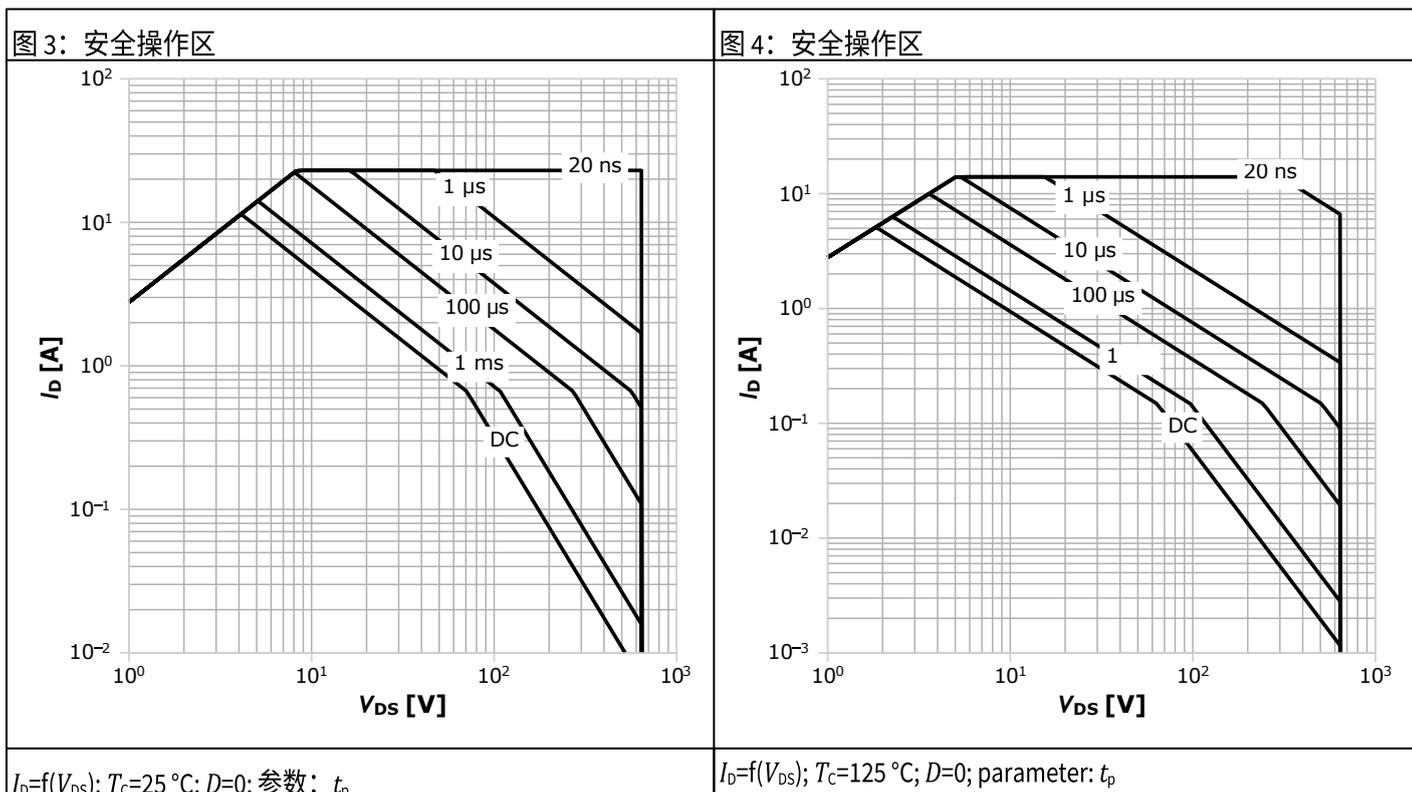
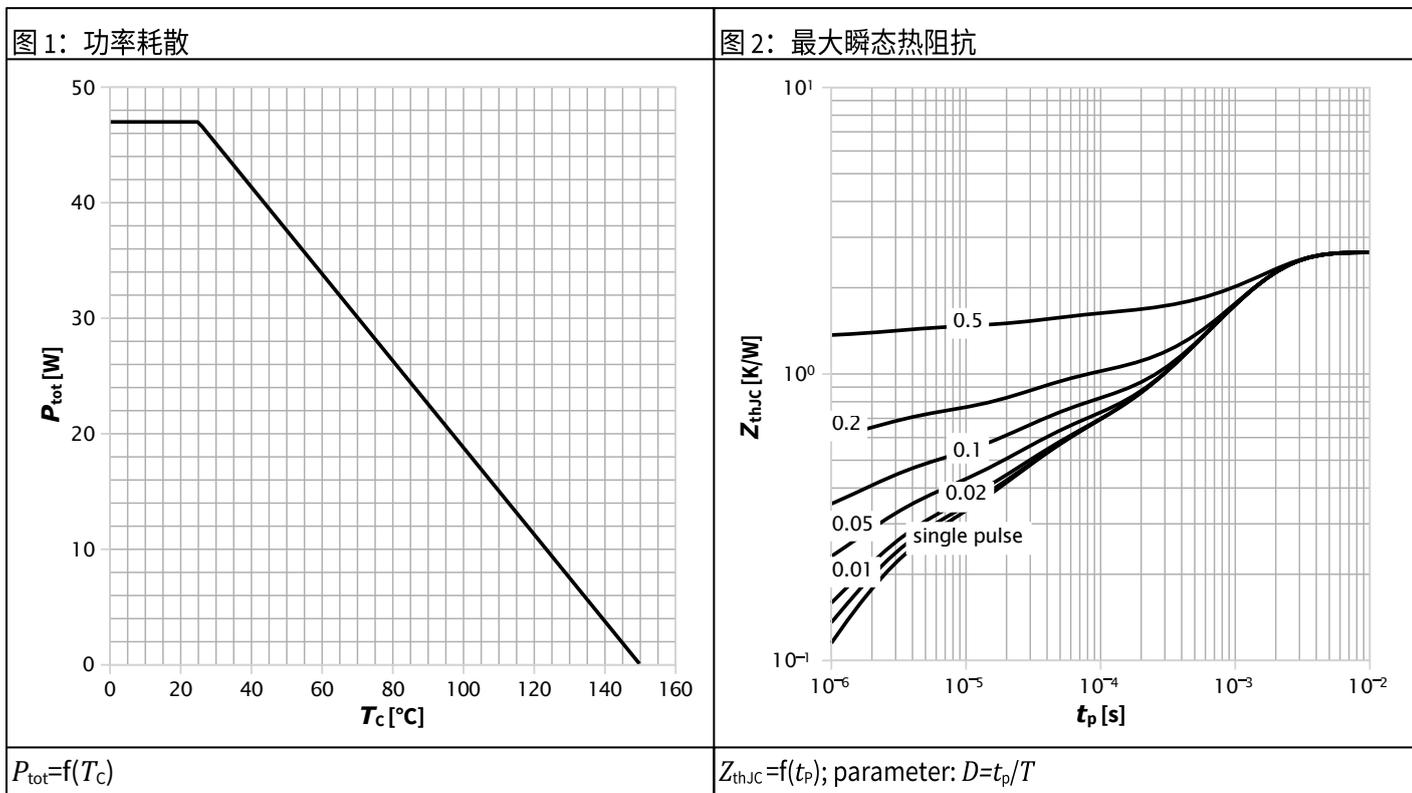
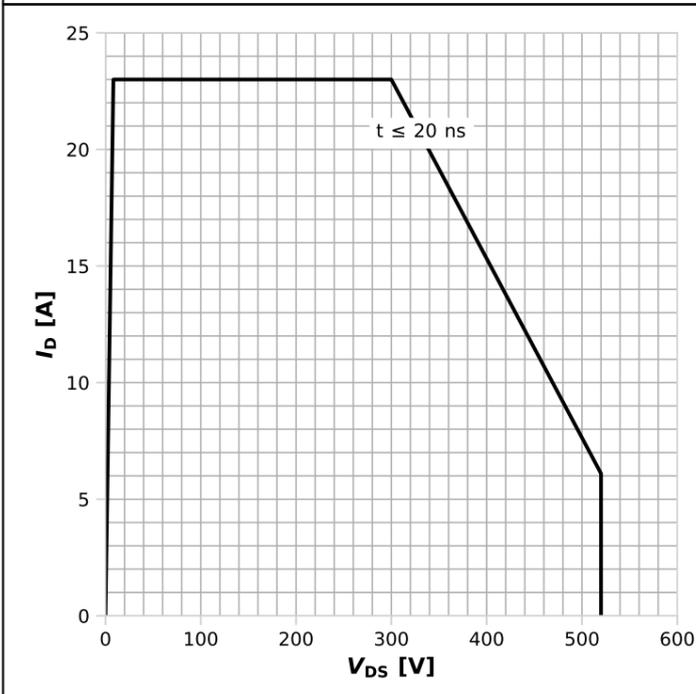
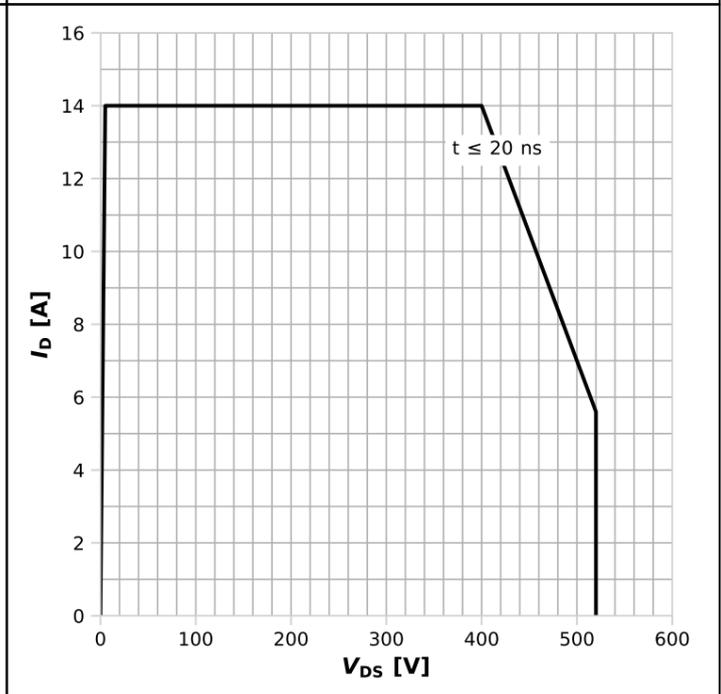


Diagram 5: Repetitive safe operating area



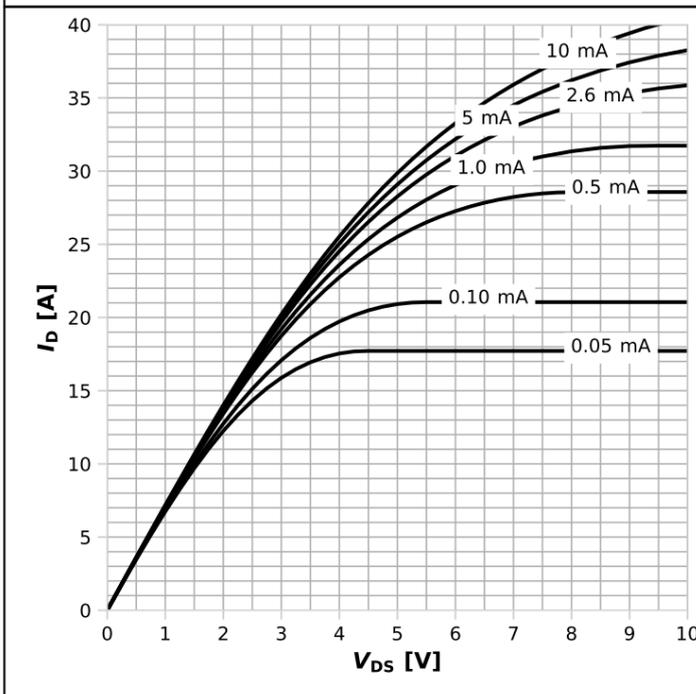
$I_D=f(V_{DS}); T_C=25^{\circ}\text{C}; T_J\leq 150^{\circ}\text{C};$ parameter: t_p

Diagram 6: Repetitive safe operating area



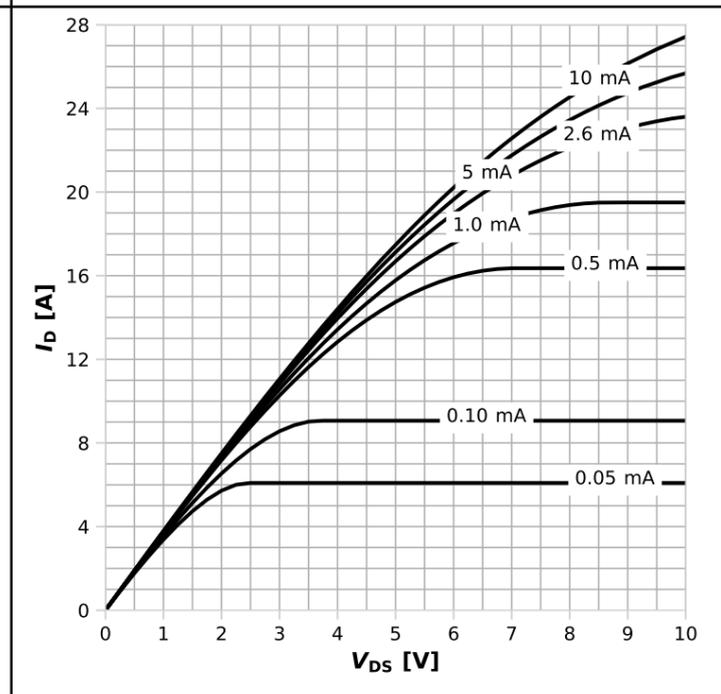
$I_D=f(V_{DS}); T_C=125^{\circ}\text{C}; T_J\leq 150^{\circ}\text{C};$ parameter: t_p

Diagram 7: Typ. output characteristics



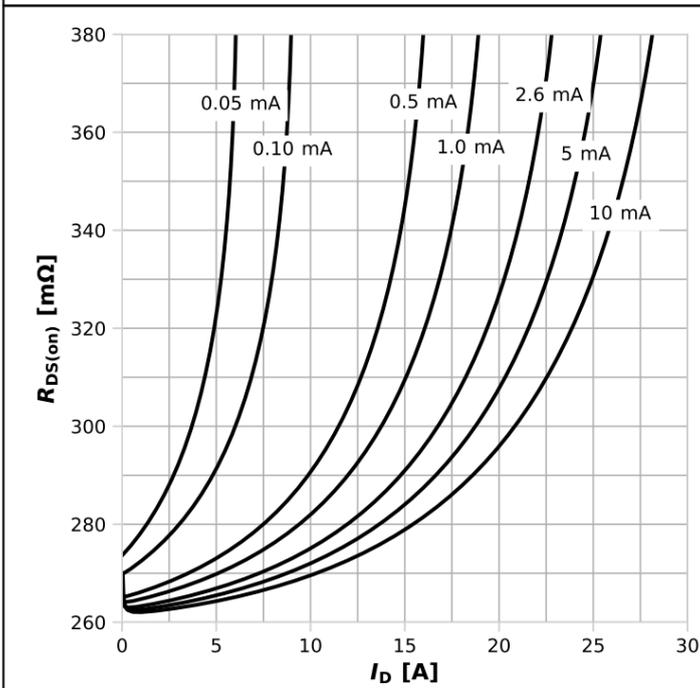
$I_D=f(V_{DS}); T_J=25^{\circ}\text{C};$ parameter: I_{GS}

Diagram 8: Typ. output characteristics



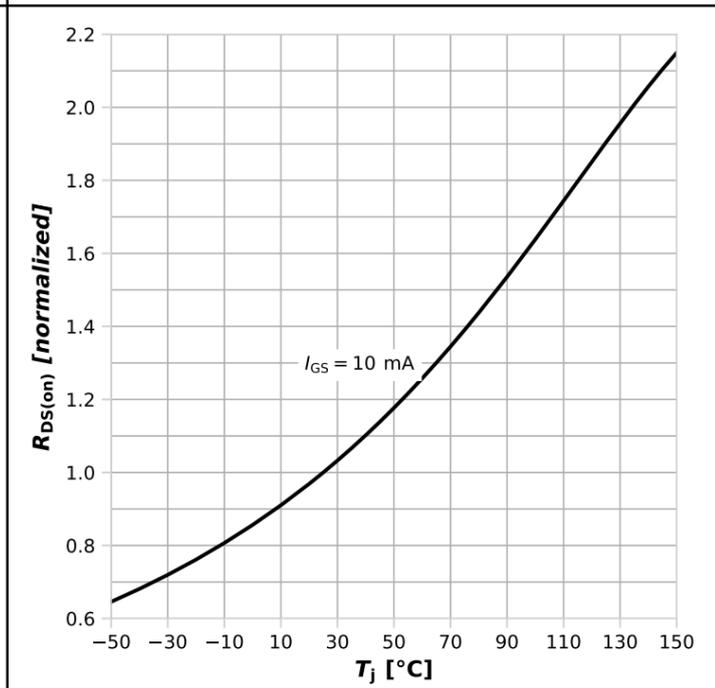
$I_D=f(V_{DS}); T_J=125^{\circ}\text{C};$ parameter: I_{GS}

Diagram 9: Typ. Drain-source on-state resistance



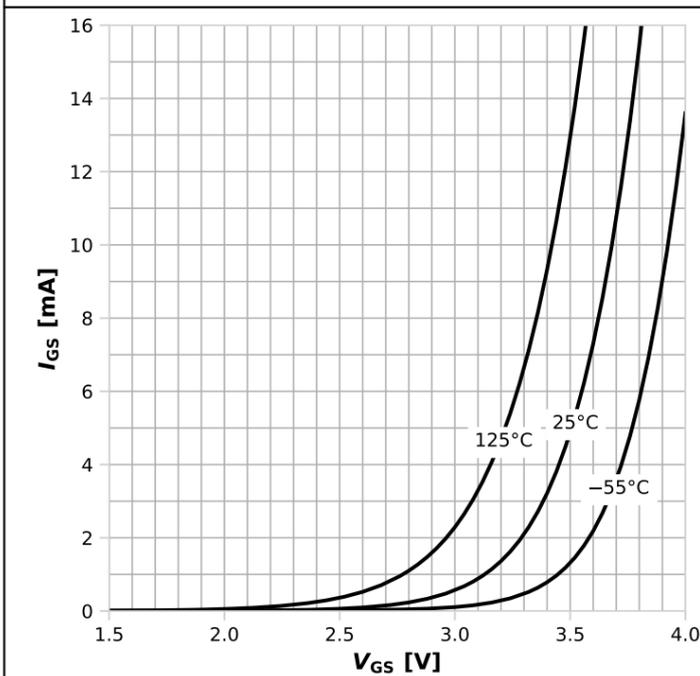
$$R_{DS(on)} = f(I_D); T_j = 125^\circ\text{C}; \text{parameter: } I_{GS}$$

Diagram 10: Drain-source on-state resistance



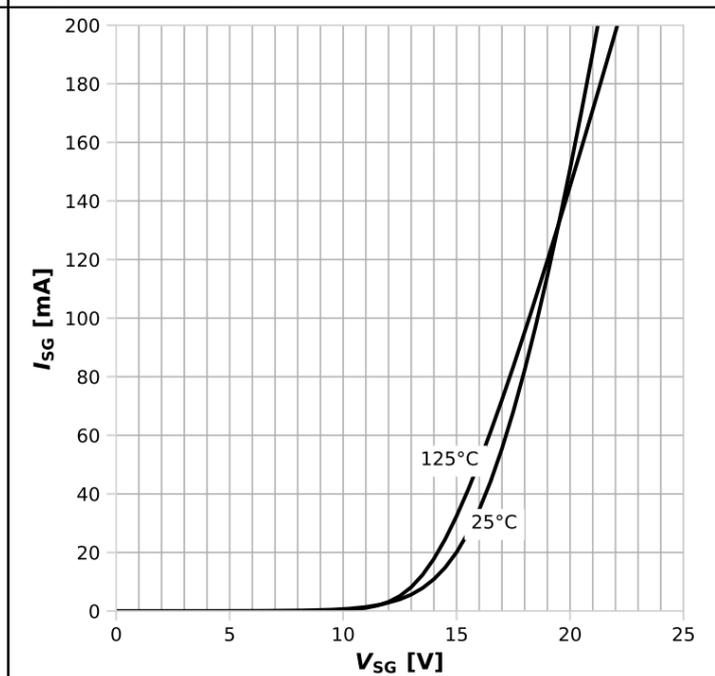
$$R_{DS(on)} = f(T_j); I_D = 3.1 \text{ A}$$

Diagram 11: Typ. gate characteristics forward



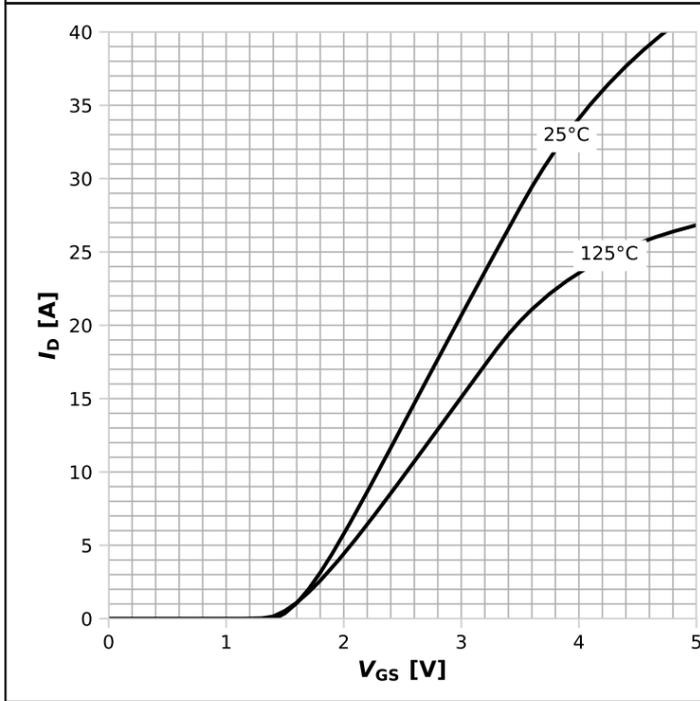
$$I_{GS} = f(V_{GS}); \text{open drain}; \text{parameter: } T_j$$

Diagram 12: Typ. gate characteristics reverse



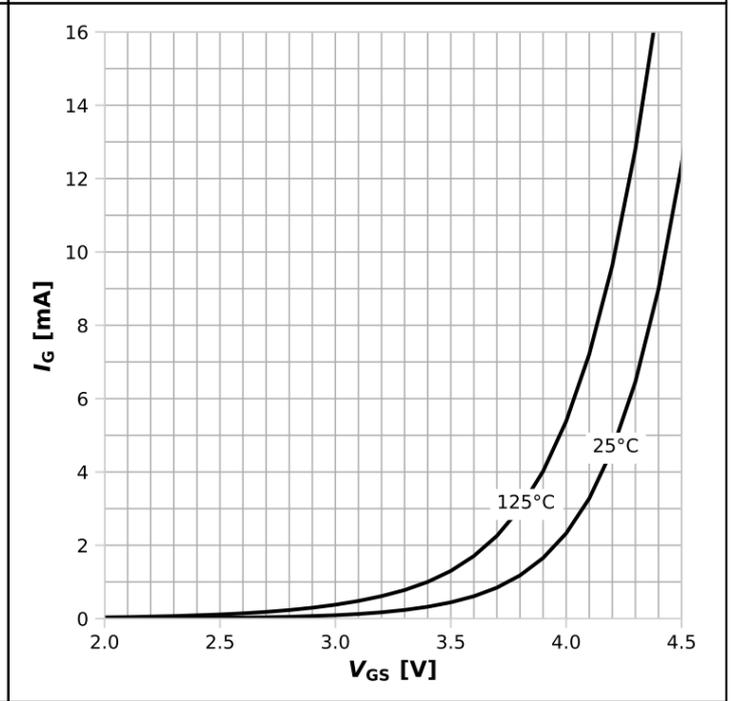
$$I_{SG} = f(V_{SG}); \text{parameter: } T_j$$

Diagram 13: Typ. transfer characteristics



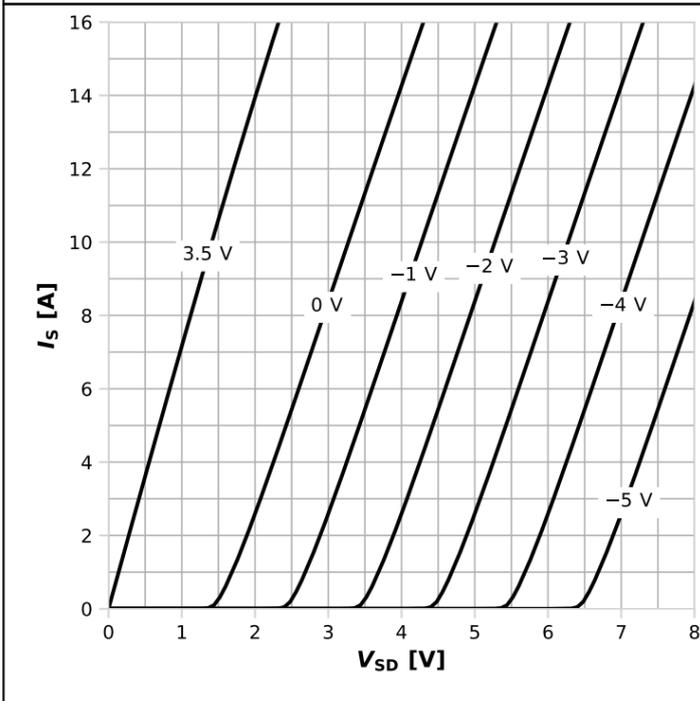
$I_D = f(I_{GS}); V_{DS} = 8V; \text{parameter: } T_j$

Diagram 14: Typ. transfer gate current characteristic



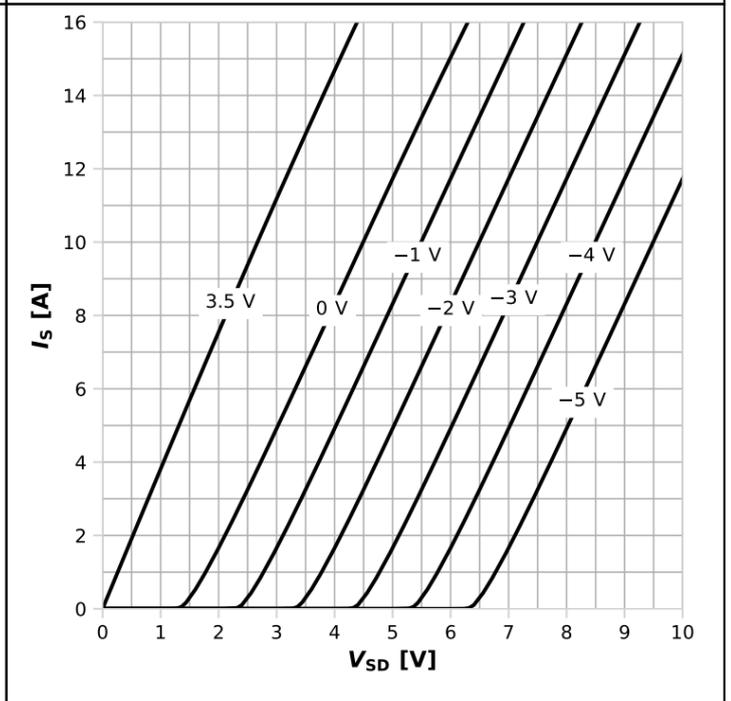
$I_G = f(V_{GS}); V_{DS} = 8V; \text{parameter: } T_j$

Diagram 15: Typ. channel reverse characteristics



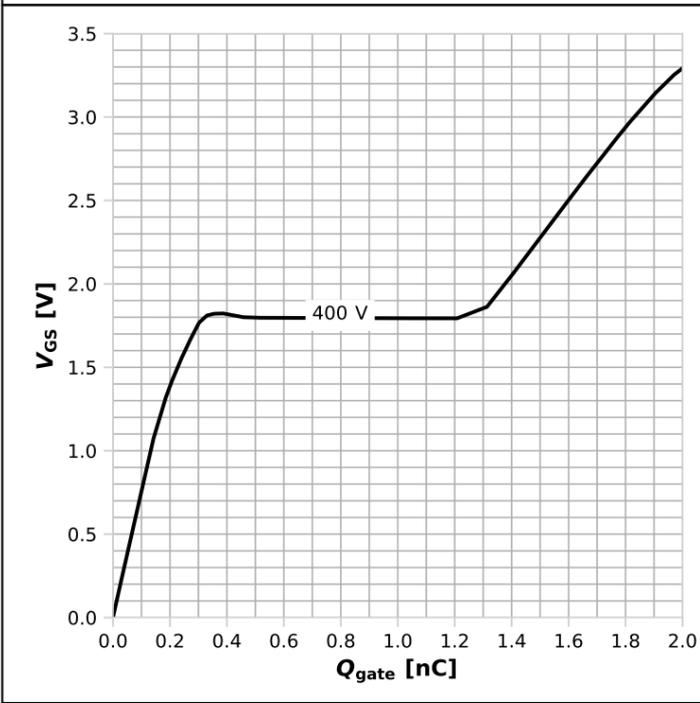
$I_S = f(V_{SD}); T_j = 25^\circ C; \text{parameter: } V_{GS}$

Diagram 16: Typ. channel reverse characteristics



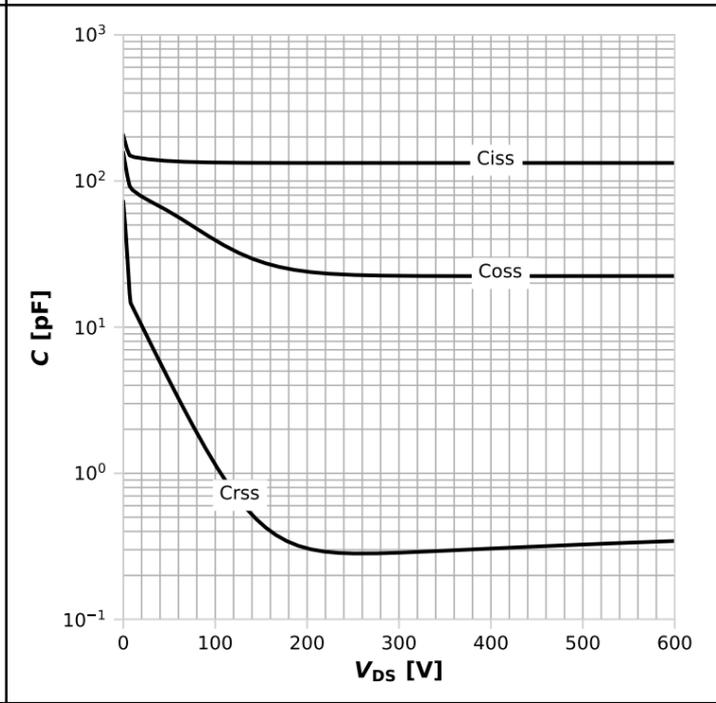
$I_S = f(V_{SD}); T_j = 125^\circ C; \text{parameter: } V_{GS}$

Diagram 17 Typ. gate charge



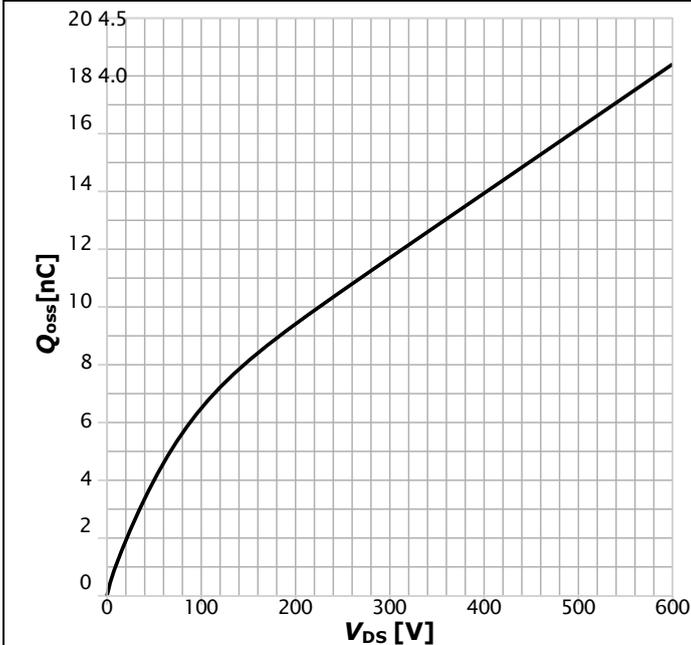
$V_{GS}=f(Q_{gate})$; $I_D=3.1$ A pulsed; $I_G=4.5$ mA; parameter: V_{DD}

Diagram 18: Typ. capacitances



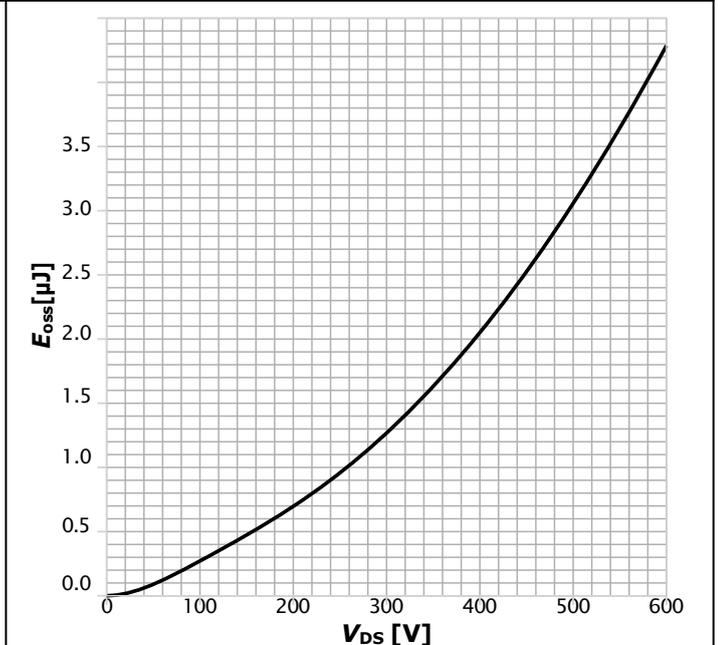
$C=f(V_{DS})$; $V_{GS}=0$ V

图 19: 典型输出电荷



$Q_{oss}=f(V_{DS})$

图 20: 典型Coss 储存能量



$E_{oss}=f(V_{DS})$

5 测试电路

表8 反向通道特性测试

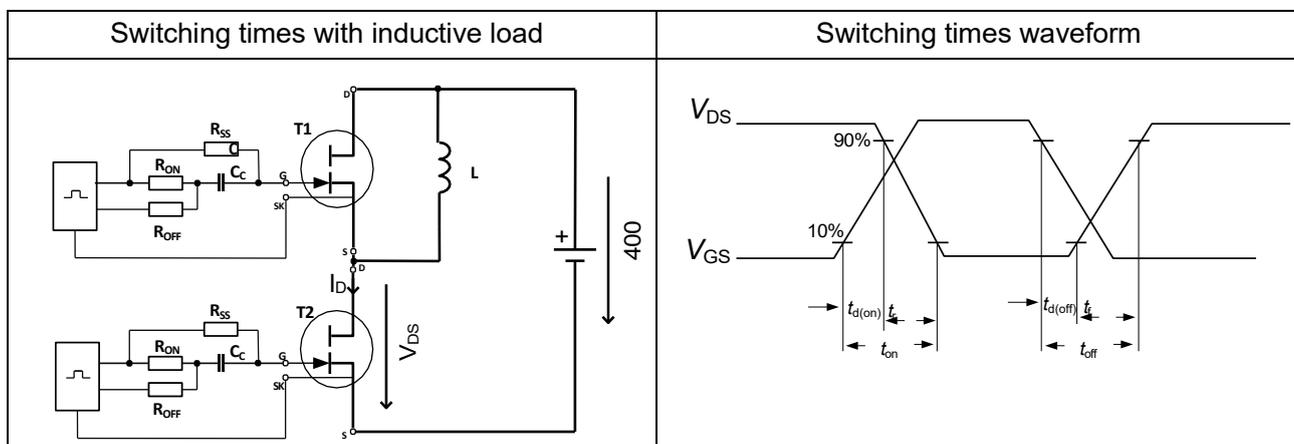
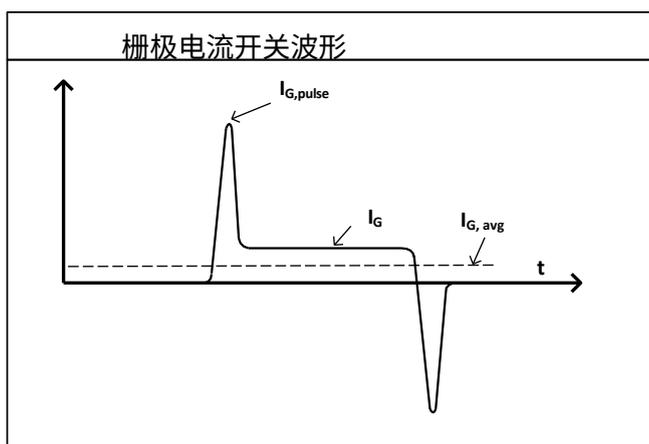
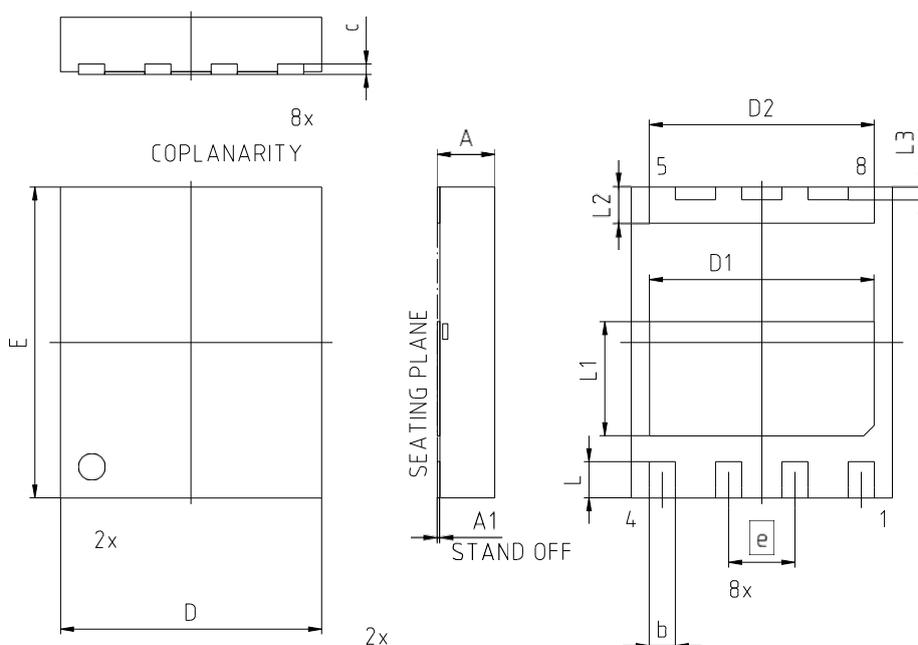


表9 栅极电流开关波形

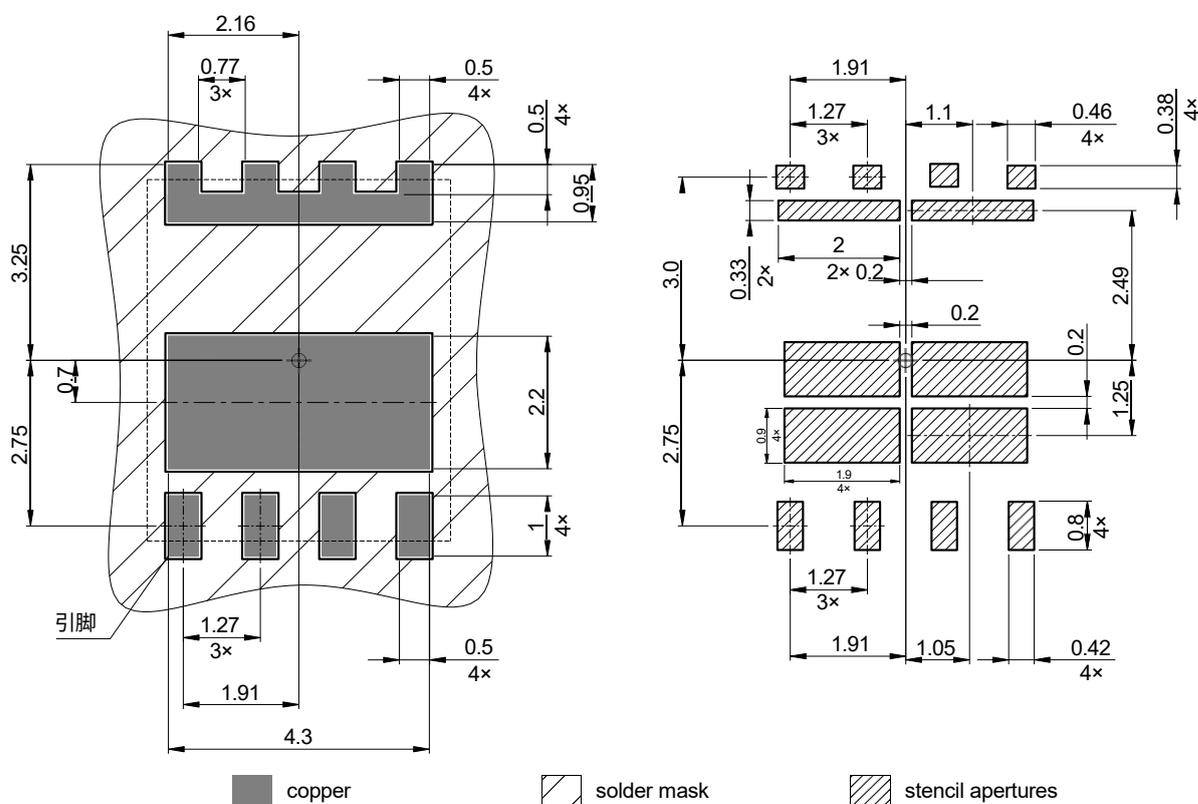


6 封装外形



PACKAGE - GROUP		
PG-TSON-8-U03		
NUMBER:		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	-	1.10
A1	-	0.05
b	0.45	0.55
c	0.20	
D	5.00	
D1	4.20	4.40
D2	4.21	4.41
E	6.00	
e	1.27	
L	0.60	0.80
L1	2.10	2.30
L2	0.60	0.80
L3	0.15	0.35

图 1 PG-HSOF-8 外形图，尺寸单位为毫米



所有焊盘均非阻焊定义所有尺寸单位均为毫米

图 2 PG-HSOF-8 封装图，尺寸单位为毫米

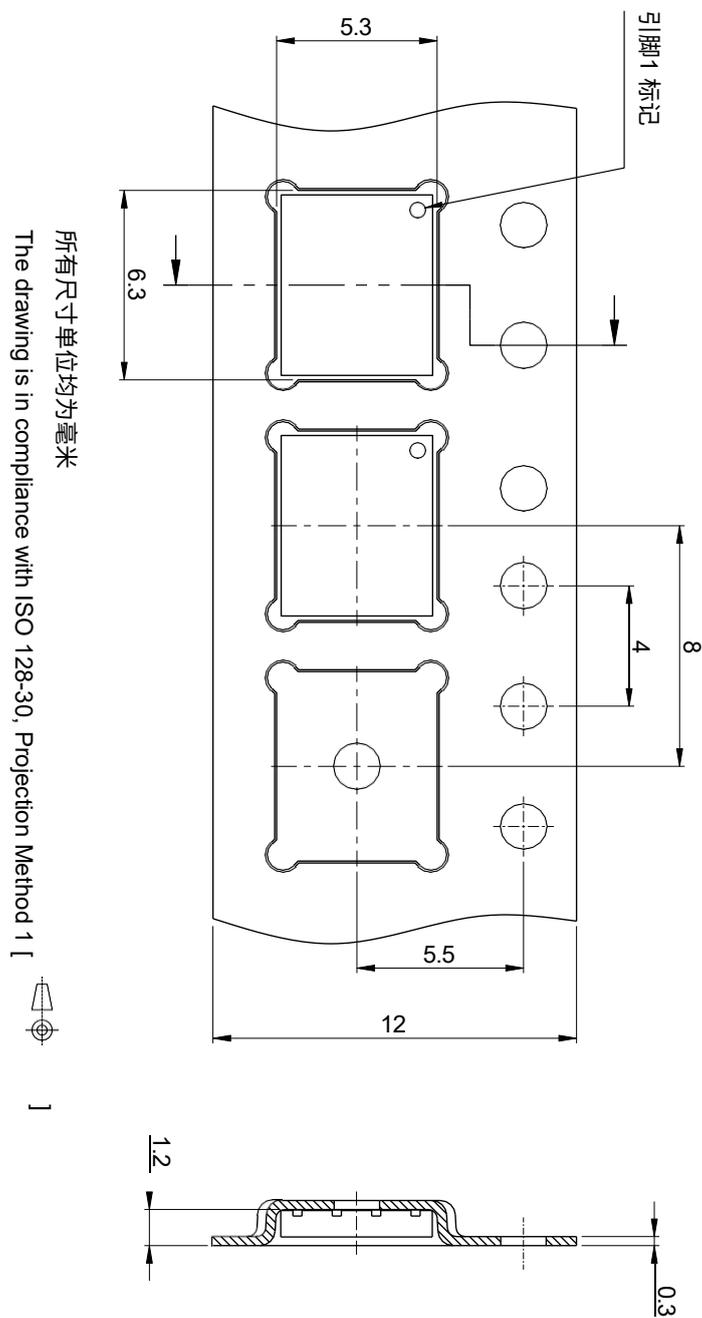


图 3 PG-HSOF-8 包装型号，尺寸单位为毫米

7 附录A

表 10 相关链接

- CoolGaN™ webpage
- CoolGaN™ reliability white paper
- CoolGaN™ gate driver application note ●
- CoolGaN™ applications information



修订记录

I GLR65R140D2

Revision 2025 - 02 - 25 , Rev. 1 . 1

历史修订版本

Revision	Date	Subjects (major changes since last revision)
1.0	2024-10-25	Release of final
1.1	2025-02-25	Package picture and symbol updated on page 1

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