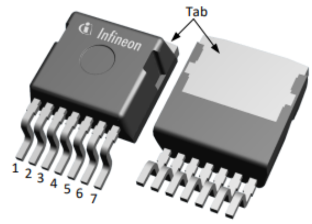
英飞凌CoolSiC ™ M1

PG-TO263-7

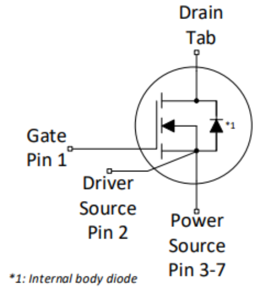


英飞凌CoolSiC ™ MOSFET 650V G1

英飞凌650 V CoolSiC ™基于英飞凌超过20 年的碳化硅技术积累构建。650V CoolSiC ™ MOSFET 利用宽带隙 SiC 材料的特性，提供了性能、可靠性和易用性的独特组合。它适用于高温和恶劣的操作，能够以简化且经济高效的方式实现行业领先的系统效率。

特性

- 优化高电流下的开关行为
- 具有低 Q_{fr} 值的快速体二极管确保换向的稳健性
- 卓越的栅极氧化物可靠性
- $T_{j,max}$ =175°C 和优异的热性能
- 较低 $R_{DS(on)}$和脉冲电流对温度的依赖性
- 增强雪崩能力
- 与标准驱动兼容
- 开尔文源可将开关损耗降低 4 倍



优点

- 高性能、高可靠性和易用性的独特组合
- 易于使用和集成
- 适用于连续硬换向拓扑
- 更高的稳健性和系统可靠性
- 提高效率
- 减小系统尺寸，提高功率密度

潜在的应用

- 通信和服务器 SMPS
- UPS（不间断电源）
- 太阳能逆变器
- 电动汽车充电基础设施
- 储能和电池化成
- D 类放大器

产品认证

完全符合 JEDEC 工业应用标准

请注意：源和感测源引脚不可互换。 它们的交换可能会导致故障。

表 1 主要性能参数

Parameter	Value	Unit
V_{DS} @ T_J = 25 °C	650	V
$R_{DS(on),typ}$	260	mΩ
$R_{DS(on),max}$	346	mΩ
$Q_{G,typ}$	6	nC
$I_{DM,max}$	19	A
Q_{oss} @ 400 V	22	nC
E_{oss} @ 400 V	3.4	µJ

Type/Ordering Code	Package	Marking	Related Links
IMBG65R260M1H	PG-TO263-7	65R260M1	see Appendix A

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 最大额定值

除非另有规定，$T_j = 25$ °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表中所述最大额定值的80%。

表 2 最大额定值

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Continuous DC drain current [1]	I_{DDC}	-	-	6 5	A	$T_c = 25$ °C $T_c = 100$ °C
Peak drain current [2]	I_{DM}	-	-	19	A	$T_c = 25$ °C, $V_{GS} = 18$ V
Avalanche energy, single pulse	E_{AS}	-	-	30	mJ	$I_D = 1.1$ A, $V_{DD} = 50$ V; see table 11
Avalanche energy, repetitive	E_{AR}	-	-	0.15	mJ	$I_D = 1.1$ A, $V_{DD} = 50$ V; see table 11
Avalanche current, single pulse	I_{AS}	-	-	1.1	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	200	V/ns	$V_{DS} = 0...400$ V
Gate source voltage (static) [3]	V_{GS}	-5	-	23	V	-
Gate source voltage (transient)	V_{GS}	-7	-	25	V	$t_{pulse} \leq 1\%$ duty cycle/f_{sw}
Power dissipation	P_{tot}	-	-	65	W	$T_c = 25$ °C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	175	°C	-
Mounting torque	-	-	-	n.a.	Ncm	-
Continuous reverse drain current [1]	I_{SDC}	-	-	6	A	$V_{GS} = 18$ V, $T_c = 25$ °C $V_{GS} = 0$ V, $T_c = 25$ °C
Peak reverse drain current [2]	I_{SM}	-	-	19	A	$T_c = 25$ °C, $t_p \leq 250$ ns
Insulation withstand voltage	V_{ISO}	-	-	n.a.	V	V_{rms}, $T_c = 25$ °C, $t = 1$ min

1) 受$T_{j,max}$限制。
2) 脉冲宽度 t_{pulse} 受 $T_{j,max}$ 限制。
3) 应用设计中的最大栅极源电压应符合IPC-9592B的规定。

2 热特性

表3 热特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{th(j-c)}$	-	-	2.30	°C/W	-
Thermal resistance, junction - ambient	$R_{th(j-a)}$	-	-	62	°C/W	device on PCB, minimal footprint
Thermal resistance, junction - ambient, SMD version	$R_{th(j-a)}$	-	35	45	°C/W	Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.
Soldering temperature, wave- & reflow soldering allowed	T_{sold}	-	-	260	°C	reflow MSL1

3 工作范围

表 4 工作范围

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate-source voltage operating range including undershoots [4)]	V_{GS}	-2	-	20	V	-
Recommended turn-on voltage	$V_{GS(on)}$	-	18	-	V	-
Recommended turn-off voltage	$V_{GS(off)}$	-	0	-	V	-

4)

重要提示：如果应用中器件的栅极源电压超出工作范围（表 4），则器件 $R_{DS,on}$和 $V_{GS(th)}$可能会在器件使用寿命结束时超过数据表中规定的最大值。为了确保器件在计划使用寿命内正常运行，必须考虑最大额定值（表 2）和 CoolSiC ™ MOSFET 650V M1 沟槽功率器件应用说明 AN_1907_PL52_1911_144109。

4 电气特性

除非另有规定， $T_j = 25\ °C$

表 5 直流特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source voltage	V_{DSS}	650	-	-	V	$V_{GS} = 0\ V$, $I_D = 0.17\ mA$
Gate threshold voltage [5]	$V_{GS(th)}$	3.5	4.5	5.7	V	$V_{DS} = V_{GS}$, $I_D = 1.1\ mA$
Zero gate voltage drain current	I_{DSS}	-	1 3	100 -	µA	$V_{DS} = 650\ V$, $V_{GS} = 0\ V$, $T_j = 25\ °C$ $V_{DS} = 650\ V$, $V_{GS} = 0\ V$, $T_j = 175\ °C$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS} = 20\ V$, $V_{DS} = 0\ V$
Drain-source on-state resistance	$R_{DS(on)}$	-	260 364	346 -	mΩ	$V_{GS} = 18\ V$, $I_D = 3.6\ A$, $T_j = 25\ °C$ $V_{GS} = 18\ V$, $I_D = 3.6\ A$, $T_j = 175\ °C$
Internal gate resistance	$R_{G,int}$	-	24.0	-	Ω	$f = 1\ MHz$

5) 在 $V_{GS} = +20\ V$ 时 1 ms 脉冲之后进行测试。

表 6 直流特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	201	-	pF	$V_{GS} = 0\ V$, $V_{DS} = 400\ V$, $f = 250\ kHz$
Reverse transfer capacitance	C_{rss}	-	3.7	-	pF	$V_{GS} = 0\ V$, $V_{DS} = 400\ V$, $f = 250\ kHz$
Output capacitance [6]	C_{oss}	-	37	48	pF	$V_{GS} = 0\ V$, $V_{DS} = 400\ V$, $f = 250\ kHz$
Output charge [6]	Q_{oss}	-	22	29	nC	calculation based on C_{oss}
Effective output capacitance, energy related [7]	$C_{o(er)}$	-	42	-	pF	$V_{GS} = 0\ V$, $V_{DS} = 0...400\ V$
Effective output capacitance, time related [8]	$C_{o(tr)}$	-	55	-	pF	I_D = constant, $V_{GS} = 0\ V$, $V_{DS} = 0...400\ V$
Turn-on delay time	$t_{d(on)}$	-	5.3	-	ns	$V_{DD} = 400\ V$, $V_{GS} = 0/18\ V$, $I_D = 3.6\ A$, $R_{G,ext} = 1.8\ Ω$; see table 10
Rise time	t_r	-	5.3	-	ns	$V_{DD} = 400\ V$, $V_{GS} = 0/18\ V$, $I_D = 3.6\ A$, $R_{G,ext} = 1.8\ Ω$; see table 10
Turn-off delay time	$t_{d(off)}$	-	7.7	-	ns	$V_{DD} = 400\ V$, $V_{GS} = 0/18\ V$, $I_D = 3.6\ A$, $R_{G,ext} = 1.8\ Ω$; see table 10
Fall time	t_f	-	13.0	-	ns	$V_{DD} = 400\ V$, $V_{GS} = 0/18\ V$, $I_D = 3.6\ A$, $R_{G,ext} = 1.8\ Ω$; see table 10

6) 最大规格由计算出的六西格玛置信上限定义。

7) $C_{o(er)}$ 是一个固定电容，当 V_{DS} 从 0 上升至 400 V 时，其提供与 C_{oss} 相同的储存能量。

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

表7 栅极电荷特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Plateau gate to source charge	$Q_{GS(pl)}$	-	1	-	nC	V_{DD} = 400 V, I_D = 3.6 A, V_{GS} = 0 to 18 V
Gate to drain charge	Q_{GD}	-	1	-	nC	V_{DD} = 400 V, I_D = 3.6 A, V_{GS} = 0 to 18 V
Total gate charge	Q_G	-	6	-	nC	V_{DD} = 400 V, I_D = 3.6 A, V_{GS} = 0 to 18 V

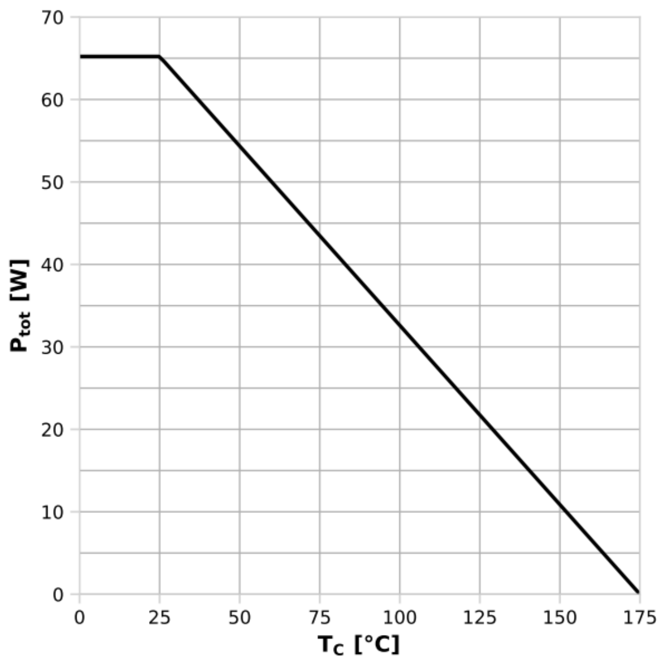
表8 反向二极管特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source reverse voltage	V_{SD}	-	4.0	-	V	V_{GS} = 0 V, I_S = 3.6 A, T_j = 25 °C
MOSFET forward recovery time	t_{fr}	-	16.6	-	ns	V_{DD} = 400 V, I_S = 3.6 A, di_S/dt = 1000 A/µs; see table 9
MOSFET forward recovery charge 9)	Q_{fr}	-	33	-	nC	V_{DD} = 400 V, I_S = 3.6 A, di_S/dt = 1000 A/µs; see table 9
MOSFET peak forward recovery current	I_{frm}	-	4.2	-	A	V_{DD} = 400 V, I_S = 3.6 A, di_S/dt = 1000 A/µs; see table 9

9) Q_{fr}包括Q_{oss}。

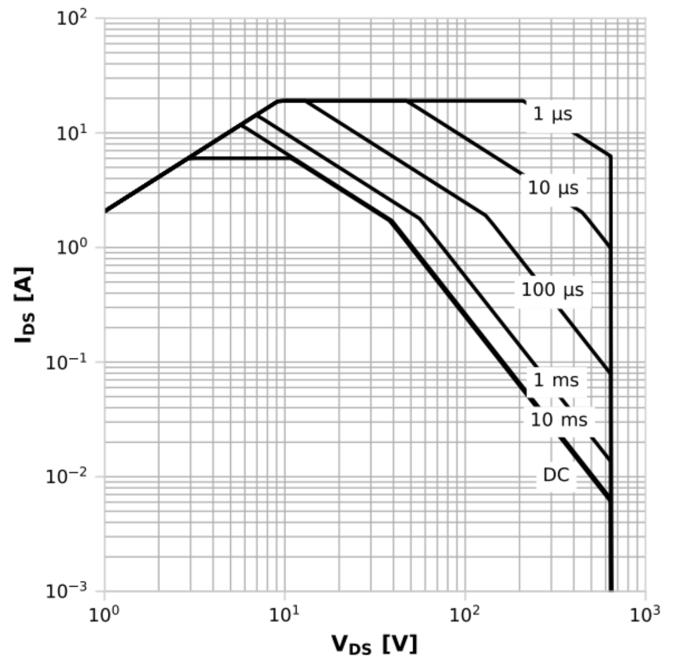
5 电气特性图

Diagram 1: Power dissipation



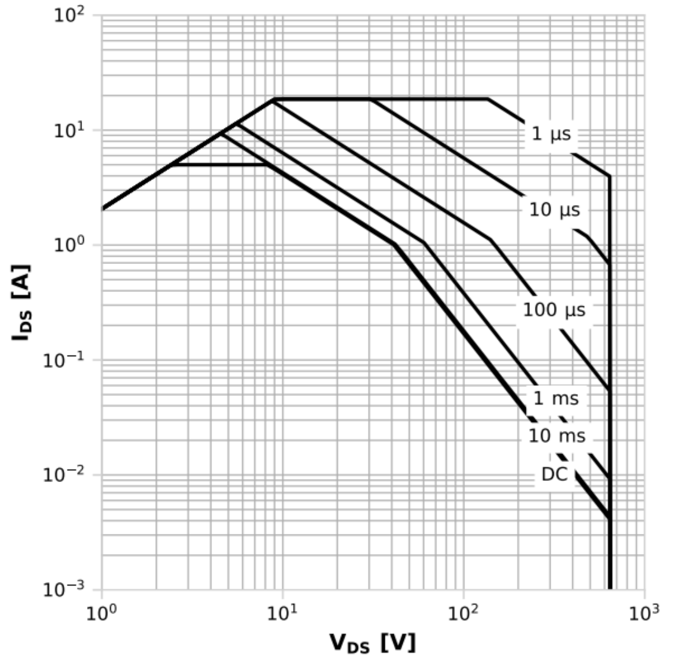
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



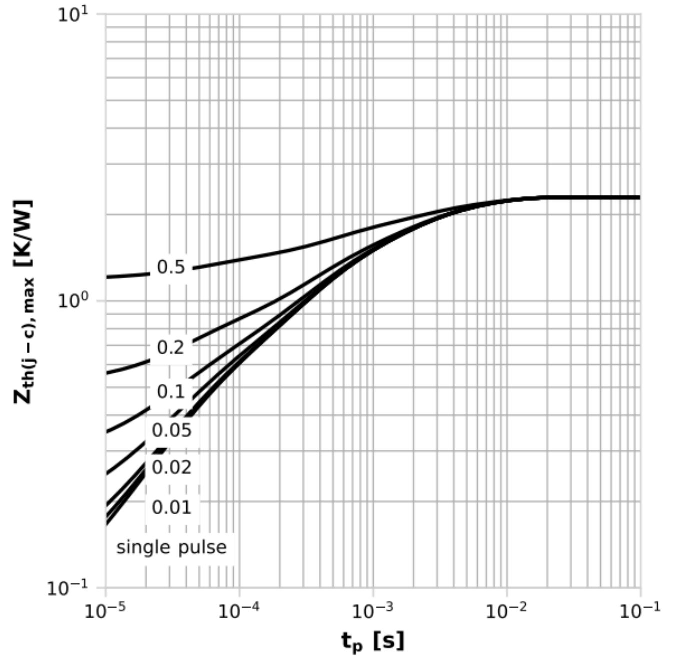
$I_{DS}=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



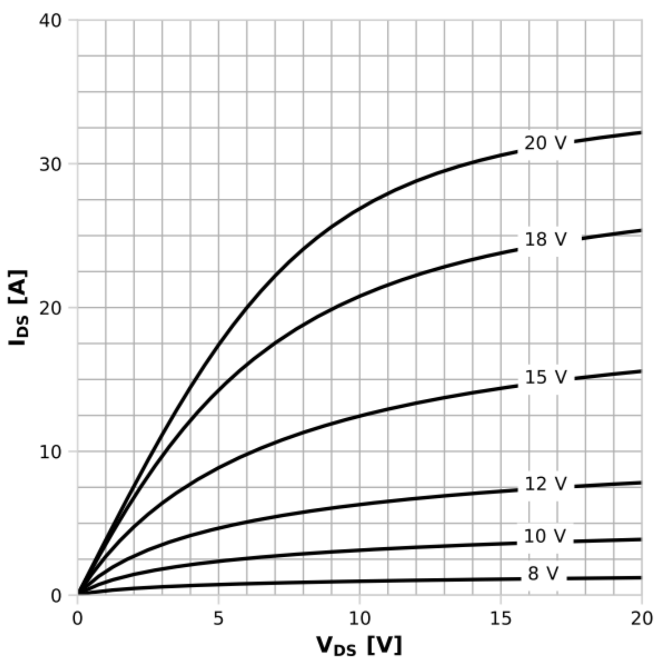
$I_{DS}=f(V_{DS})$; T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



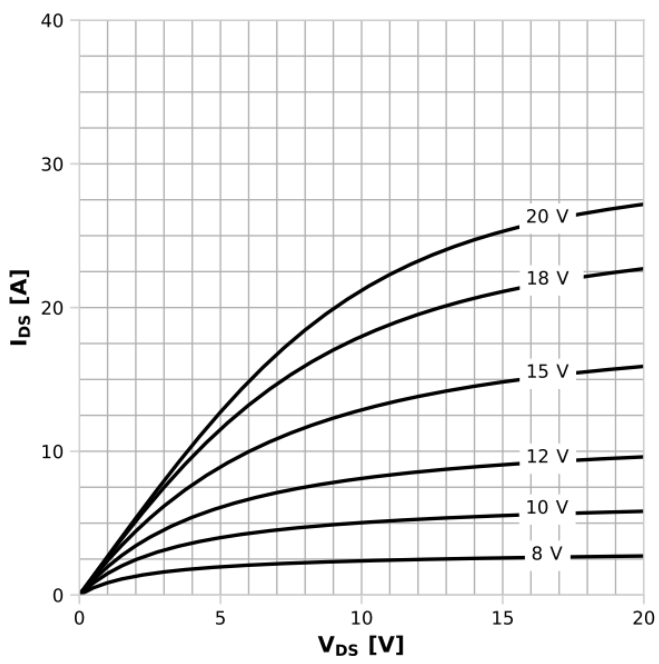
$Z_{th(j\text{-}c),max}=f(t_p)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



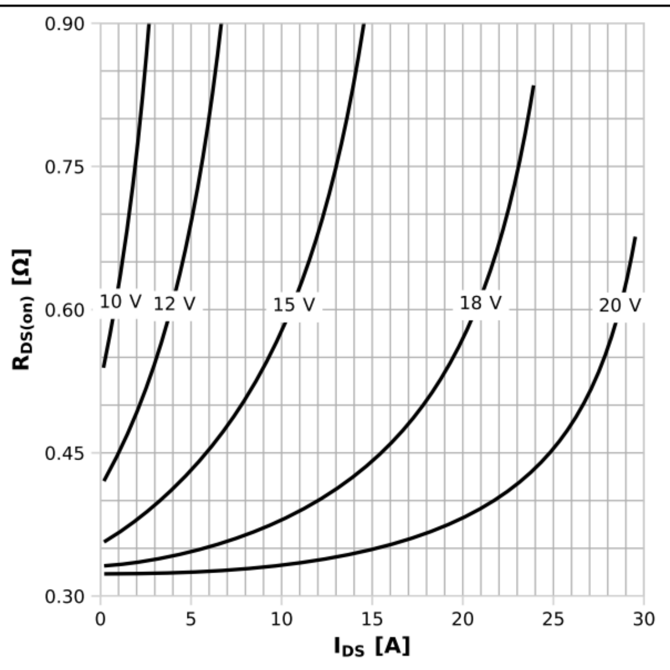
$I_{DS}=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



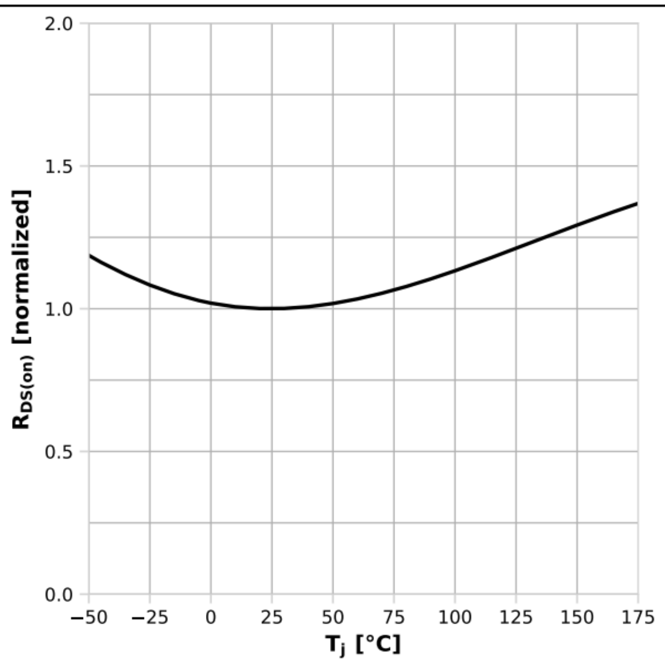
$I_{DS}=f(V_{DS})$; $T_j=175$ °C; parameter: V_{GS}

Diagram 7: Typ. drain-source on-state resistance



$R_{DS(on)}=f(I_{DS})$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



$R_{DS(on)}=f(T_j)$; $I_D=3.6$ A; $V_{GS}=18$ V

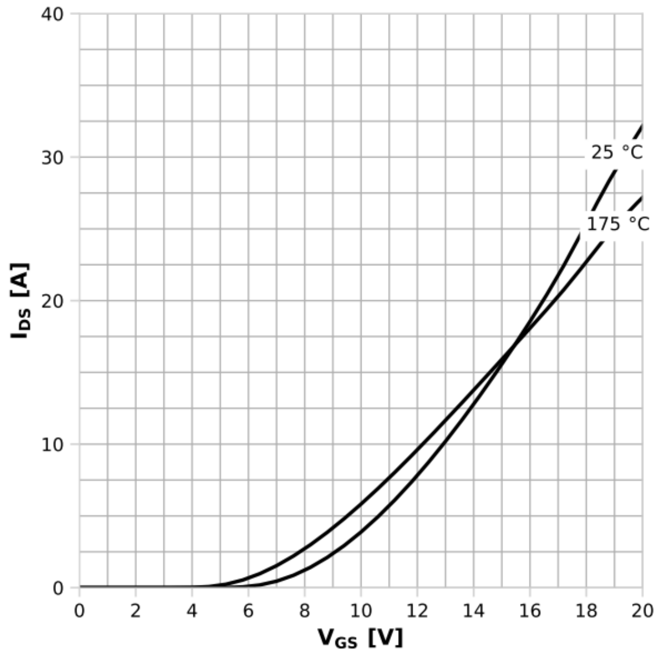
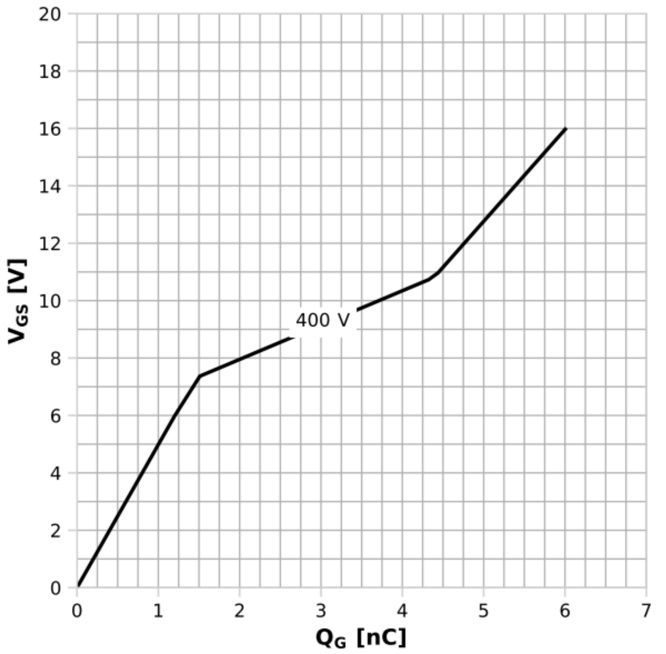
Diagram 9: Typ. transfer characteristics	Diagram 10: Typ. gate charge
	
I_{DS}=f(V_{GS}); V_{DS}=20V; parameter: T_j	V_{GS}=f(Q_G); I_D=3.6 A pulsed; parameter: V_{DD}

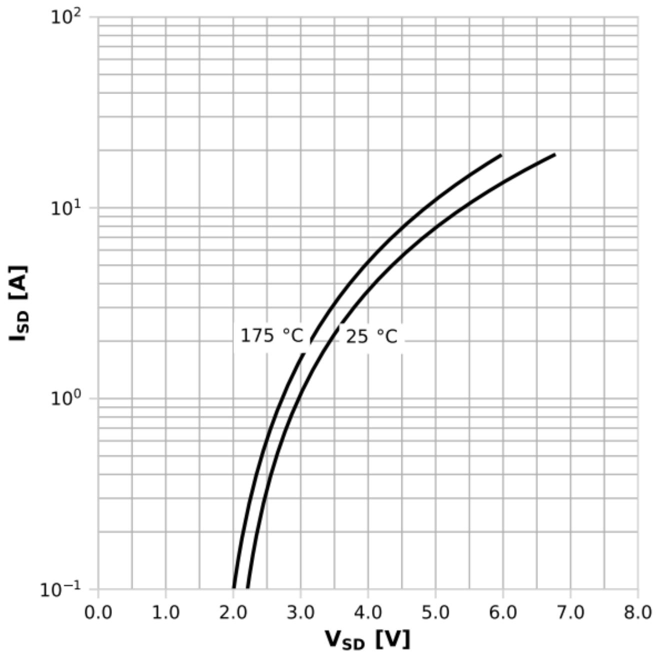
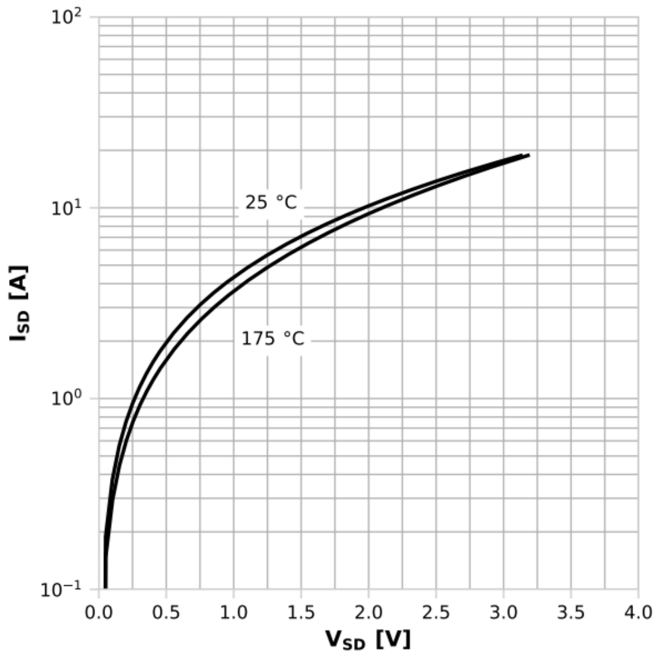
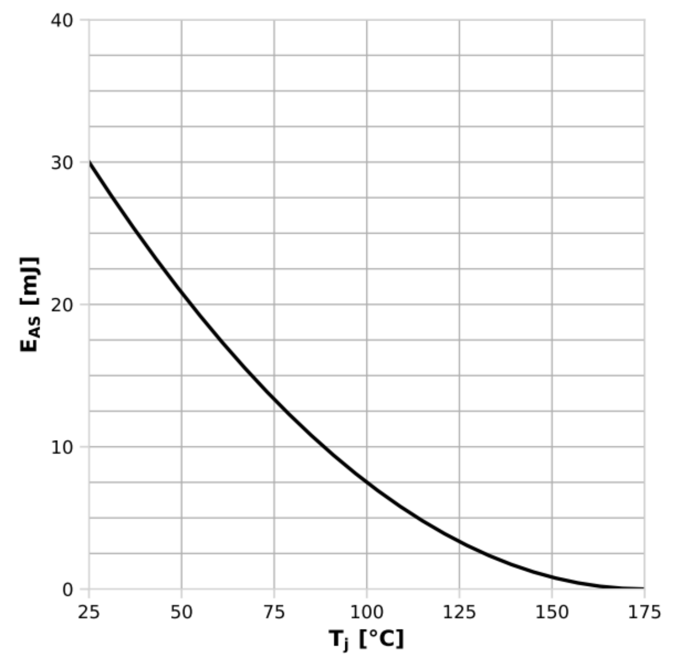
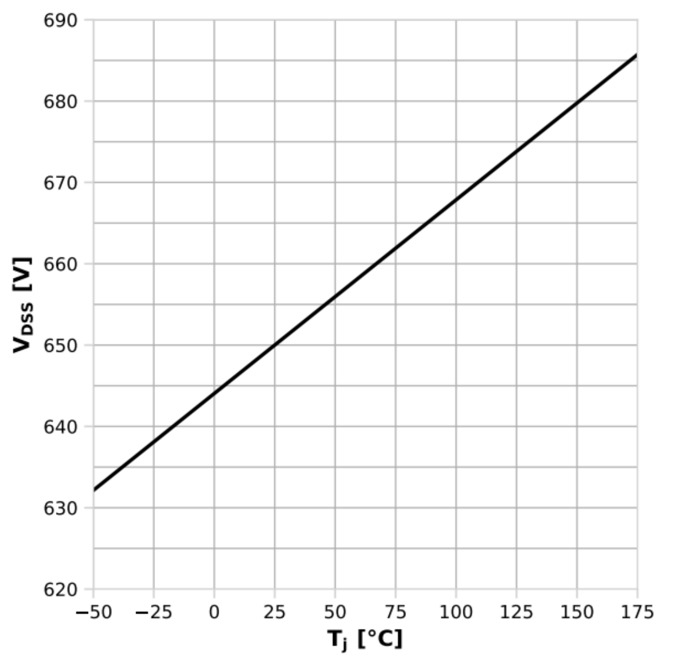
Diagram 11: Typ. reverse drain current characteristics	Diagram 12: Typ. reverse drain current characteristics
	
I_{SD}=f(V_{SD}); V_{GS}=0 V; parameter: T_j	I_{SD}=f(V_{SD}); V_{GS}=18 V; parameter: T_j

Diagram 13: Avalanche energy



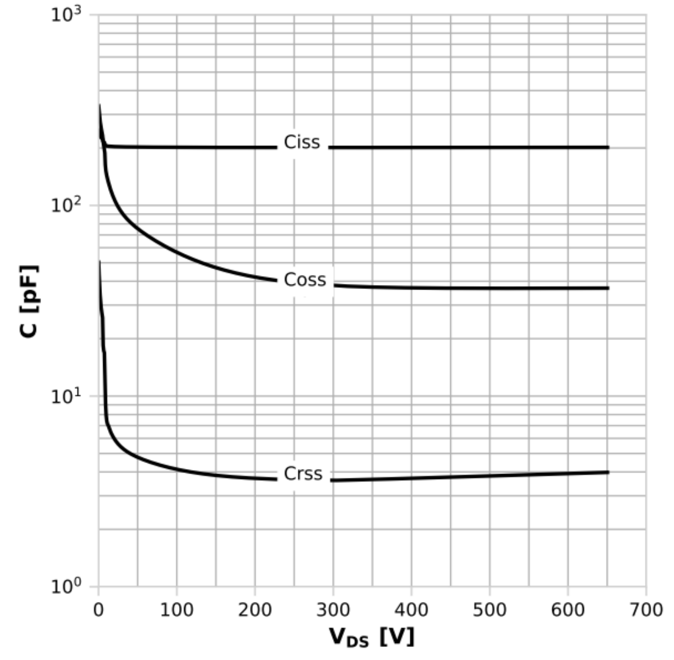
E_{AS}=f(T_j); I_D=1.1 A; V_{DD}=50 V

Diagram 14: Drain-source breakdown voltage



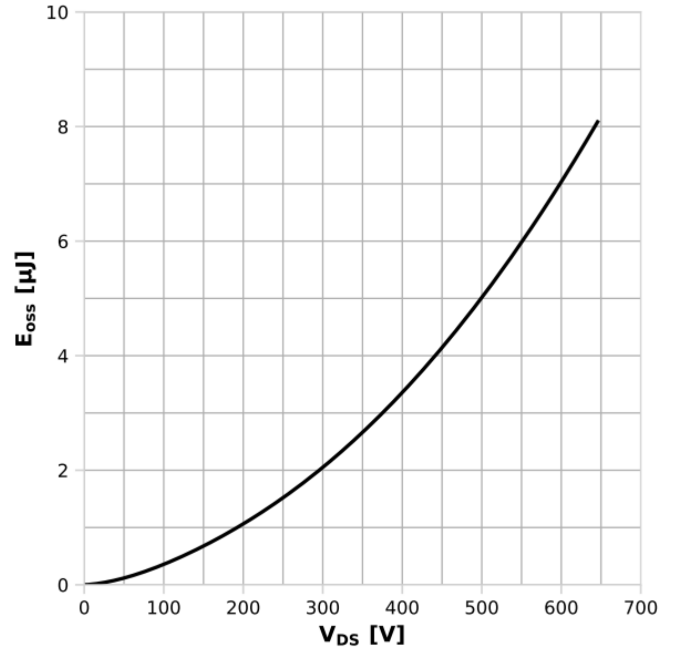
V_{DSS}=f(T_j); I_D=0.17 mA

Diagram 15: Typ. capacitances



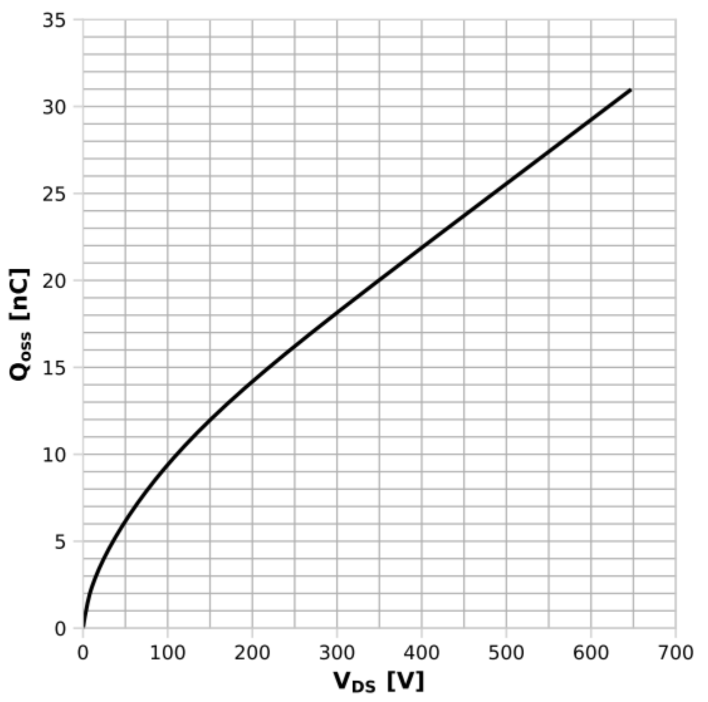
C=f(V_{DS}); V_{GS}=0 V; f=250 kHz

Diagram 16: Typ. Coss stored energy



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

Diagram 17: Typ. Qoss output charge



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

6 测试电路

表 9 体二极管特性（CoolSiC）

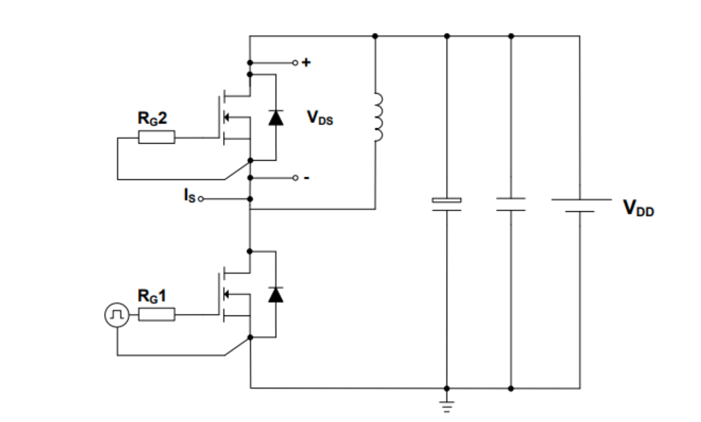
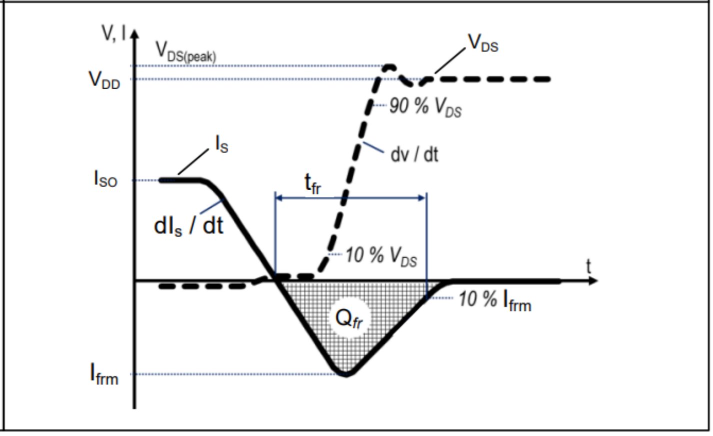
Test circuit for body diode characteristics	Body diode recovery waveform
	

表 10 开关时间 (CoolSiC)

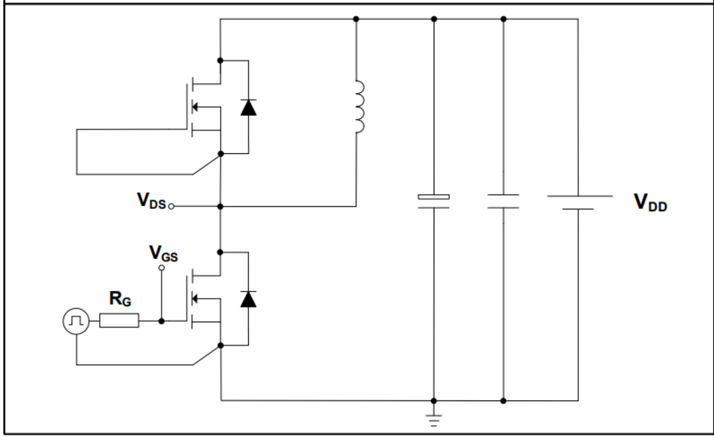
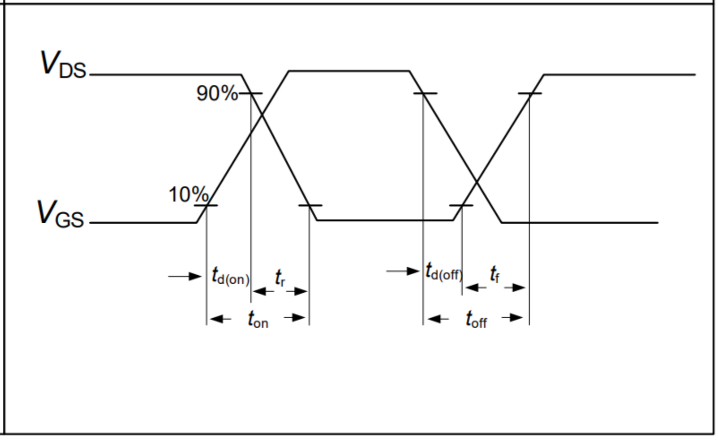
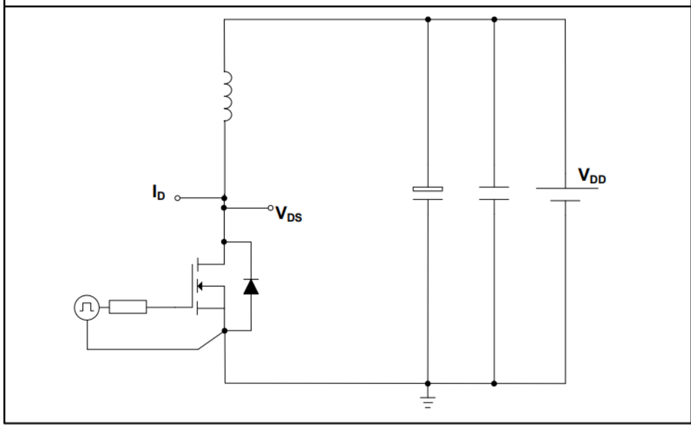
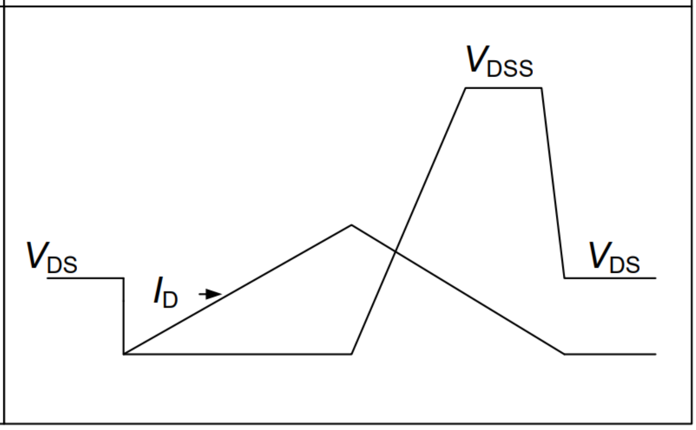
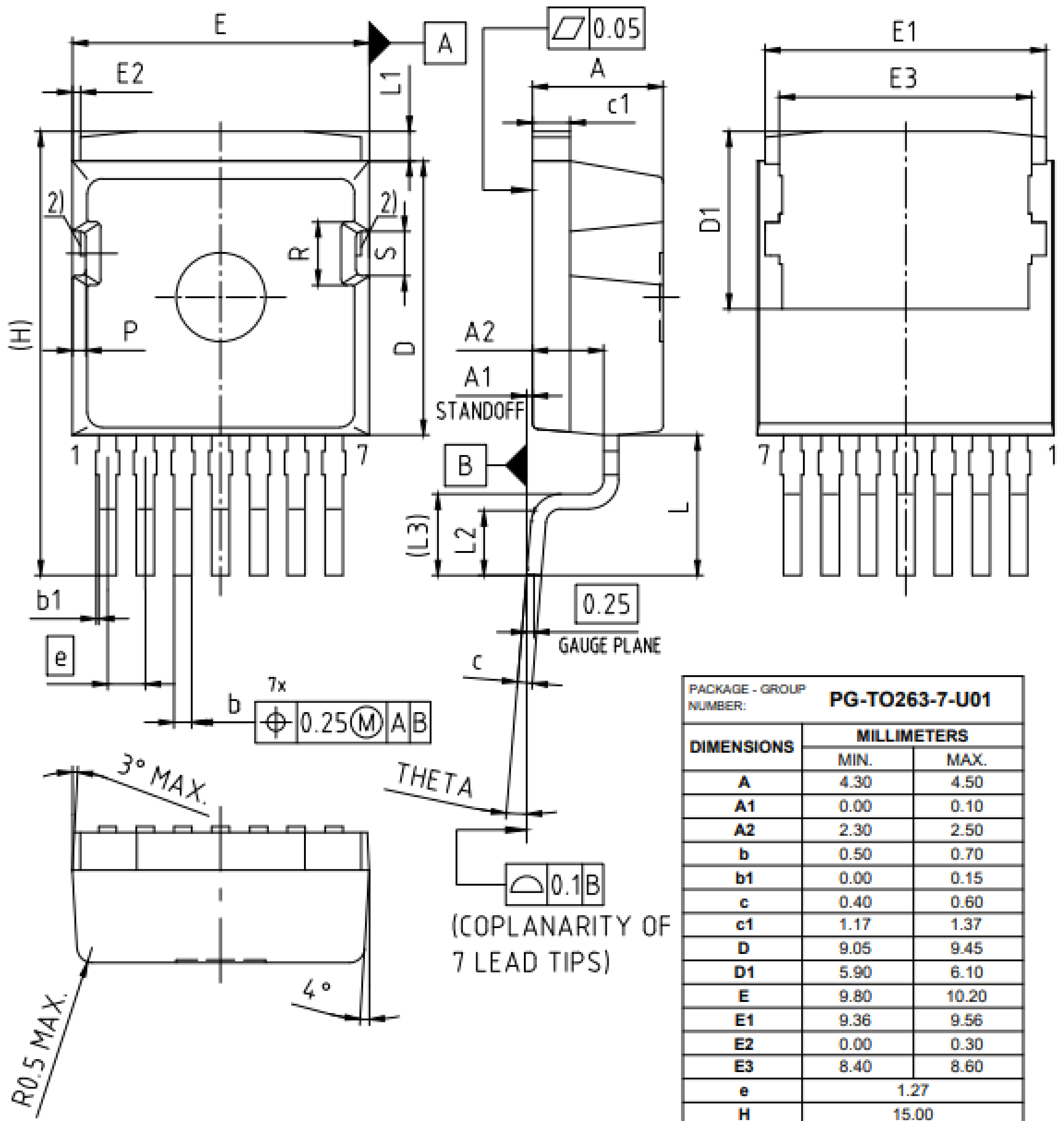
Switching times test circuit for inductive load	Switching times waveform
	

表 11 非钳位感性负载

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 封装外形



PACKAGE - GROUP NUMBER:	PG-TO263-7-U01	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.30	4.50
A1	0.00	0.10
A2	2.30	2.50
b	0.50	0.70
b1	0.00	0.15
c	0.40	0.60
c1	1.17	1.37
D	9.05	9.45
D1	5.90	6.10
E	9.80	10.20
E1	9.36	9.56
E2	0.00	0.30
E3	8.40	8.60
e	1.27	
H	15.00	
L	4.20	5.20
L1	0.70	1.30
L2	1.70	2.30
L3	2.70	
P	0.35	0.55
R	2.03	2.23
S	1.40	1.60
THETA	0.00°	8.00°

NOTES:
1) ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT
2) MOLD FILLING IS ACCEPTABLE AT THIS AREA

图 1 PG-TO263 - 7外形图，尺寸单位为毫米

8 附录A

表 12 相关链接

- 英飞凌 CoolSiC CoolSiC™ MOSFET 650 V G1 网页
- 英飞凌CoolSiC CoolSiC™ MOSFET 650 V G1应用笔记
- 英飞凌CoolSiC CoolSiC™ MOSFET 650 V G1仿真模型
- 英飞凌设计工具

修订记录

IMGBG65R260M1H

Revision 2024 - 08 - 26 , Rev. 2 . 1

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.0	2021-12-10	Release of final version
2.1	2024-08-26	IDSS update, nomenclature update, datasheet layout update

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