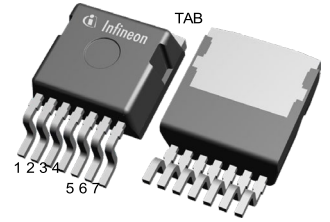


最终数据手册

英飞凌 CoolSiC™ 1200 V SiC 沟槽 MOSFET：碳化硅MOSFET

特性

- $T_{vj} = -55 \dots 175^\circ\text{C}$ 时 $V_{DS} = 1200\text{ V}$
- $T_C = 25^\circ\text{C}$ 时 $I_{DDC} = 38\text{ A}$
- $R_{DS(on)} = 60\text{ m}\Omega$ ($V_{GS} = 20\text{ V}$, $T_{vj} = 25^\circ\text{C}$ 时)
- 新的性能优化芯片技术 (Gen1p), 改善了 $R_{DS(on)} \cdot A$
- 业界领先的开关能量特性, 可降低开关损耗并减少冷却需求
- 最低的器件电容值, 可实现更高的开关速度和更高的功率密度
- 低 C_{rss}/C_{iss} 电容比值和高 $V_{GS(th)}$ 的组合, 可避免寄生导通并实现单极性栅极驱动
- 降低了总栅极电荷 Q_G , 可降低驱动功率和损耗
- 提高了建议开启电压 ($V_{GS(on)} = 20\text{ V}$) 以降低 $R_{DS(on)}$
- .XT 芯片粘接技术, 实现业界领先的热性能
- 低封装杂散电感, 可实现更快、更干净的开关动作
- 带有开尔文 (Kelvin) 源极引脚, 实现更好的栅极控制并降低开关损耗
- 爬电距离为 5.8 毫米 (材料组 II), 适用于 800 V 应用
- SMT 封装, 便于自动化装配并降低系统成本



潜在的应用

- 车载充电器
- 直流/直流转换器
- 辅助驱动

产品验证

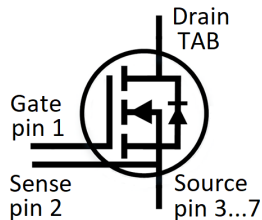
- 适合汽车应用。根据 AEC-Q100/101 进行产品验证

描述

引脚定义:

- Pin 1 - 栅极
- Pin 2 - 开尔文检测
- Pin 3...7 - 源极
- Tab - 漏极

注意: 源极引脚和检测引脚不可互换, 互换可能会导致故障



Type	Package	Marking
AIMBG120R060M1	PG-TO263-7-U01	AS60MM1

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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AIMBG120R060M1

CoolSiC™ 1200 V SiC Trench MOSFET



1 封装

1 封装

表1 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}				260	°C
MOSFET/body diode thermal resistance, junction-case ¹⁾	$R_{\text{th(j-c)}}$			0.57	0.74	K/W

1) 无需经过生产测试 - 经过设计/特性验证

2 MOSFET

表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage ¹⁾	V_{DSS}	$T_{\text{vj}} = -55 \dots 175 \text{ °C}$		1200	V
Continuous DC drain current for $R_{\text{th(j-c,max)}}$, limited by $T_{\text{vj(max)}}$ ²⁾	I_{DDC}	$V_{\text{GS}} = 20 \text{ V}$	$T_{\text{c}} = 25 \text{ °C}$	38	A
			$T_{\text{c}} = 100 \text{ °C}$	27	
Peak drain current, t_{p} limited by $T_{\text{vj(max)}}$ ²⁾	I_{DM}	$V_{\text{GS}} = 20 \text{ V}$		97	A
Gate-source voltage, max. transient voltage ³⁾	V_{GS}	$t_{\text{p}} \leq 0.5 \text{ } \mu\text{s}, D < 0.01$		-10...25	V
Gate-source voltage, max. static voltage ³⁾	V_{GS}			-5...23	V
Avalanche energy, single pulse	E_{AS}	$I_{\text{D}} = 10 \text{ A}, V_{\text{DD}} = 50 \text{ V}, L = 3.6 \text{ mH}$		180	mJ
Power dissipation, limited by $T_{\text{vj(max)}}$ ²⁾	P_{tot}		$T_{\text{c}} = 25 \text{ °C}$	202	W
			$T_{\text{c}} = 100 \text{ °C}$	101	

1) 在 $T_{\text{vj}}=25\text{°C}$ 下进行测试，并通过全温度范围内的设计/特性验证

2) 无需经过生产测试 - 经过设计/特性验证

3) **重要注释：**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	$V_{GS(on)}$		20	V
Recommended turn-off gate voltage	$V_{GS(off)}$		0	V

AIMBG120R060M1

CoolSiC™ 1200 V SiC Trench MOSFET

2 MOSFET



表4 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 13\text{ A}$	$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 20\text{ V}$		60	75	mΩ
			$T_{vj} = 100\text{ °C}$, $V_{GS(on)} = 20\text{ V}$		84		
			$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 20\text{ V}$		120		
			$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		65		
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 4.3\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$)	$T_{vj} = 25\text{ °C}$	3.7	4.4	5.1	V
			$T_{vj} = 175\text{ °C}$		3.6		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.3	13	μA
			$T_{vj} = 175\text{ °C}$		10		
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$	$V_{GS} = 25\text{ V}$			100	nA
			$V_{GS} = -10\text{ V}$			-100	
Forward transconductance	g_{fs}	$I_D = 13\text{ A}$, $V_{DS} = 20\text{ V}$			8.1		S
Short-circuit withstand time ²⁾	t_{SC}	$V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $T_{vj(start)} = 25\text{ °C}$, $R_{G,ext} = 2\text{ Ω}$	$V_{GS(on)} = 20\text{ V}$		1.5		μs
			$V_{GS(on)} = 18\text{ V}$		2		
			$V_{GS(on)} = 15\text{ V}$		2.5		
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$			4		Ω
Input capacitance	C_{iss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			880		pF
Output capacitance	C_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			43		pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			2		pF
C_{oss} stored energy	E_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			18		μJ
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse			32		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse			8		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse			5		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/20\text{ V}$, $R_{G,ext} = 2\text{ Ω}$, $L_\sigma = 20\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		6.2		ns
			$T_{vj} = 175\text{ °C}$		6.2		

(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	$V_{DD} = 800 \text{ V}$, $I_D = 13 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	5.4		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	6.4		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800 \text{ V}$, $I_D = 13 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	13		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	13.9		
Fall time	t_f	$V_{DD} = 800 \text{ V}$, $I_D = 13 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	8		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	8.5		
Turn-on energy	E_{on}	$V_{DD} = 800 \text{ V}$, $I_D = 13 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	79.3		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	113.3		
Turn-off energy	E_{off}	$V_{DD} = 800 \text{ V}$, $I_D = 13 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	31.5		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	30.7		
Total switching energy	E_{tot}	$V_{DD} = 800 \text{ V}$, $I_D = 13 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	110.8		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	144		
Virtual junction temperature	T_{vj}		-55		175	$^\circ\text{C}$

注释：特征参数在 $T_{vj} = 25^\circ\text{C}$ 下测定，除非另有说明。

3 体二极管 (MOSFET)

表5 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit
Drain-source voltage ¹⁾	V_{DSS}	$T_{vj} = -55...175 \text{ }^\circ\text{C}$	1200	V
Continuous reverse drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$ ²⁾	I_{SDC}	$V_{GS} = 0 \text{ V}$	$T_c = 25 \text{ }^\circ\text{C}$	A
			$T_c = 100 \text{ }^\circ\text{C}$	
Peak reverse drain current, t_p limited by $T_{vj(max)}$ ²⁾	I_{SM}	$V_{GS} = 0 \text{ V}$	30	A

1) 在 $T_{vj}=25^\circ\text{C}$ 下进行测试，并通过全温度范围内的设计/特性验证

2) 无需经过生产测试 - 经过设计/特性验证



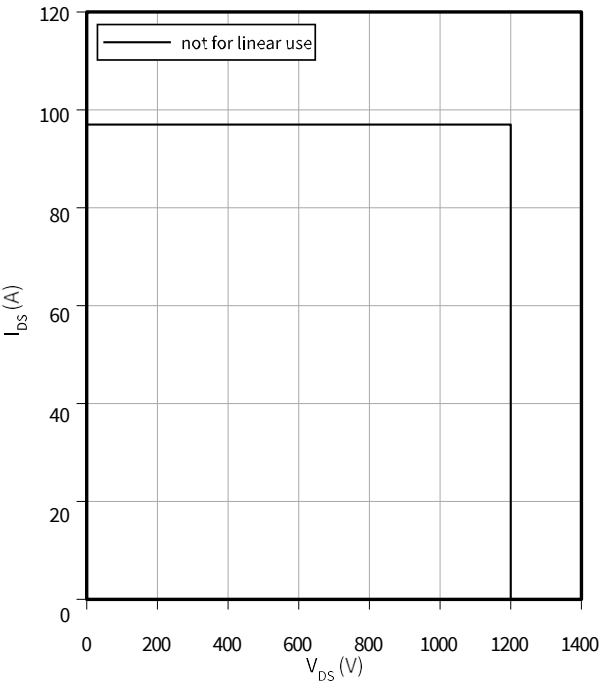
表6 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 13\text{ A}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		3.9	5	V
			$T_{vj} = 100\text{ °C}$		3.8		
			$T_{vj} = 175\text{ °C}$		3.7		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V},$ $I_{SD} = 13\text{ A}, V_{GS} = 0\text{ V},$ $-di_{SD}/dt = 2000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_c	$T_{vj} = 25\text{ °C}$		106		nC
			$T_{vj} = 175\text{ °C}$		207		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V},$ $I_{SD} = 13\text{ A}, V_{GS} = 0\text{ V},$ $-di_{SD}/dt = 2000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_c	$T_{vj} = 25\text{ °C}$		7.8		A
			$T_{vj} = 175\text{ °C}$		10.1		
Virtual junction temperature	T_{vj}			-55		175	°C

4 特性图

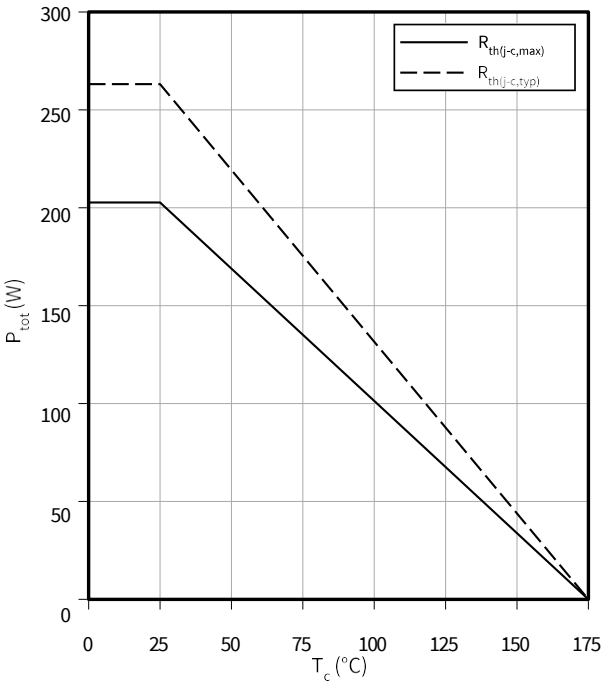
Reverse bias safe operating area (RBSOA)

$I_{DS} = f(V_{DS})$
 $T_{vj} \leq 175\text{ }^{\circ}\text{C}$, $V_{GS} = 0/20\text{ V}$, $T_c = 25\text{ }^{\circ}\text{C}$



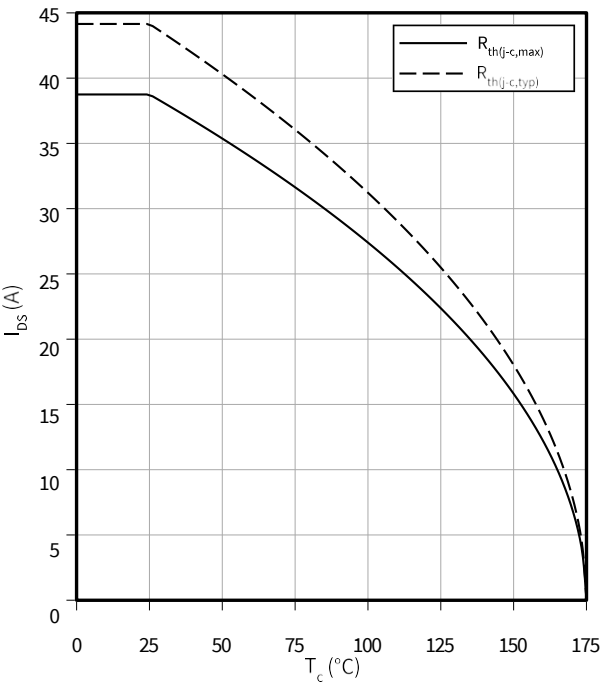
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



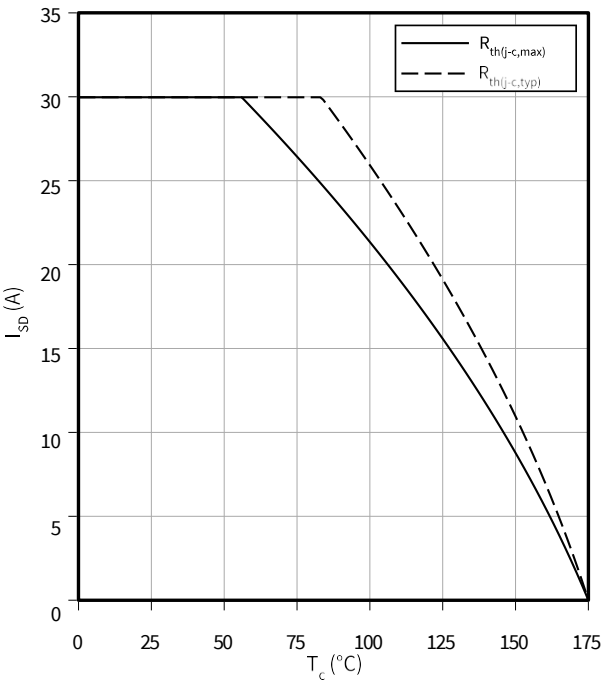
Maximum DC drain to source current as a function of case temperature

$I_{DS} = f(T_c)$



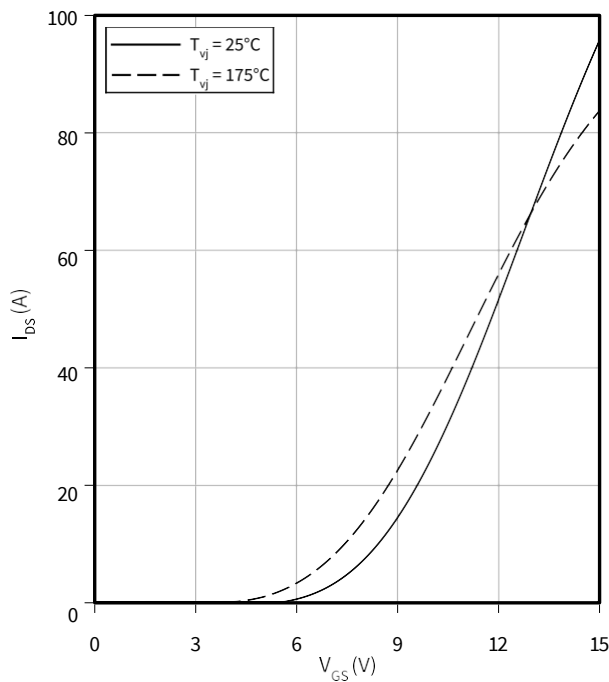
Maximum source to drain current as a function of case temperature

$I_{SD} = f(T_c)$
 $V_{GS} = 0\text{ V}$



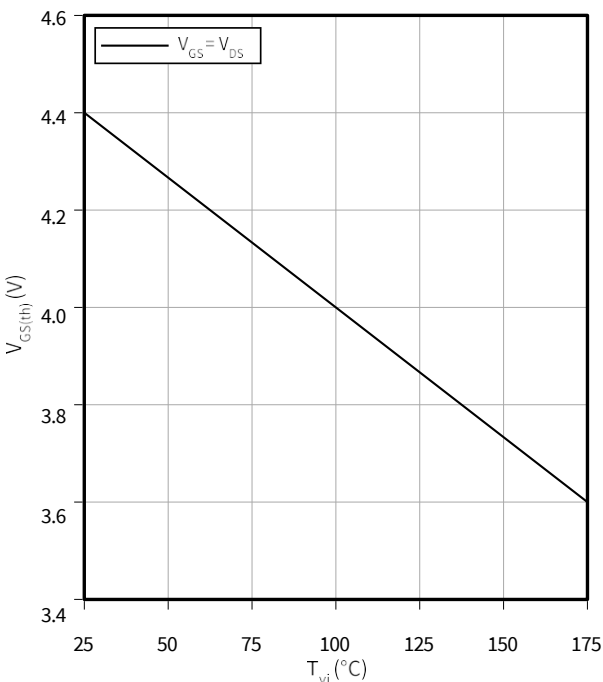
Typical transfer characteristic

$I_{DS} = f(V_{GS})$
 $V_{DS} = 20\text{ V}$, $t_p = 20\text{ }\mu\text{s}$



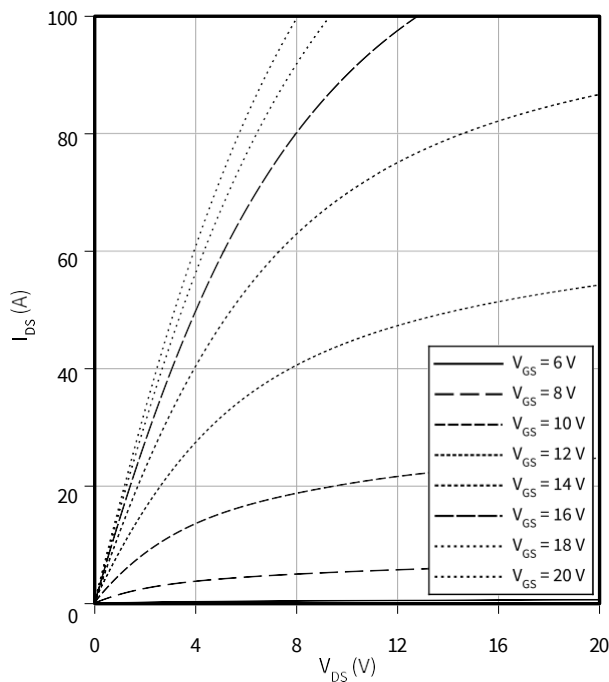
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 4.3\text{ mA}$



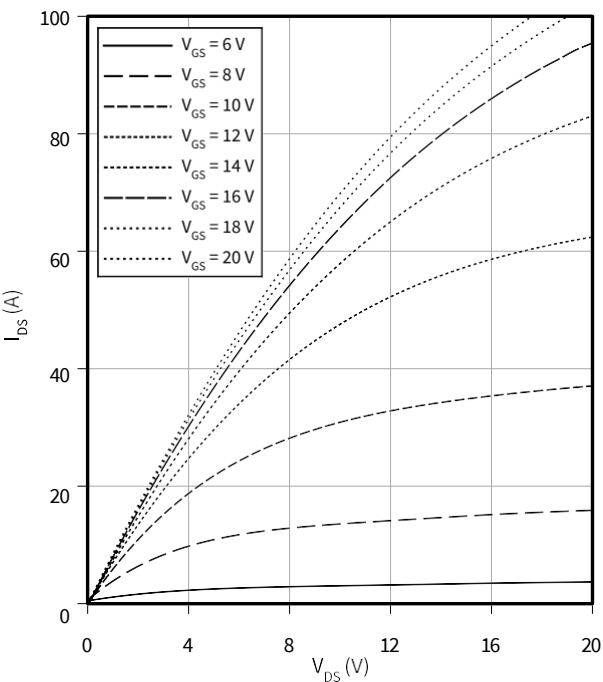
Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
 $T_{vj} = 25\text{ }^\circ\text{C}$, $t_p = 20\text{ }\mu\text{s}$



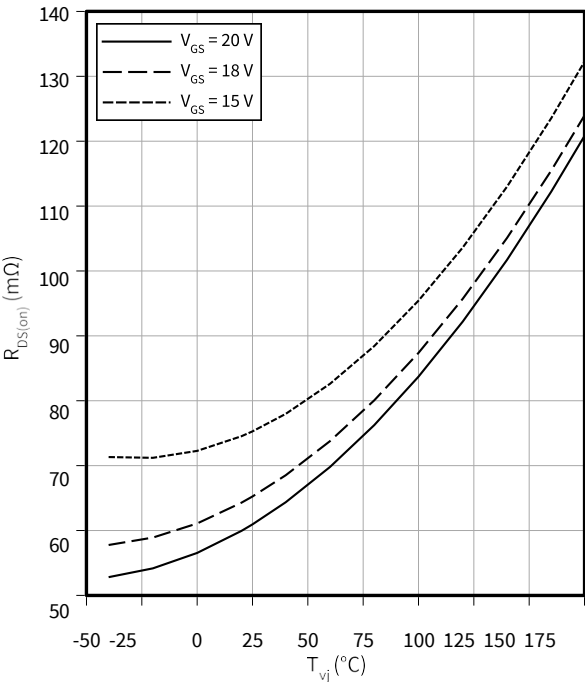
Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
 $T_{vj} = 175\text{ }^\circ\text{C}$, $t_p = 20\text{ }\mu\text{s}$



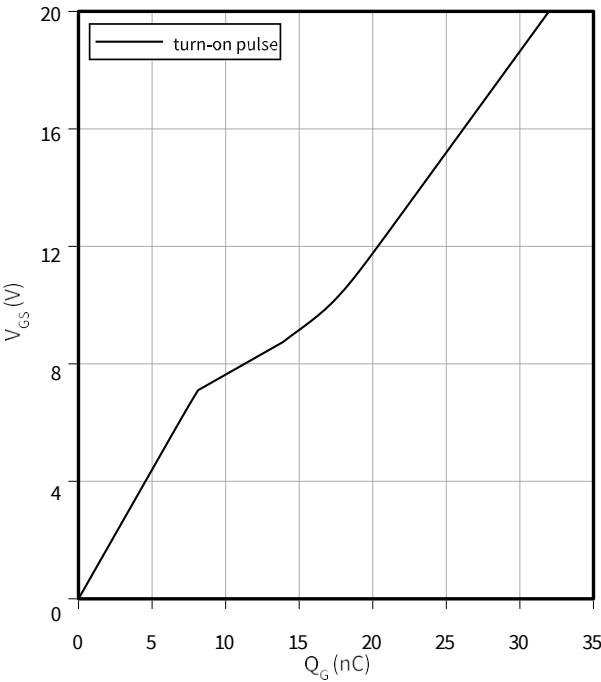
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 13\text{ A}$



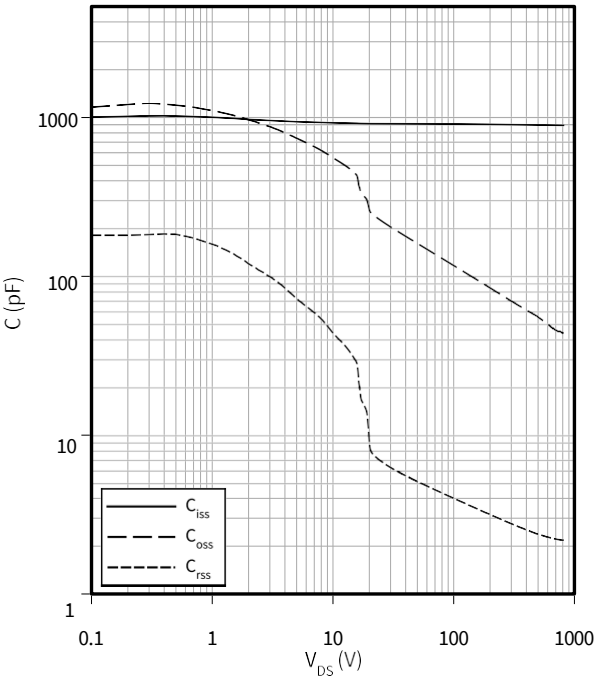
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 13\text{ A}, V_{DS} = 800\text{ V}$



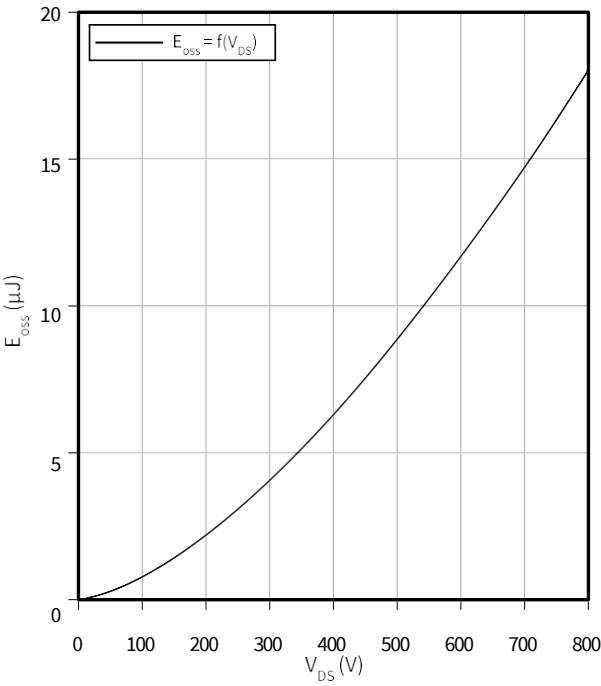
Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$
 $f = 100\text{ kHz}, V_{GS} = 0\text{ V}$



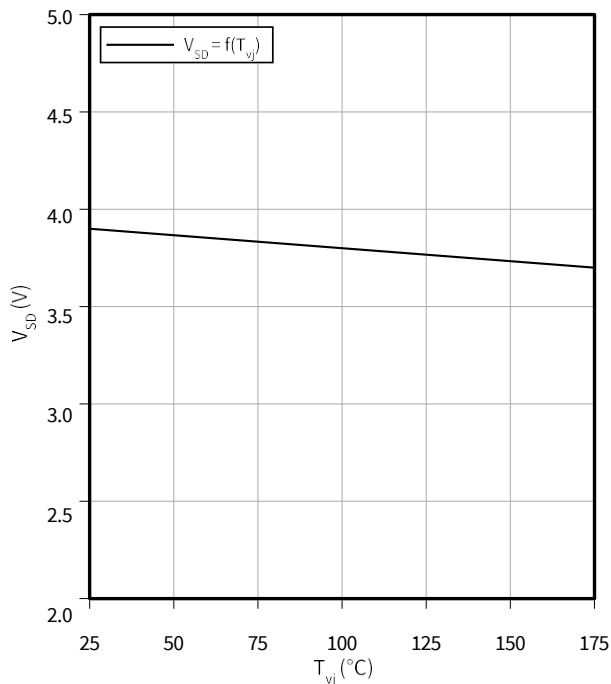
Typical C_{oss} stored energy

$E_{oss} = f(V_{DS})$
 $f = 100\text{ kHz}, V_{GS} = 0\text{ V}$



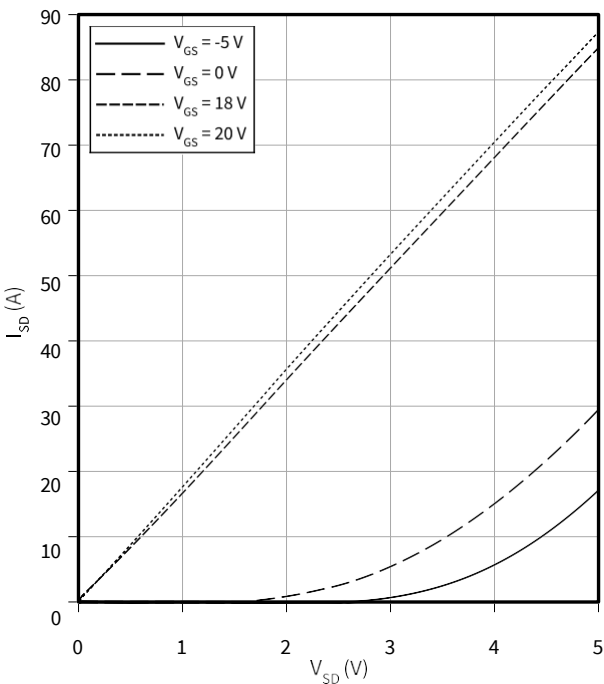
Typical reverse drain voltage as function of junction temperature

$V_{SD} = f(T_{vj})$
 $I_{SD} = 13\text{ A}$, $V_{GS} = 0\text{ V}$



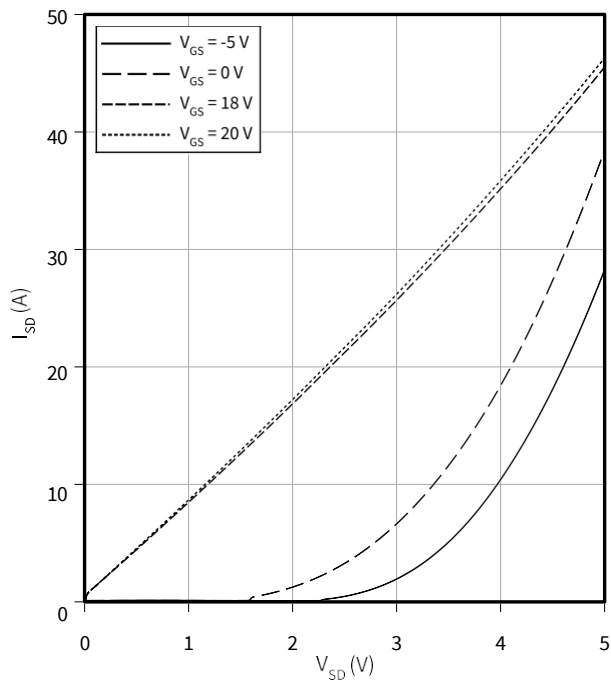
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 25\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



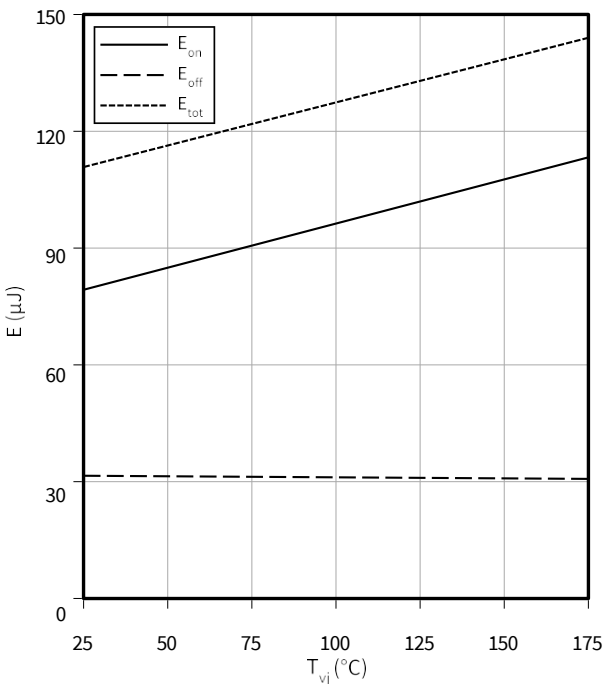
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 175\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

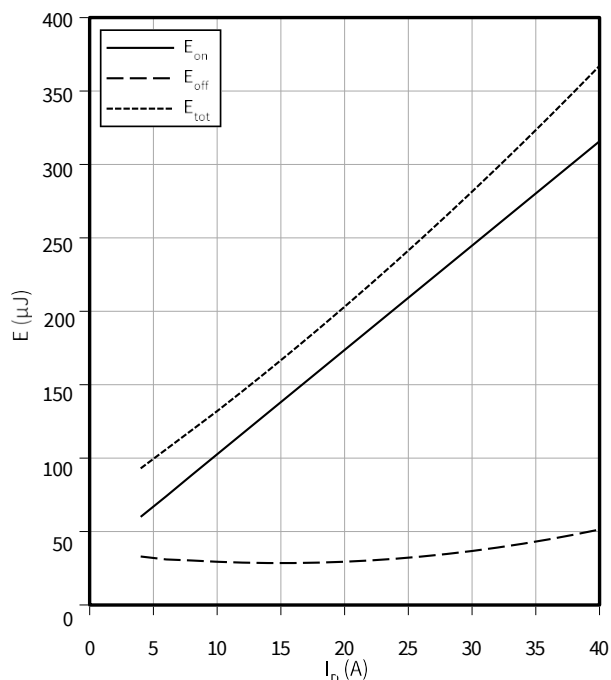
$E = f(T_{vj})$
 $V_{GS} = 0/20\text{ V}$, $I_D = 13\text{ A}$, $R_{G,ext} = 2\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

$$E = f(I_D)$$

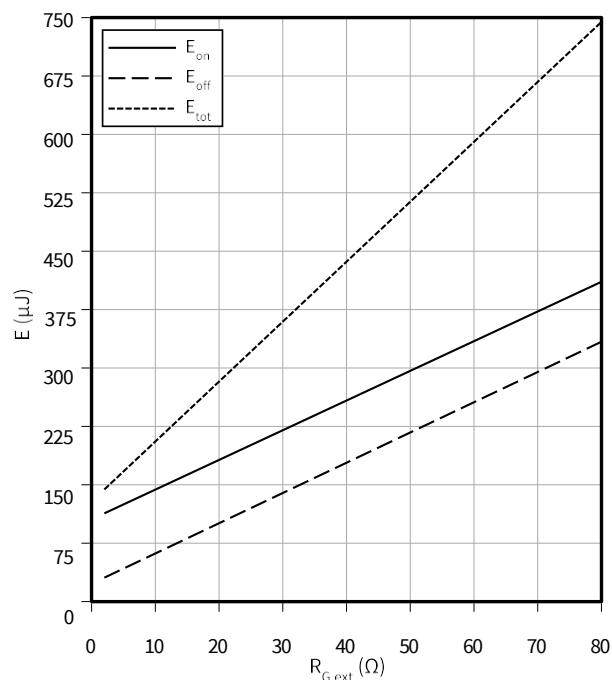
$V_{GS} = 0/20$ V, $T_{vj} = 175$ °C, $R_{G,ext} = 2$ Ω , $V_{DD} = 800$ V



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

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

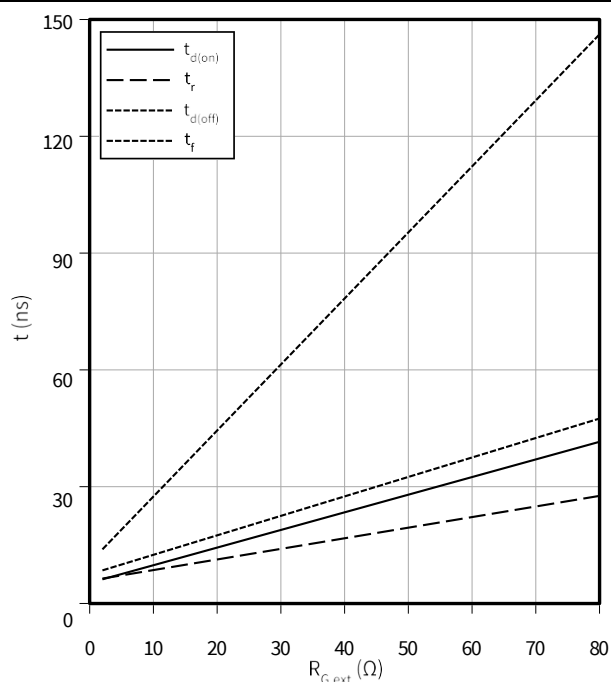
$V_{GS} = 0/20$ V, $I_D = 13$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

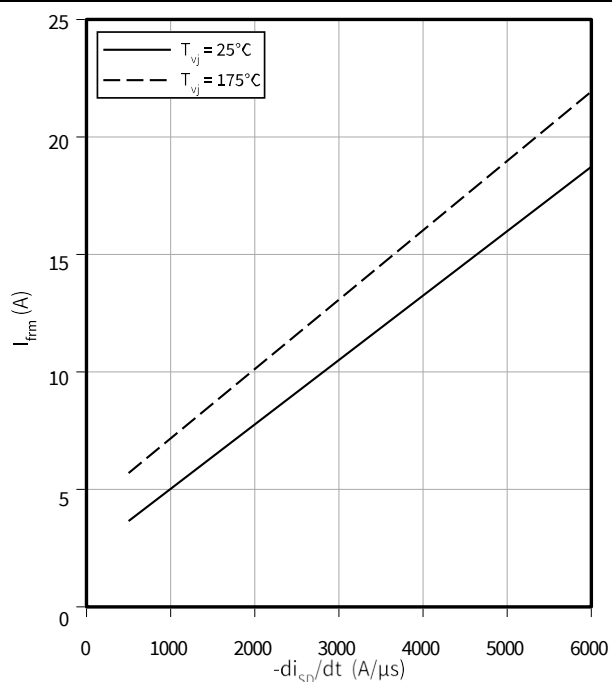
$V_{GS} = 0/20$ V, $I_D = 13$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



Typical MOSFET peak forward recovery current as a function of reverse drain current slope

$$I_{frm} = f(-di_{SD}/dt)$$

$V_{GS} = 0/20$ V, $I_{SD} = 13$ A, $V_{DD} = 800$ V



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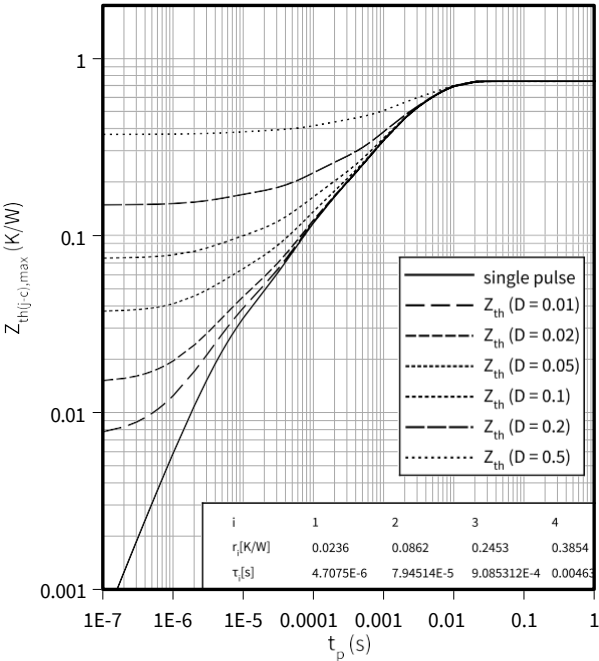
CoolSiC™ 1200 V SiC Trench MOSFET



Max. transient thermal impedance (MOSFET/diode)

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

$D = t_p/T$



5 封装外形

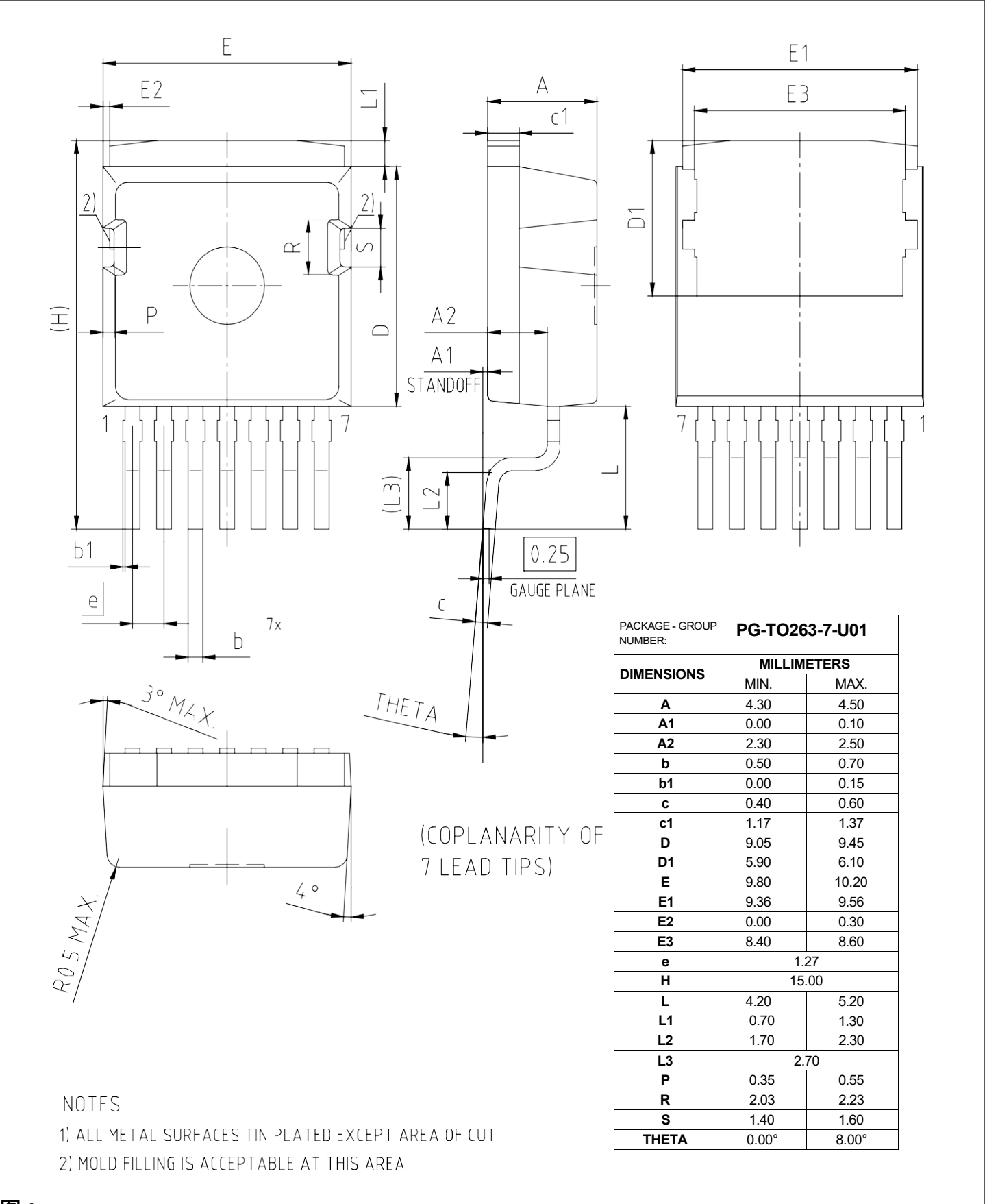


图 1

6 测试条件

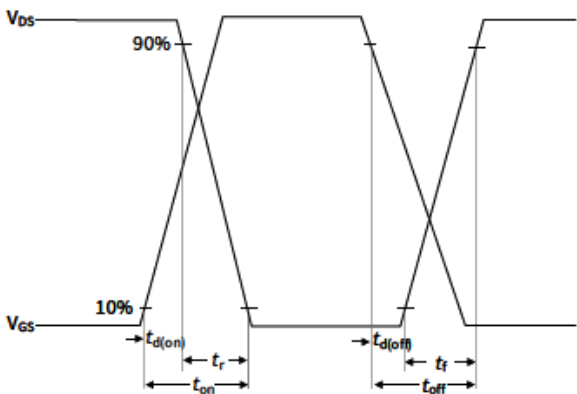


Figure A. Definition of switching times

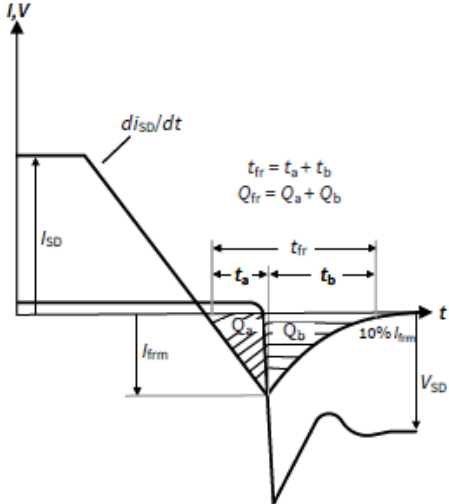


Figure B. Definition of body diode switching characteristics

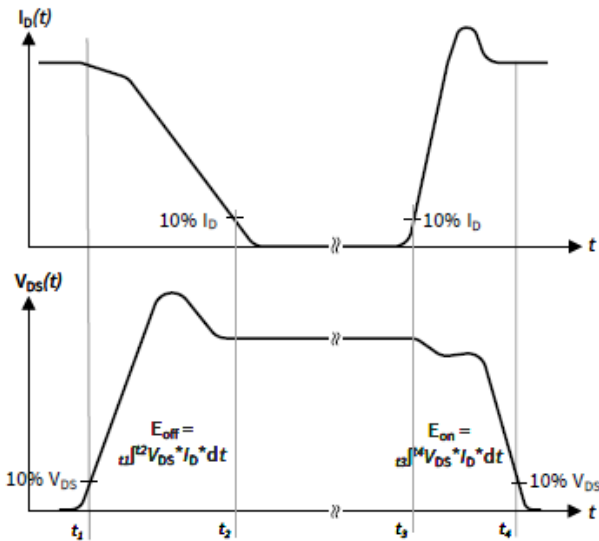


Figure C. Definition of switching losses

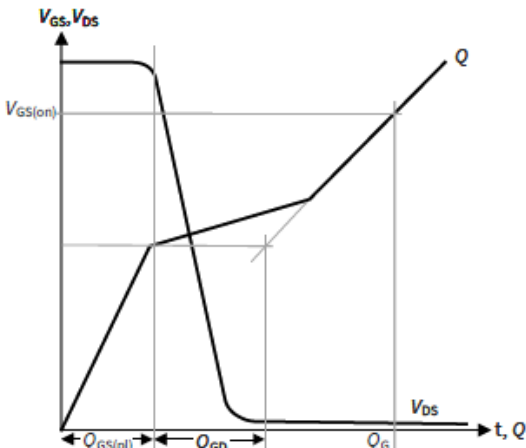


Figure D. Definition of QGD

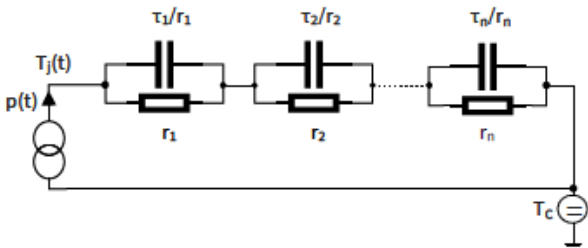


Figure E. Thermal equivalent circuit

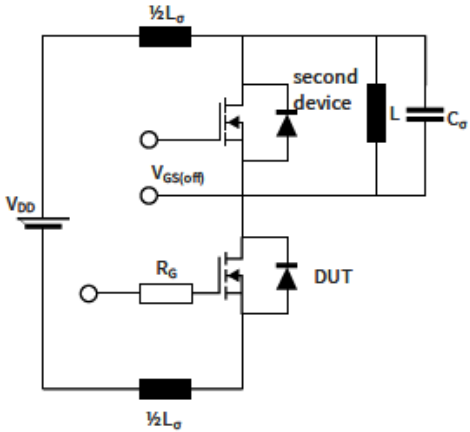


Figure F. Dynamic test circuit
Parasitic inductance L_σ
Parasitic capacitor C_σ

Figure 2

AIMBG120R060M1

CoolSiC™ 1200 V SiC Trench MOSFET



修订记录

修订记录

Document revision	Date of release	Description of changes
0.10	2022-12-08	Preliminary datasheet
0.20	2022-12-09	Update of "Drain-source on-state resistance", value ' Max. ' for 25°C, in Table 4 "Characteristic values"
1.00	2023-05-16	Final datasheet
1.10	2024-04-02	Updated table values: Vgsth, Idss, gfs, tdon, tr, tdoff, tf, Eon, Eoff, Etot,Qfr, lfrm Updated graphs: IDS = f(VGS), VGS(th) = f(Tvj), IDS = f(VDS), RDS(on) = f(Tvj), ISD = f(VSD), E = f(Tvj), E = f(RG,ext), t = f(RG,ext), lfrm = f(-diSD/dt) Added new graphs: E = f(ID), Eoss = f(VDS) No change to the product, new values based on additional characterization
1.20	2024-11-12	Updated features: “Minimal creepage distance 5.85mm (material group II) to fit 800V applications without coating” changed to “Creepage distance of 5.8mm (material group II) to fit 800V applications” Updated package from PG-TO263-7-HV-ND5.8 to PG-TO263-7-U01



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