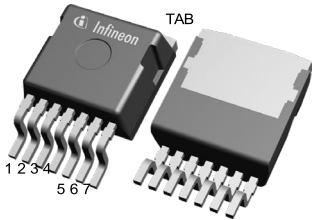


最终数据手册

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

特性

- $T_{vj} = -55...175^{\circ}\text{C}$ 时 $V_{DS} = 1200\text{ V}$
- $T_C = 25^{\circ}\text{C}$ 时 $I_{DC} = 70\text{ A}$
- $R_{DS(on)} = 30\text{ m}\Omega$ ($V_{GS} = 20\text{ V}$ 、 $T_{vj} = 25^{\circ}\text{C}$ 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



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

潜在应用

- 车载充电器
- 直流/直流转换器
- 辅助驱动

产品验证

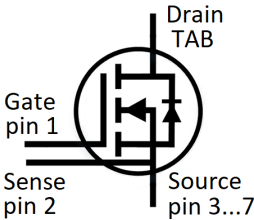
- 适合汽车应用。根据 AEC-Q100/101 进行产品验证

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：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
AIMBG120R030M1	PG-TO263-7-U01	AS30MM1

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

	说明	1
	特征	1
	潜在应用	1
	产品验证	1
	目录	2
1	封装	3
2	MOSFET	3
3	体 二极管 (MOSFET)	5
4	特征图.....	7
5	封装外形	13
6	测试条件.....	14
	修订记录	16
	免责声明.....	16

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⁾	$R_{\text{th(j-c)}}$			0.35	0.45	K/W

1) 未经过生产测试 - 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}	$V_{\text{GS}} = 20 \text{ V}$	$T_{\text{c}} = 25 \text{ °C}$	70	A
			$T_{\text{c}} = 100 \text{ °C}$	50	
Peak drain current, t_{p} limited by $T_{\text{vj(max)}}$ ²⁾	I_{DM}	$V_{\text{GS}} = 20 \text{ V}$		180	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}	$I_{\text{D}} = 20 \text{ A}, V_{\text{DD}} = 50 \text{ V}, L = 1.8 \text{ mH}$		361	mJ
Power dissipation, limited by $T_{\text{vj(max)}}$ ²⁾	P_{tot}		$T_{\text{c}} = 25 \text{ °C}$	333	W
			$T_{\text{c}} = 100 \text{ °C}$	167	

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) 未经过生产测试 - 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	$V_{\text{GS(on)}}$		20	V
Recommended turn-off gate voltage	$V_{\text{GS(off)}}$		0	V

表4 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 27\text{ A}$	$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 20\text{ V}$		30	38	mΩ
			$T_{vj} = 100\text{ °C}$, $V_{GS(on)} = 20\text{ V}$		42		
			$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 20\text{ V}$		60		
			$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		33		
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 8.6\text{ mA}$, $V_{DS} = V_{GS}$ (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}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.4	26	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}	$I_D = 27\text{ A}$, $V_{DS} = 20\text{ V}$			16.5		S
Short-circuit withstand time ²⁾	t_{SC}	$V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $T_{vj(start)} = 25\text{ °C}$, $R_{G,ext} = 2\text{ }\Omega$	$V_{GS(on)} = 20\text{ V}$		1.5		μs
			$V_{GS(on)} = 18\text{ V}$		2		
			$V_{GS(on)} = 15\text{ V}$		2.5		
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$			2.6		Ω
Input capacitance	C_{iss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			1738		pF
Output capacitance	C_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			82		pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			4.4		pF
C_{oss} stored energy	E_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			34		μJ
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 27\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse			57		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 27\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse			15		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 27\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse			10		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{ V}$, $I_D = 27\text{ A}$, $V_{GS} = 0/20\text{ V}$, $R_{G,ext} = 2\text{ }\Omega$, $L_\sigma = 20\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		8.3		ns
			$T_{vj} = 175\text{ °C}$		8.2		

(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	$V_{DD} = 800 \text{ V}$, $I_D = 27 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	7.6		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	9.2		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800 \text{ V}$, $I_D = 27 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	18.6		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	19.8		
Fall time	t_f	$V_{DD} = 800 \text{ V}$, $I_D = 27 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	8.5		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	8.7		
Turn-on energy	E_{on}	$V_{DD} = 800 \text{ V}$, $I_D = 27 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	179		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	255		
Turn-off energy	E_{off}	$V_{DD} = 800 \text{ V}$, $I_D = 27 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	57		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	56		
Total switching energy	E_{tot}	$V_{DD} = 800 \text{ V}$, $I_D = 27 \text{ A}$, $V_{GS} = 0/20 \text{ V}$, $R_{G,ext} = 2 \Omega$, $L_\sigma = 20 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	236		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	311		
Virtual junction temperature	T_{vj}		-55		175	$^\circ\text{C}$

注：特征参数在 $T_{vj} = 25 \text{ }^\circ\text{C}$ 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}	$V_{GS} = 0 \text{ V}$	60	A

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

2) 未经过生产测试 - 经过设计/特性验证

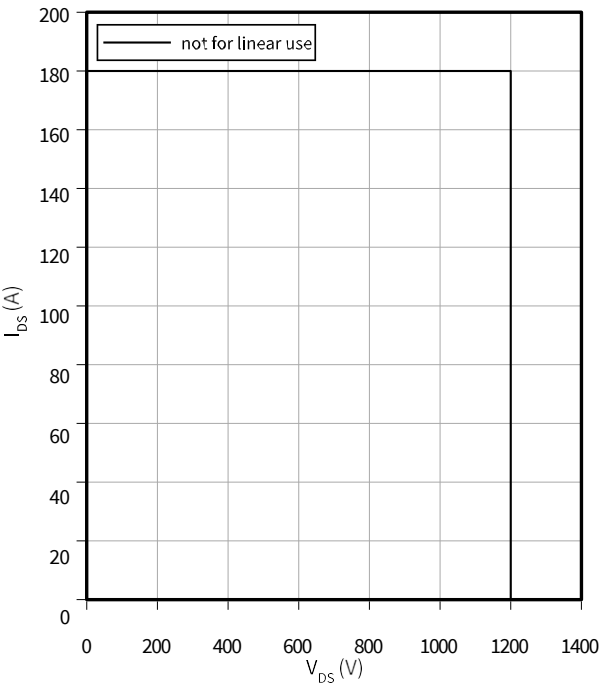
表6 **特征值**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 27\text{ A}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		3.9	5	V
			$T_{vj} = 100\text{ °C}$		3.8		
			$T_{vj} = 175\text{ °C}$		3.7		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V}$, $I_{SD} = 27\text{ A}$, $V_{GS} = 0\text{ V}$, $-di_{SD}/dt = 2000\text{ A}/\mu\text{s}$, Q_{fr} includes also Q_C	$T_{vj} = 25\text{ °C}$		175		nC
			$T_{vj} = 175\text{ °C}$		339		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V}$, $I_{SD} = 27\text{ A}$, $V_{GS} = 0\text{ V}$, $-di_{SD}/dt = 2000\text{ A}/\mu\text{s}$, Q_{fr} includes also Q_C	$T_{vj} = 25\text{ °C}$		13.5		A
			$T_{vj} = 175\text{ °C}$		16.6		
Virtual junction temperature	T_{vj}			-55		175	°C

4 特性图

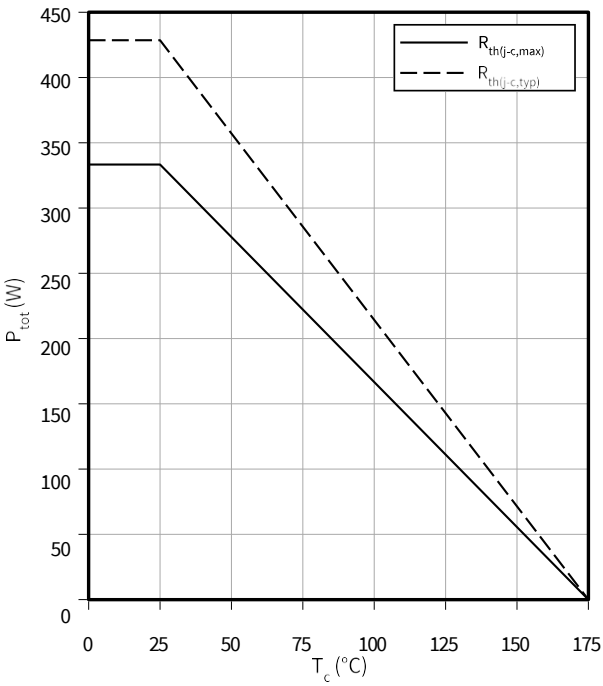
Reverse bias safe operating area (RBSOA)

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



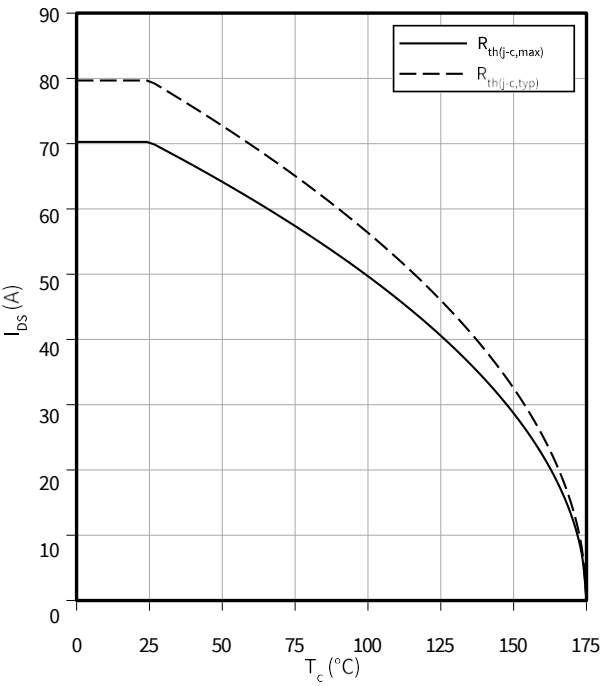
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



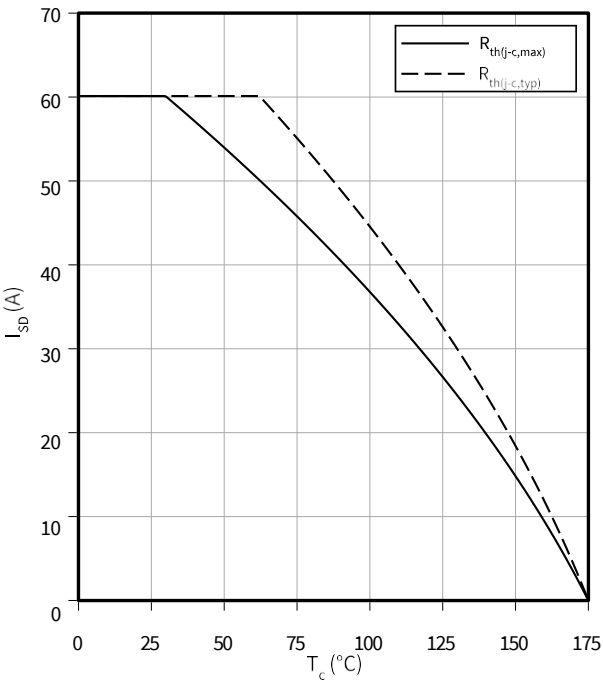
Maximum DC drain to source current as a function of case temperature

$I_{DS} = f(T_c)$



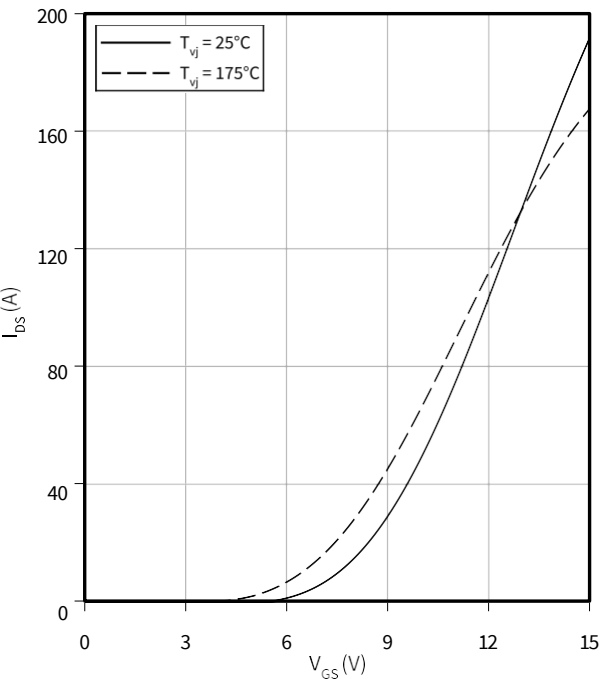
Maximum source to drain current as a function of case temperature

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



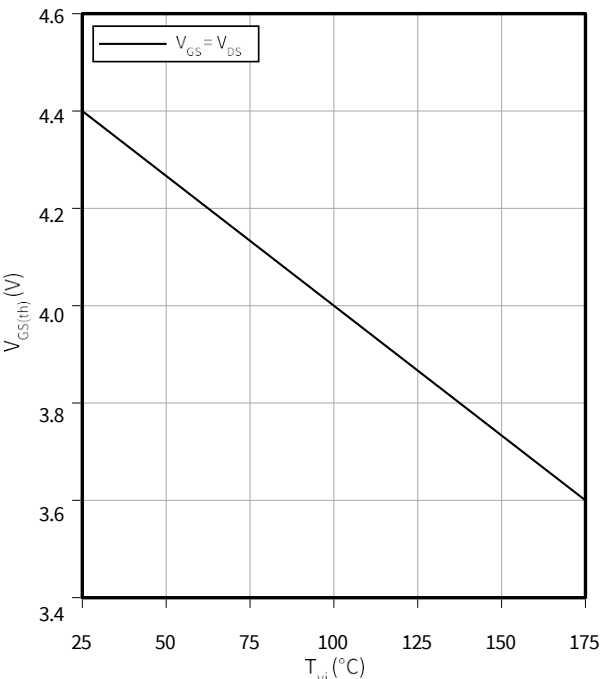
Typical transfer characteristic

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



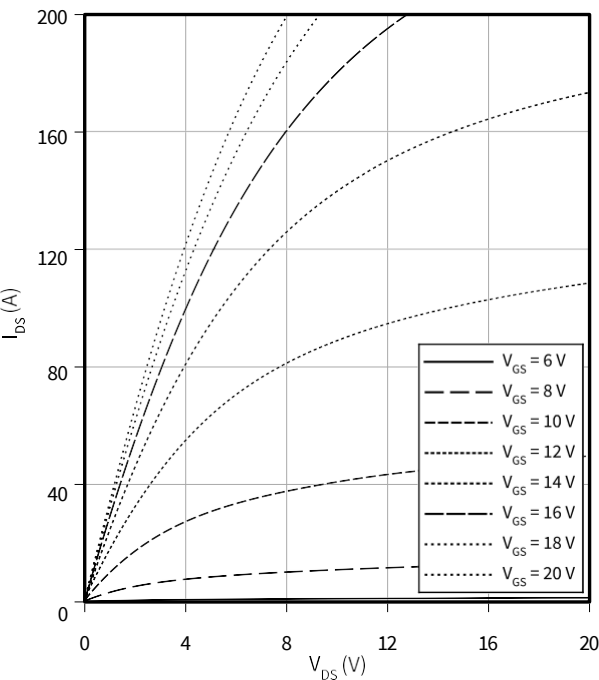
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 8.6\text{ mA}$



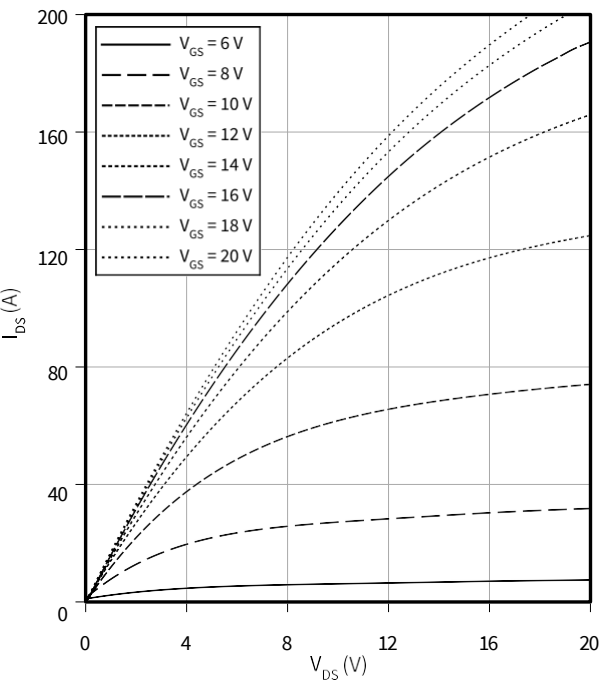
Typical output characteristic, V_{GS} as parameter

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



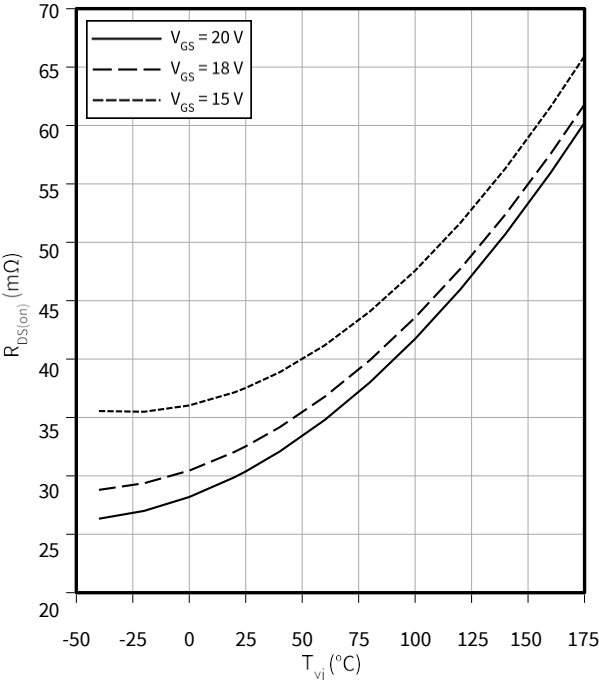
Typical output characteristic, V_{GS} as parameter

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



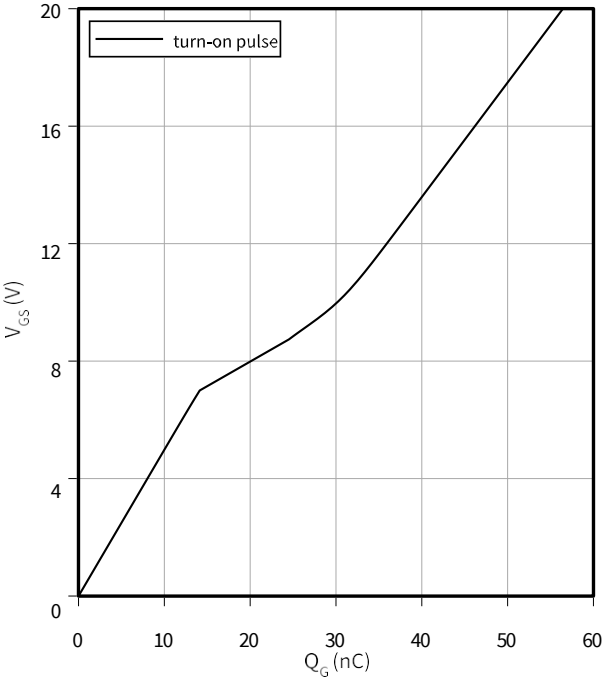
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 27\text{ A}$



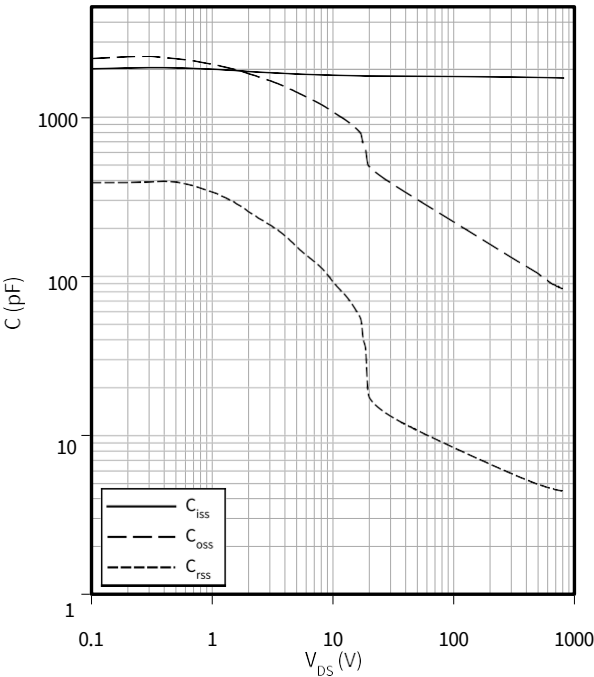
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 27\text{ A}, V_{DS} = 800\text{ V}$



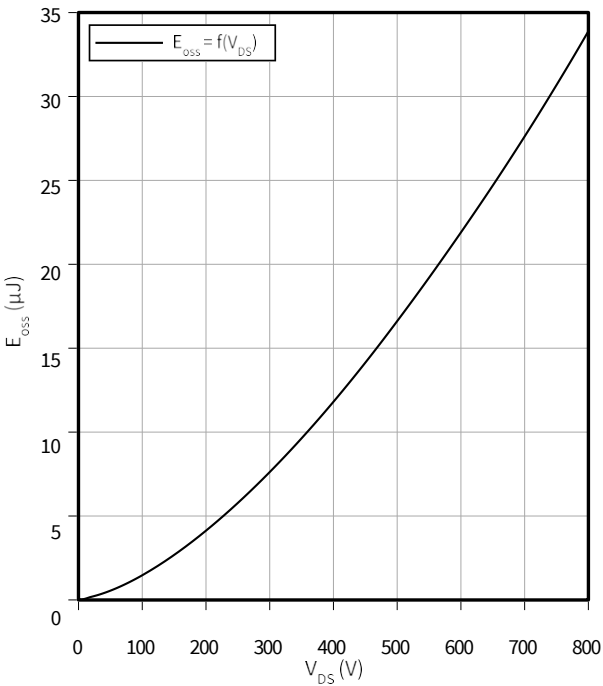
Typical capacitance as a function of drain-source voltage

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



Typical C_{oss} stored energy

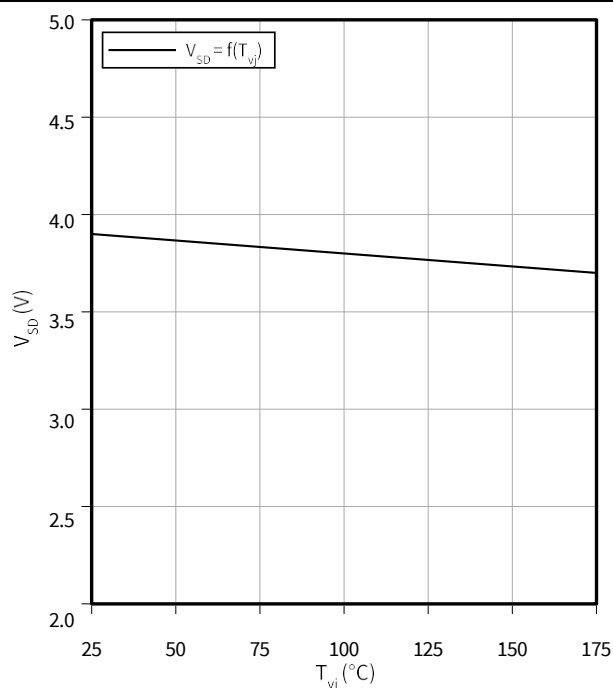
$E_{oss} = f(V_{DS})$
 $f = 100\text{ kHz}, V_{GS} = 0\text{ V}$



Typical reverse drain voltage as function of junction temperature

$$V_{SD} = f(T_{vj})$$

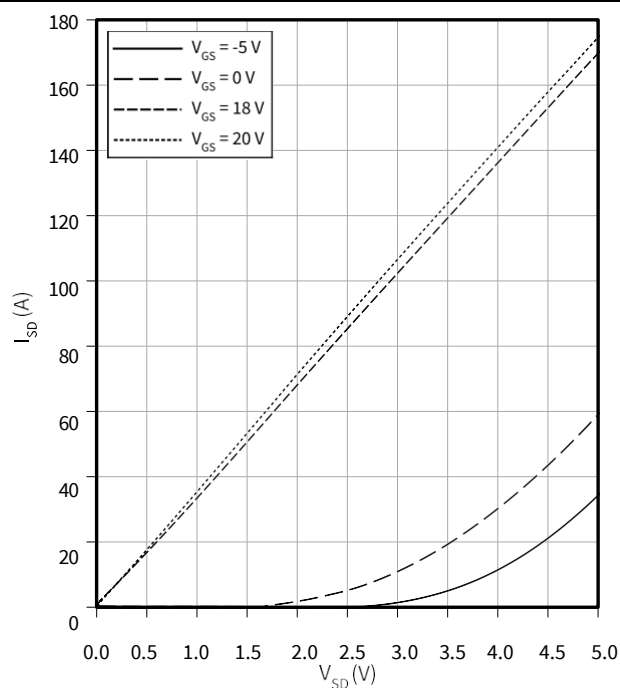
$$I_{SD} = 27 \text{ A}, V_{GS} = 0 \text{ V}$$



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

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

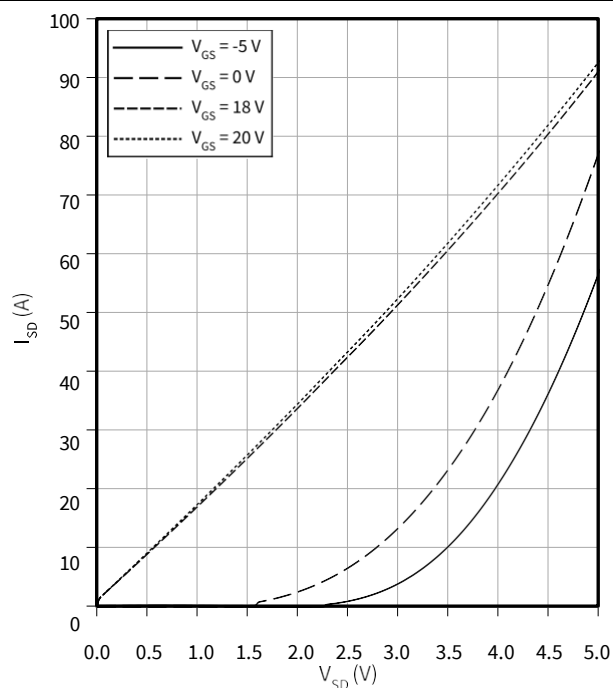
$$T_{vj} = 25 \text{ °C}, t_p = 20 \text{ } \mu\text{s}$$



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

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

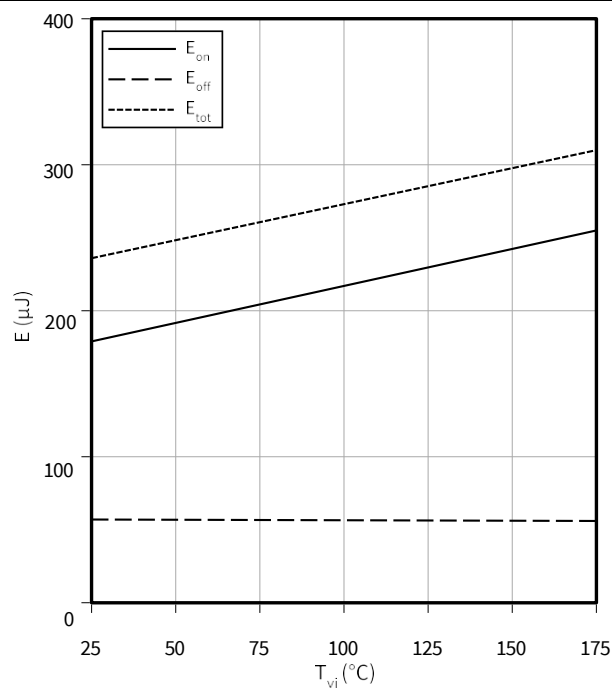
$$T_{vj} = 175 \text{ °C}, t_p = 20 \text{ } \mu\text{s}$$



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

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

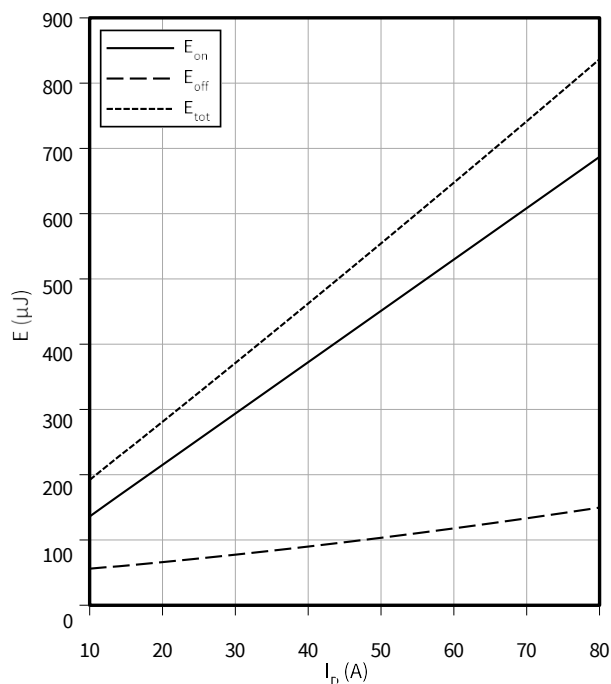
$$V_{GS} = 0/20 \text{ V}, I_D = 27 \text{ A}, R_{G,ext} = 2 \text{ } \Omega, V_{DD} = 800 \text{ V}$$



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

$$E = f(I_D)$$

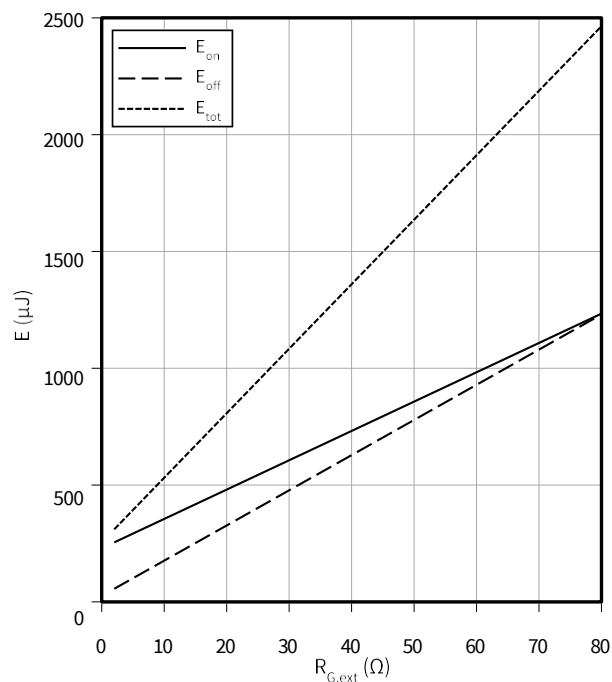
$V_{GS} = 0/20$ V, $T_{vj} = 175$ °C, $R_{G,ext} = 2$ Ω , $V_{DD} = 800$ V



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

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

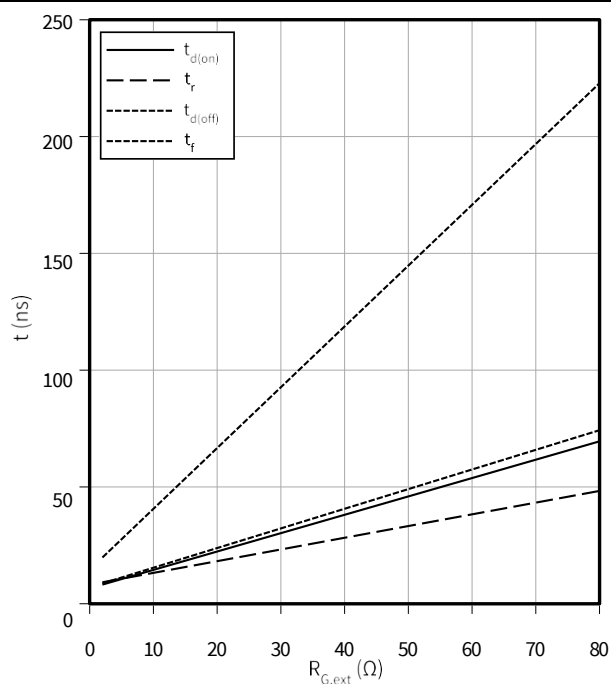
$V_{GS} = 0/20$ V, $I_D = 27$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

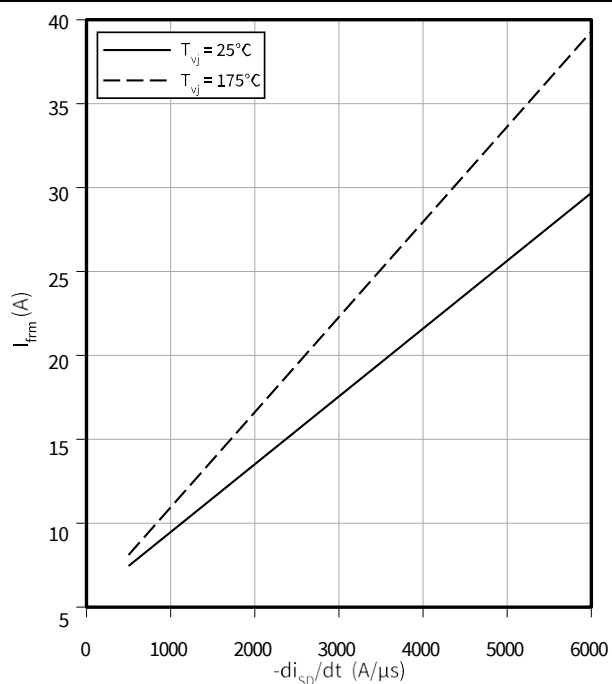
$V_{GS} = 0/20$ V, $I_D = 27$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

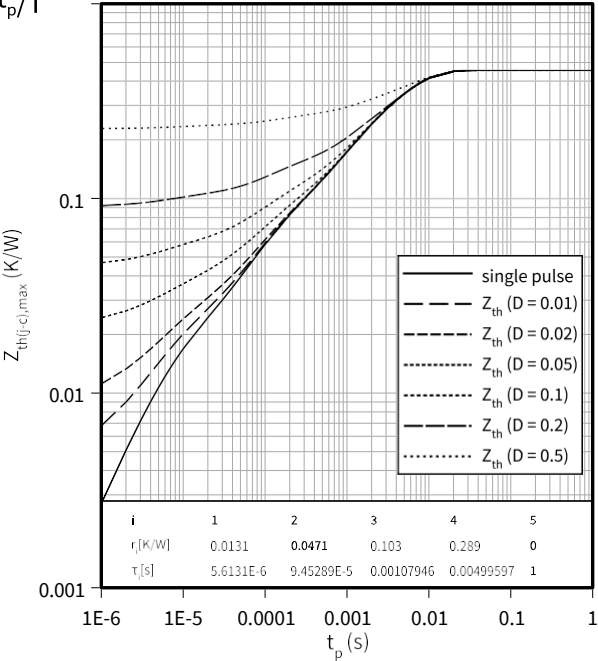
$I_{SD} = 27$ A, $V_{DD} = 800$ V, $V_{GS} = 0/20$ V



Max. transient thermal impedance
(MOSFET/diode)

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

$D = t_p/T$



5 封装外形

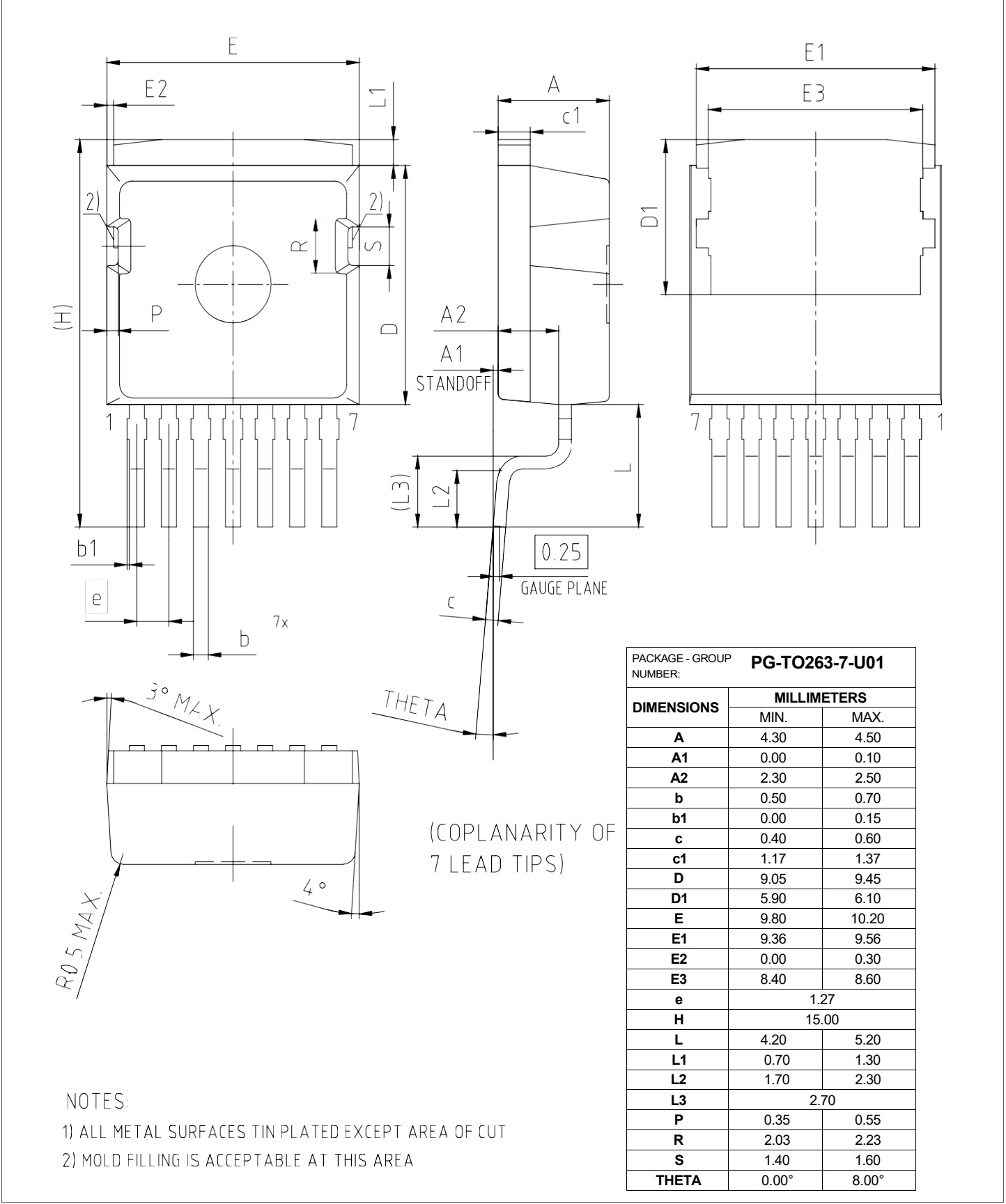


图 1

6 测试条件

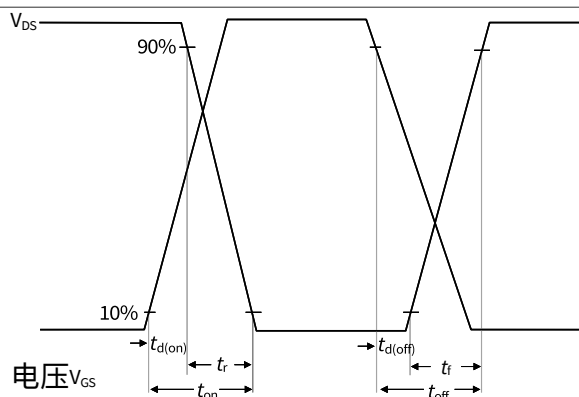
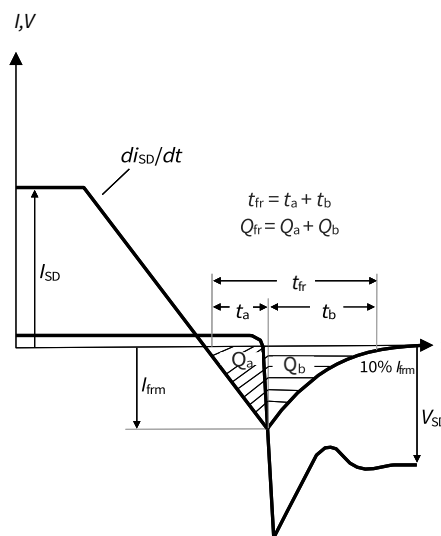


图 A.开关时间的定义



图B.体二极管开关特性的定义

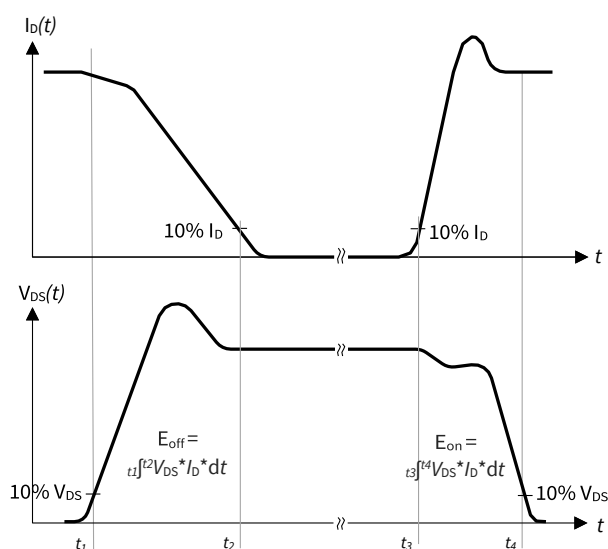


图 C.开关损耗的定义

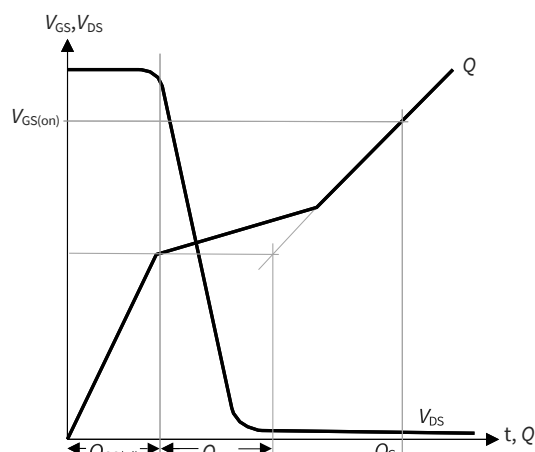


图 D. QGD 的定义

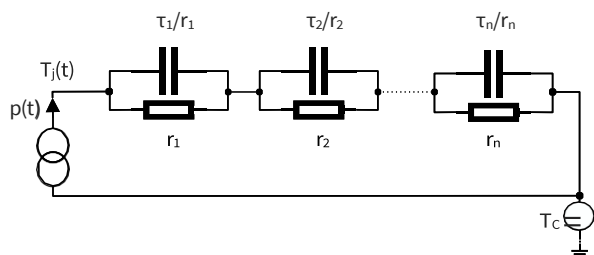
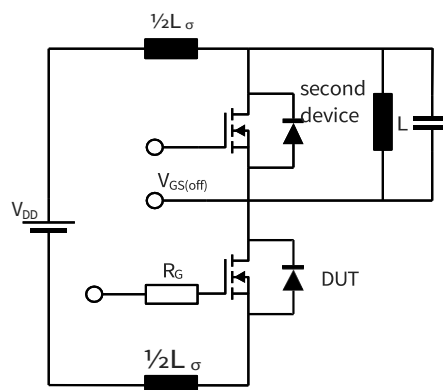


图 E.热等效电路



图F.动态测试电路寄生电感 L_{σ} ，寄生电容 C_{σ}



修订记录

修订记录

Document revision	Date of release	Description of changes
0.10	2022-12-08	Preliminary datasheet
1.00	2023-06-23	Final datasheet
1.10	2024-04-02	Updated table values: Rdson. Vgsth, Idss, gfs, tdon, tr, tdoff, tf, Eon, Eoff, Etot,Qfr, lfrm, lsd, lsm Updated graphs: ISD=f(Tc), 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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