

英飞凌CoolGaN™ G5

PG-DSO-20

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。它采用 200 毫米（8 英寸）晶圆技术和全自动生产线生产，具有生产公差小的特点，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。

潜在的应用

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。

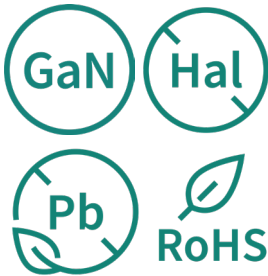
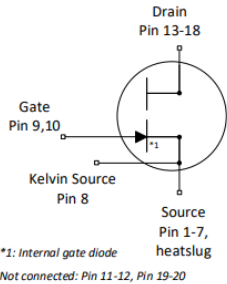
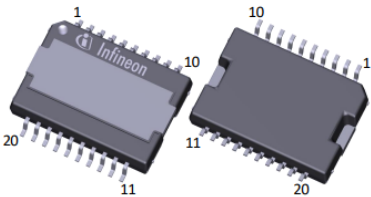
产品认证

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
$R_{DS(on),max}$	54	mΩ
$Q_{g,typ}$	6	nC
$I_{D,pulse}$	76	A
$Q_{oss} @ 400 V$	45	nC
Q_{rr}	0	nC

Type / Ordering code	Package	Marking	Related links
IGOT65R045D2	PG-DSO-20	65R045D2	see Appendix A



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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，英飞凌建议工作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	$I_{DS,trans}$	-	-	16	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	$V_{DS,pulsed}$	-	-	750 650	V	$T_j = 25^\circ\text{C}$; $V_{GS} \leq 0\text{ V}$; cumulated stress time $\leq 1\text{ h}$ $T_j = 125^\circ\text{C}$; $V_{GS} \leq 0\text{ V}$; 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 $I_{D,pulse} = 34\text{ A}$; $T_j = 105^\circ\text{C}$; $f \leq 100\text{ kHz}$, $t \leq 100\text{ s}$ (10 million pulses)
Continuous current, drain source ¹⁾	I_D	-	-	34	A	$T_c = 25^\circ\text{C}$; $T_j = T_{j,max}$
Pulsed current, drain source	$I_{D,pulse}$	-76 -46	-	76 46	A	$T_j = 25^\circ\text{C}$; $I_G = 33\text{ mA}$; See Diagram 3, 5 $T_j = 125^\circ\text{C}$; $I_G = 33\text{ mA}$; See Diagram 4, 6
Gate current, continuous ²⁾	$I_{G,avg}$	-	-	25	mA	$T_j = -55^\circ\text{C}$ to $T_j = 150^\circ\text{C}$; See Table 9
Gate current, pulsed ²⁾	$I_{G,pulsed}$	-2.5	-	2.5	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}	-	-	109	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 $T_{j,max}$ 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}	-	-	1.2	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	70	°C/W	Device on PCB, minimum footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	61	°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. PCB is vertical without air stream cooling.
Reflow soldering temperature	T_{sold}	-	-	260	°C	reflow MSL3

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	1.6 -	V	$I_{DS}=3.3\text{ mA}$; $V_{DS}=10\text{ V}$; $T_j=25^\circ\text{C}$ $I_{DS}=3.3\text{ mA}$; $V_{DS}=10\text{ V}$; $T_j=150^\circ\text{C}$
Gate-Source reverse clamping voltage	$V_{GS,clamp}$	-	-	-8	V	$I_{GS}=-1\text{ mA}$
Drain-Source leakage current	I_{DSS}	-	1.3 26	130 -	μA	$V_{DS}=650\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25^\circ\text{C}$ $V_{DS}=650\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150^\circ\text{C}$
Drain-Source on-state resistance	$R_{DS(on)}$	-	0.045 0.096	0.054 -	Ω	$I_G=33\text{ mA}$; $I_D=10\text{ A}$; $T_j=25^\circ\text{C}$ $I_G=33\text{ mA}$; $I_D=10\text{ A}$; $T_j=150^\circ\text{C}$
Gate resistance	$R_{G,int}$	-	1.3	-	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}	-	430	-	pF	$V_{GS}=0\text{ V}$; $V_{DS}=400\text{ V}$, $f=1\text{ MHz}$
Output capacitance	C_{oss}	-	72	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=400\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance	C_{rss}	-	0.98	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=400\text{ V}$, $f=1\text{ MHz}$
Effective output capacitance, energy related ³⁾	$C_{o(er)}$	-	83	-	pF	$V_{DS}=0\text{ to }400\text{ V}$
Effective output capacitance, time related ⁴⁾	$C_{o(tr)}$	-	112	-	pF	$V_{GS}=0\text{ V}$; $V_{DS}=0\text{ to }400\text{ V}$; $I_D=\text{const}$
Output charge	Q_{oss}	-	45	-	nC	$V_{DS}=0\text{ to }400\text{ V}$
Coss stored energy	E_{oss}	-	6.6	-	μJ	$V_{DS}=0\text{ to }400\text{ V}$
Turn-on delay time	$t_{d(on)}$	-	10	-	ns	$I_D=10\text{ A}$; $R_{ON}=3.9\text{ Ohm}$; $R_{OFF}=3.9\text{ Ohm}$; $R_{SS}=270\text{ Ohm}$; $C_C=3.9\text{ nF}$; $V_{DRV}=12\text{ V}$; see Table 8
Turn-off delay time	$t_{d(off)}$	-	14	-	ns	$I_D=10\text{ A}$; $R_{ON}=3.9\text{ Ohm}$; $R_{OFF}=3.9\text{ Ohm}$; $R_{SS}=270\text{ Ohm}$; $C_C=3.9\text{ nF}$; $V_{DRV}=12\text{ V}$; see Table 8
Rise time	t_r	-	9	-	ns	$I_D=10\text{ A}$; $R_{ON}=3.9\text{ Ohm}$; $R_{OFF}=3.9\text{ Ohm}$; $R_{SS}=270\text{ Ohm}$; $C_C=3.9\text{ nF}$; $V_{DRV}=12\text{ V}$; see Table 8
Fall time	t_f	-	13	-	ns	$I_D=10\text{ A}$; $R_{ON}=3.9\text{ Ohm}$; $R_{OFF}=3.9\text{ Ohm}$; $R_{SS}=270\text{ Ohm}$; $C_C=3.9\text{ nF}$; $V_{DRV}=12\text{ V}$; see Table 8



- 3) $C_{o(er)}$ 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
4) $C_{o(tr)}$ 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

表6 栅极电荷特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate charge	Q_G	-	6	-	nC	$V_{GS}=0$ to 3 V; $V_{DS}=400$ V, $I_D=10.0$ 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	$V_{GS}=0$ V; $I_{SD}=10$ A
Pulsed current, reverse	$I_{SD,pulse}$	-	-	76	A	$I_G=33$ mA
Reverse recovery charge ⁵⁾	Q_{rr}	-	0	-	nC	$I_{SD}=10$ A; $V_{DS}=400$ V

5) 不包括 Q_{oss}

4 电气特性图

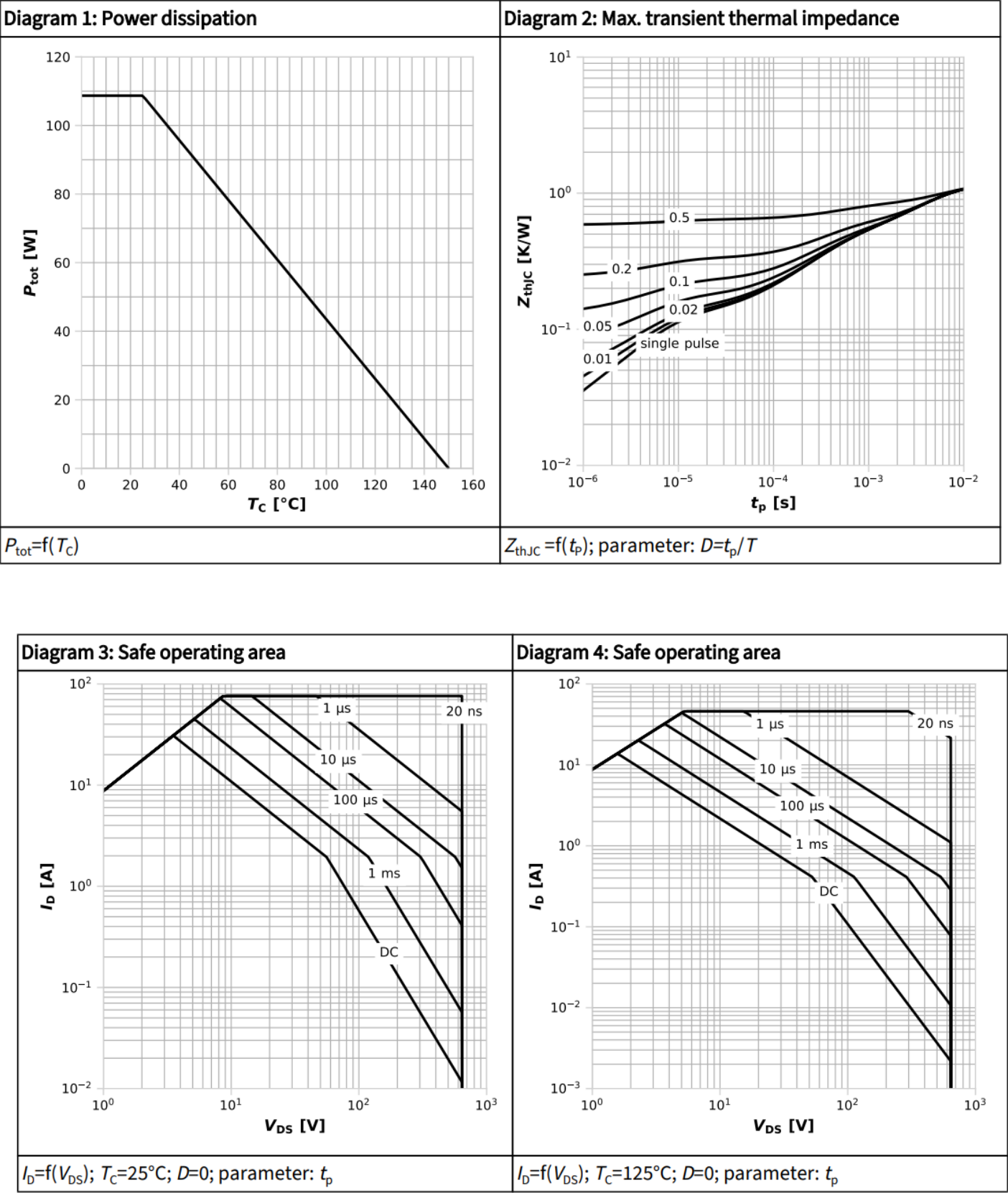
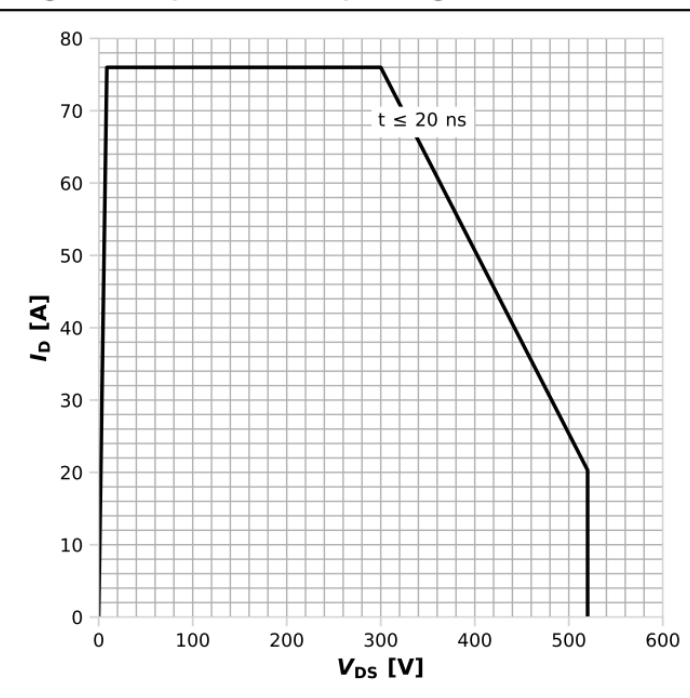


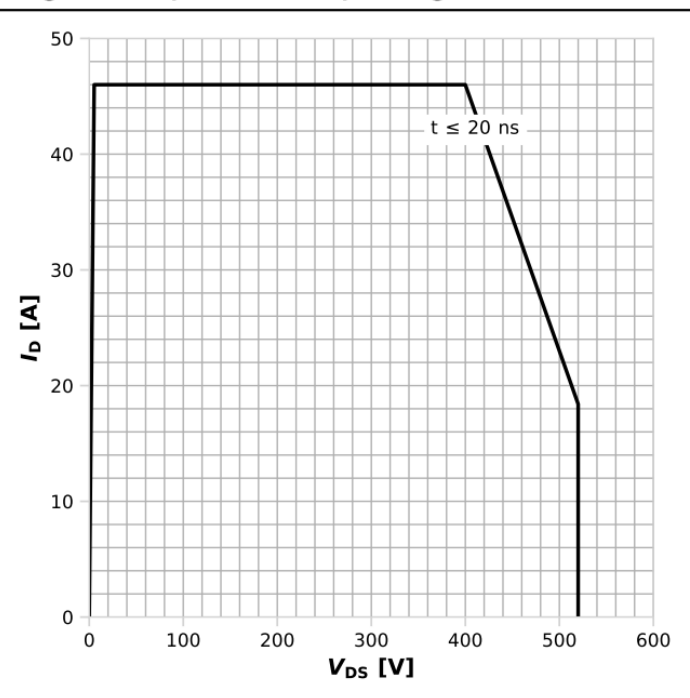


Diagram 5: Repetitive safe operating area



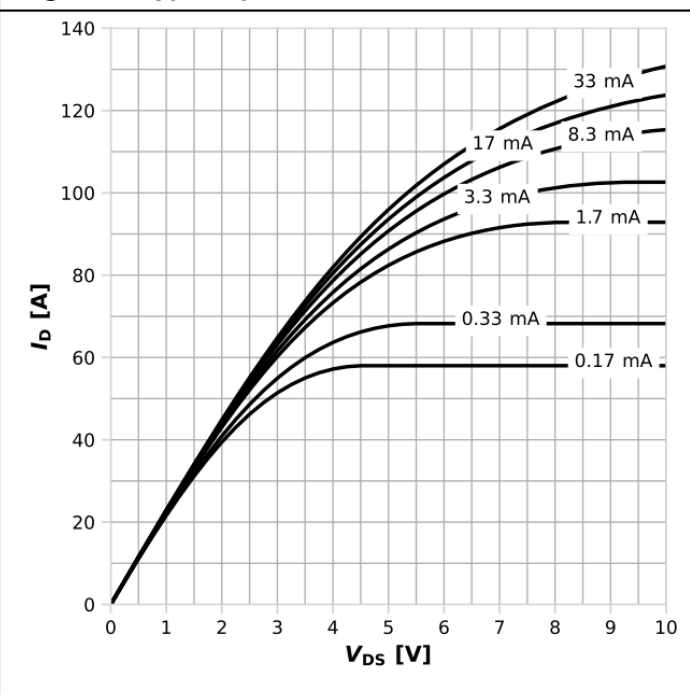
$I_D=f(V_{DS}); T_C=25^{\circ}\text{C}; T_J\leq 150^{\circ}\text{C}; \text{parameter: } t_p$

Diagram 6: Repetitive safe operating area



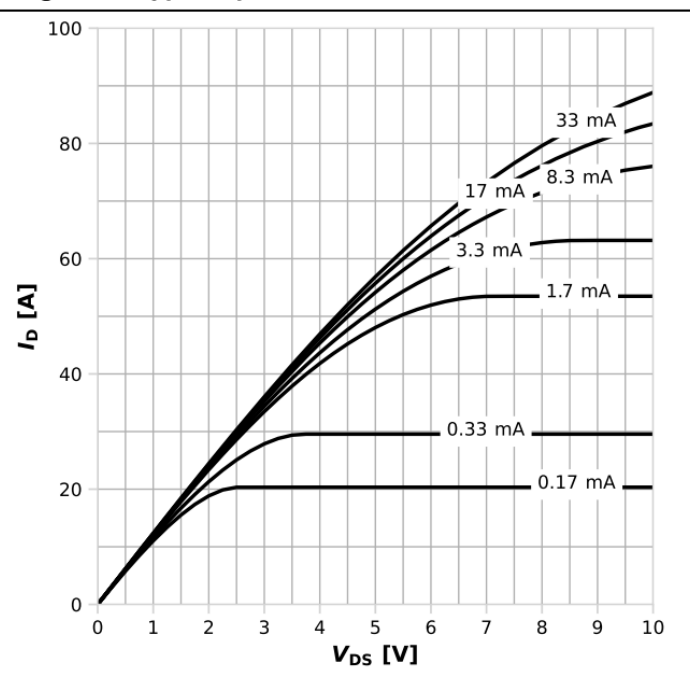
$I_D=f(V_{DS}); T_C=125^{\circ}\text{C}; T_J\leq 150^{\circ}\text{C}; \text{parameter: } t_p$

Diagram 7: Typ. output characteristics



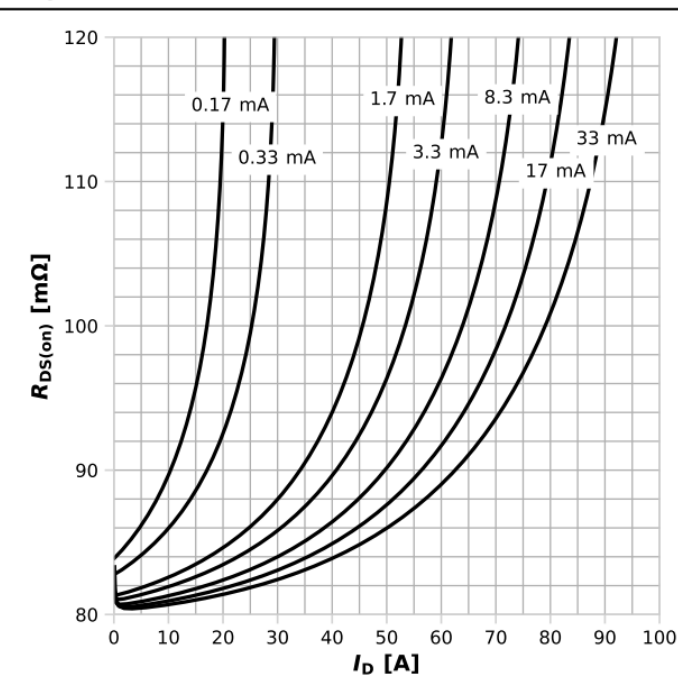
$I_D=f(V_{DS}); T_J=25^{\circ}\text{C}; \text{parameter: } I_{GS}$

Diagram 8: Typ. output characteristics



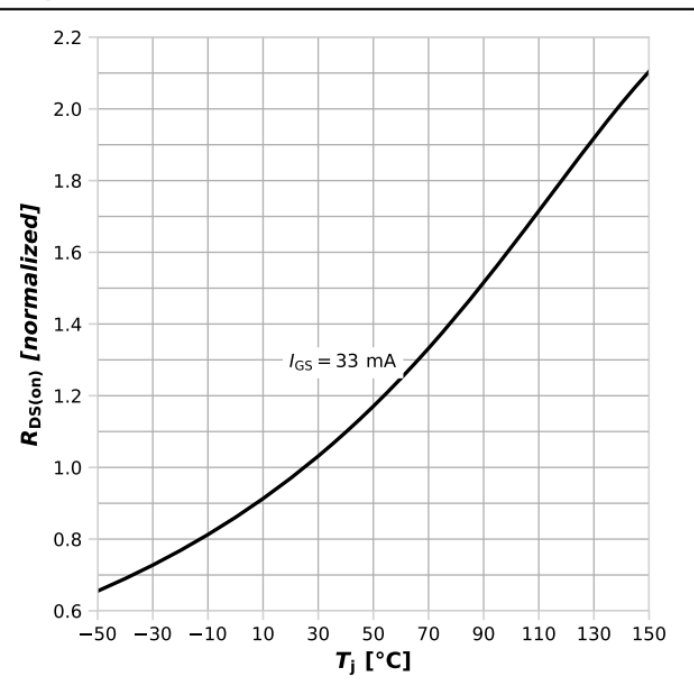
$I_D=f(V_{DS}); T_J=125^{\circ}\text{C}; \text{parameter: } I_{GS}$

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



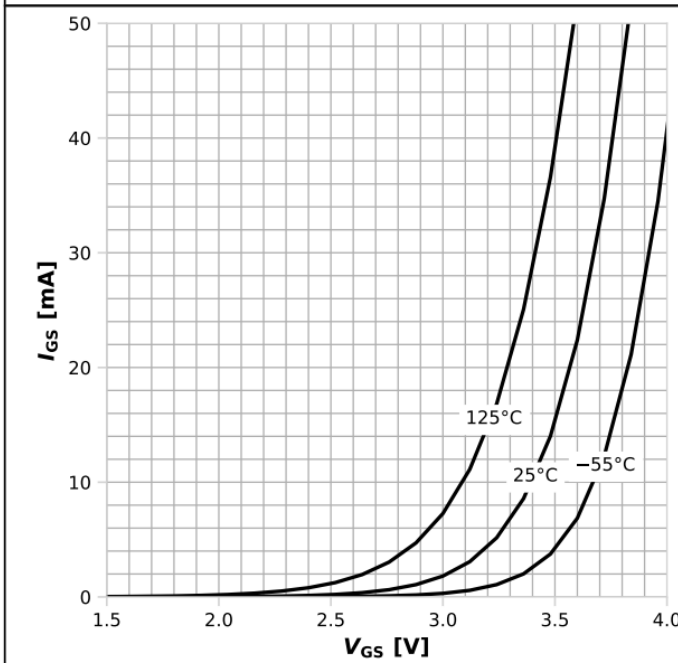
$R_{DS(on)} = f(I_D); T_j = 125^\circ\text{C}; \text{parameter: } I_{GS}$

Diagram 10: Drain-source on-state resistance



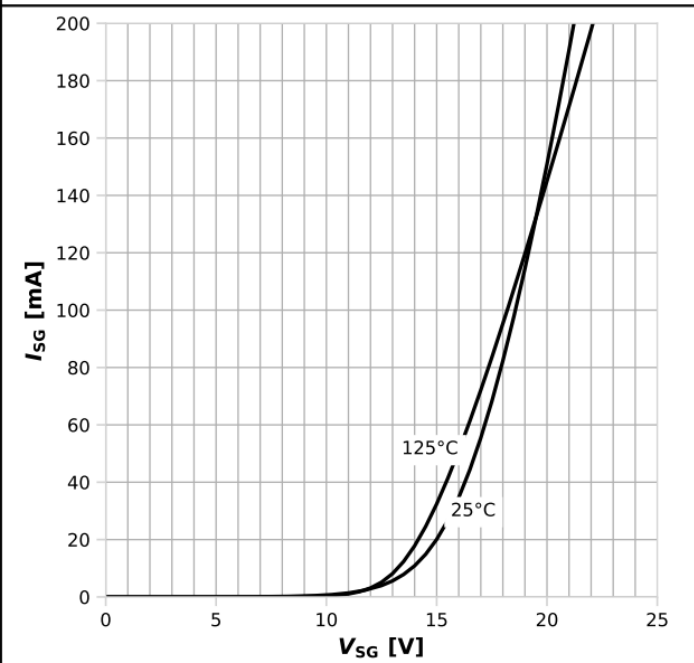
$R_{DS(on)} = f(T_j); I_D = 10 \text{ A}$

Diagram 11: Typ. gate characteristics forward



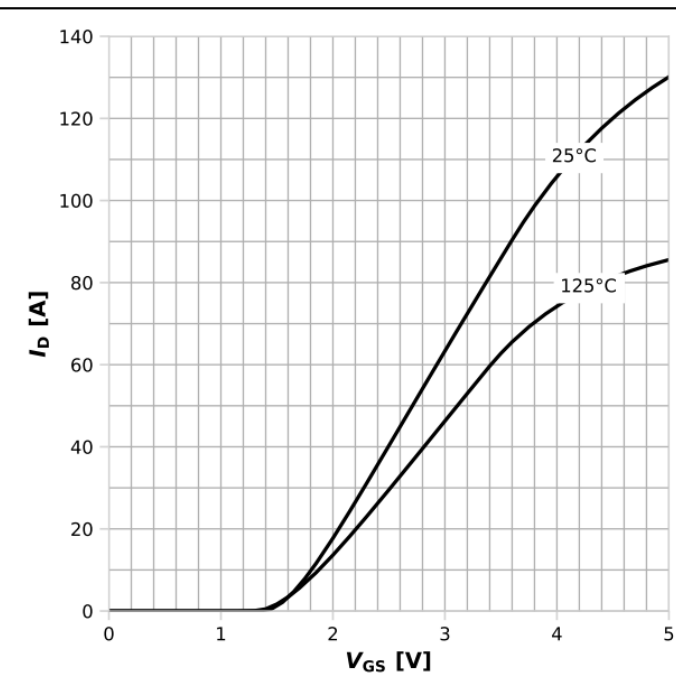
$I_{GS} = f(V_{GS}); \text{open drain}; \text{parameter: } T_j$

Diagram 12: Typ. gate characteristics reverse



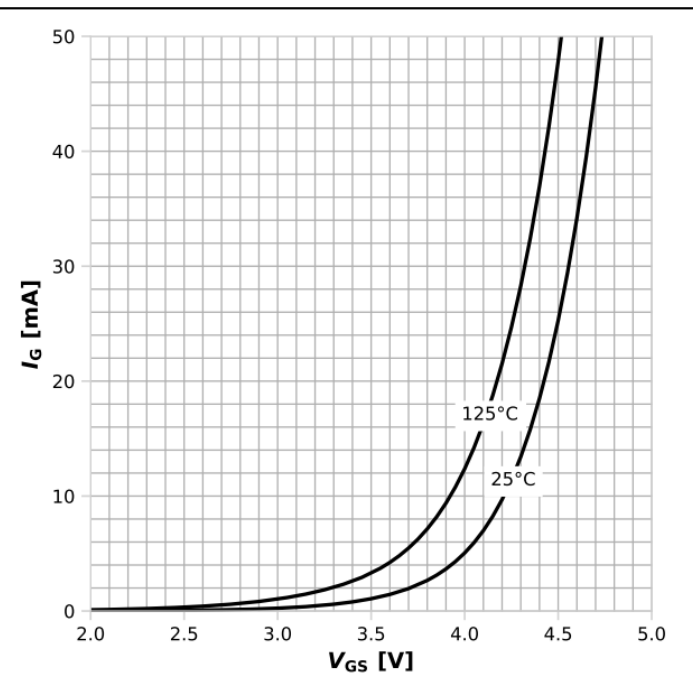
$I_{SG} = f(V_{SG}); \text{parameter: } T_j$

Diagram 13: Typ. transfer characteristics



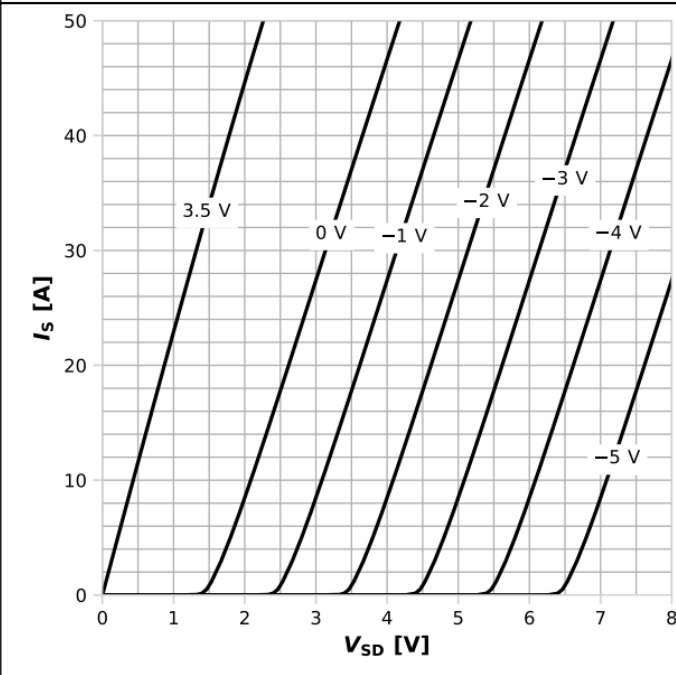
$I_D = f(V_{GS}); V_{DS}=8V; \text{parameter: } T_j$

Diagram 14: Typ. transfer gate current characteristic



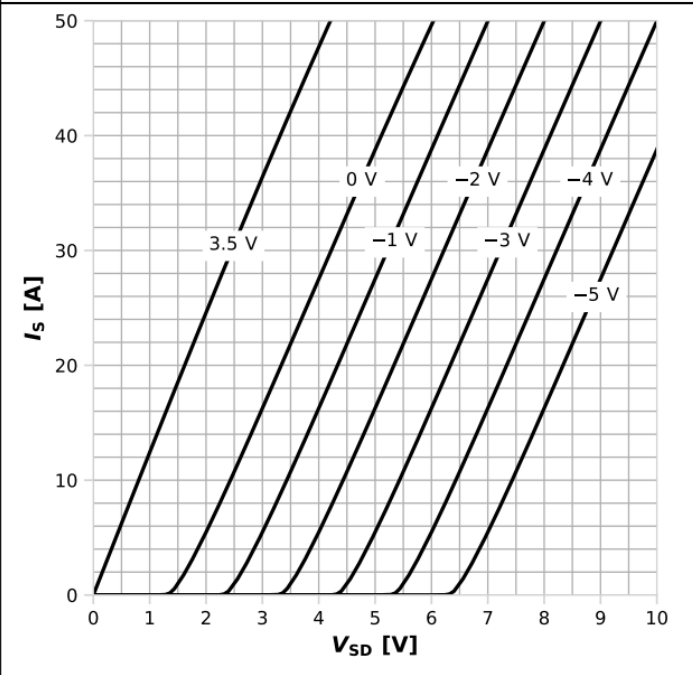
$I_G = f(V_{GS}); V_{DS}=8V; \text{parameter: } T_j$

Diagram 15: Typ. channel reverse characteristics

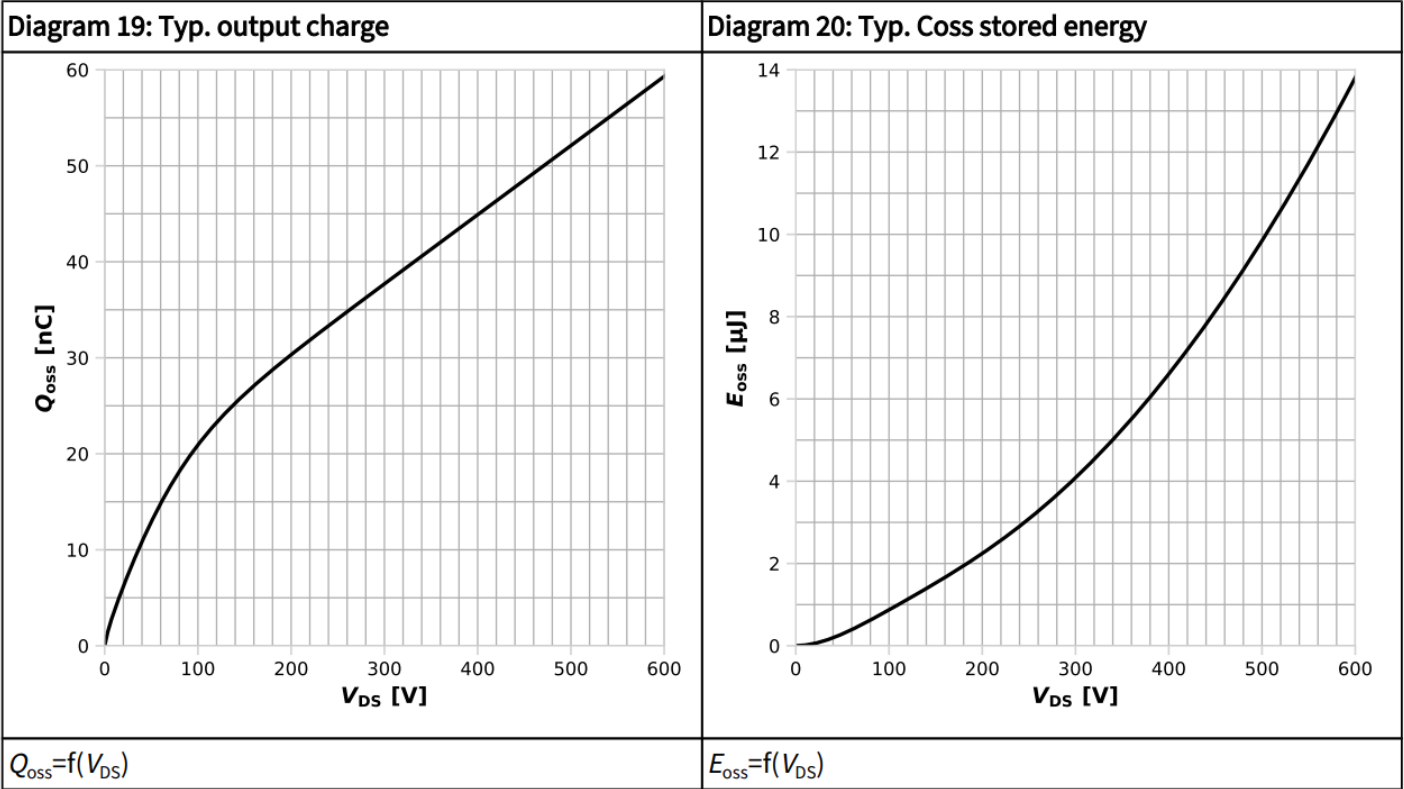
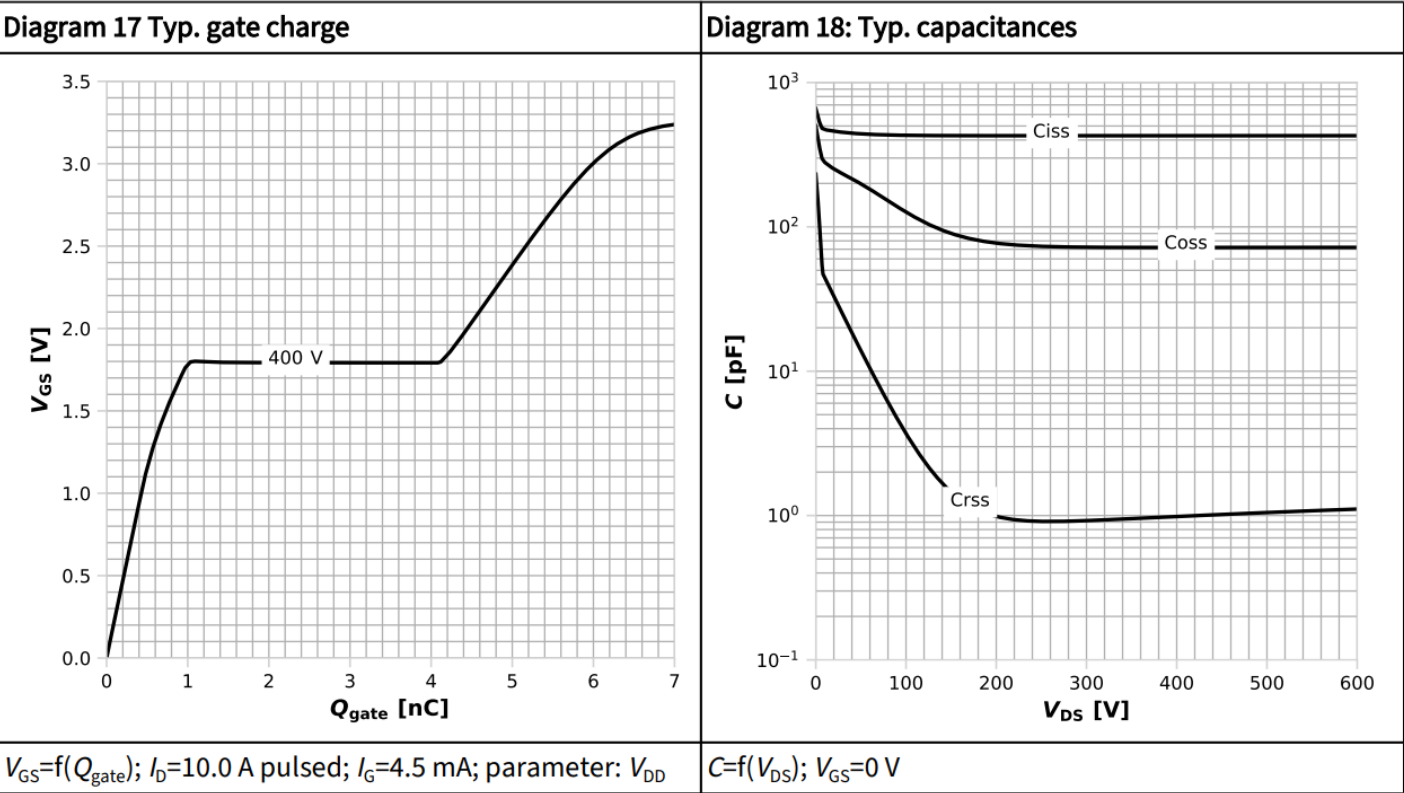


$I_S = f(V_{SD}); T_j=25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 16: Typ. channel reverse characteristics



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



5 测试电路

表8 反向通道特性测试

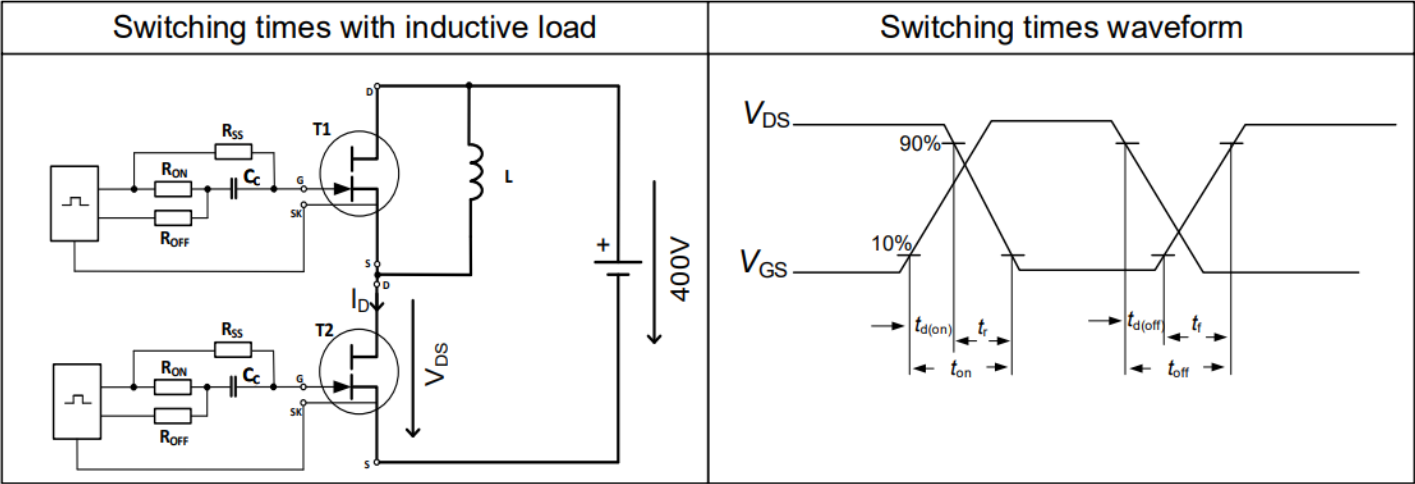
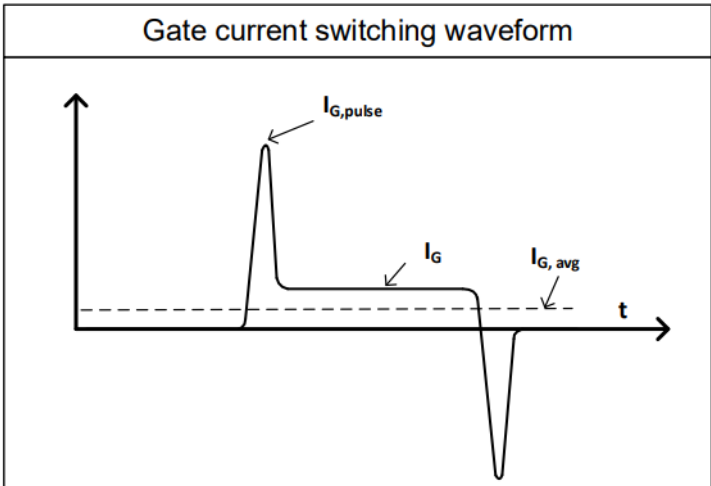
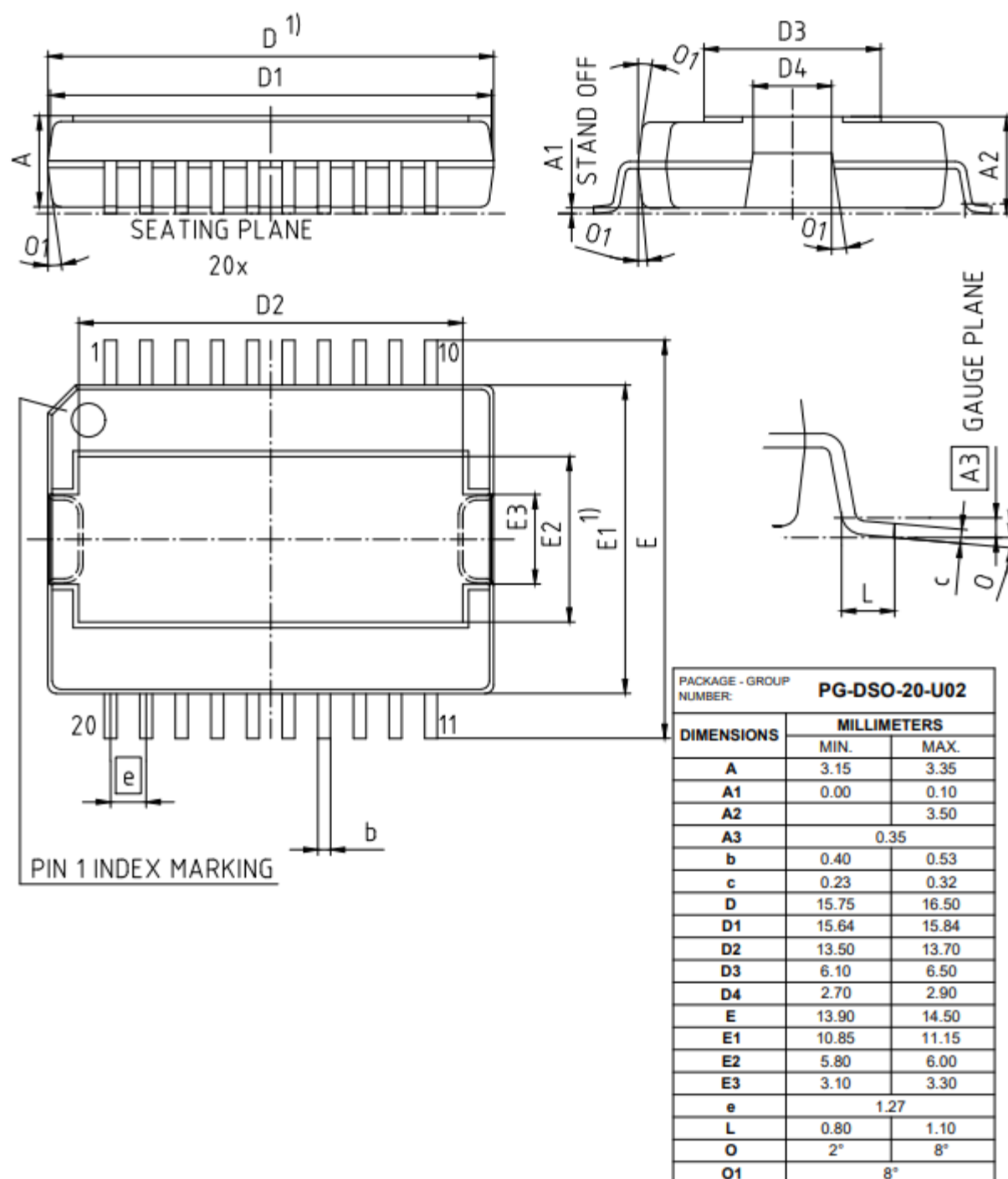


表9 栅极电流开关波形



6 封装外形



1) DOES NOT INCLUDE PLASTIC OR METAL PRUTRUSION OF 0.15 MAX. PER SIDE

图 1 PG-DSO-20 外形图，尺寸单位为毫米

7 附录A

表 10 相关链接

- [CoolGaN™ GaN 650 V 网页](#)
- [CoolGaN™ GaN 650 V 可靠性白皮书](#)
- [CoolGaN™ GaN 650 V 栅极驱动器应用手册](#)
- [CoolGaN™ GaN 650 V 应用信息](#)

修订记录

IGOT65R045D2

修订 2024 - 10 - 24 , Rev. 1 .0

历史修订记录

Revision	Date	Subjects (major changes since last revision)
1.0	2024-10-24	Release of final

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