

英飞凌IMCQ120R040M2H

CoolSiC™ 1200 V SiC MOSFET G2 : Q-DPAK 顶部冷却

特性

- $V_{DS} = 1200\text{ V}$ at $T_{vj} = 25^\circ\text{C}$
- $I_{DC} = 39\text{ A}$ at $T_C = 100^\circ\text{C}$
- $R_{DS(on)} = 39.6\text{ m}\Omega$ ($V_{GS} = 18\text{ V}$ 、 $T_{vj} = 25^\circ\text{C}$ 时)
- 开关损耗非常低
- 过载运行最高结温可达 $T_{vj} = 200^\circ\text{C}$
- 短路耐受时间 $2\ \mu\text{s}$
- 基准栅极阈值电压, $V_{GS(th)} = 4.2\text{ V}$
- 具有抗寄生导通能力, 可应用 0 V 关断栅极电压
- 坚固的体二极管, 适用于硬换向
- .XT 互连技术, 实现、行业领先的热性能
- 合适的英飞凌栅极驱动器可在 <https://www.infineon.com/gdfinder> 找到

潜在应用

- 固态断路器/固态继电器
- 电动汽车充电桩
- 在线式UPS/工业UPS
- 组串式逆变器
- 通用驱动器 (GPD)
- CAV
- 伺服驱动器

产品验证

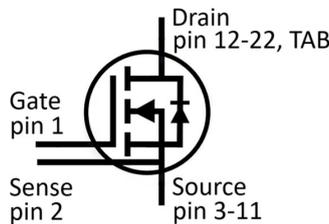
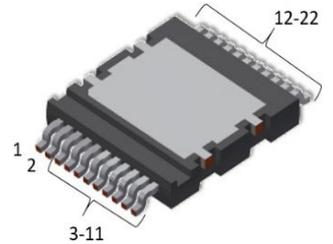
- 符合JEDEC47/20/22相关测试的工业应用要求

描述

引脚定义:

- Pin 1 – 栅极
- Pin 2 – 开尔文检测触点
- 引脚 3-11 – 信号源
- 引脚 12-22, 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
IMCQ120R040M2H	PG-HDSOP-22-U03	12M2H040

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 参考最新的英寸版本 (控制文档)

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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}	reflow soldering (MSL1 according to JEDEC J-STD-020)			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			0.4	0.52	K/W

2 MOSFET

表 2 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit	
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25 \text{ °C}$	1200	V	
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS} = 18 \text{ V}$	$T_c = 25 \text{ °C}$	56	A
			$T_c = 100 \text{ °C}$	39	
Peak drain current, t_p limited by $T_{vj(max)}$ ¹⁾	I_{DM}	$V_{GS} = 18 \text{ V}$	117	A	
Gate-source voltage, max. transient voltage ²⁾	V_{GS}	$t_p \leq 0.5 \text{ }\mu\text{s}, D < 0.01$	-10...25	V	
Gate-source voltage, max. static voltage	V_{GS}		-5...23	V	
Avalanche energy, single pulse	E_{AS}	$I_D = 17.5 \text{ A}, V_{DD} = 50 \text{ V}, L = 1.4 \text{ mH}$	220	mJ	
Avalanche energy, repetitive	E_{AR}	$I_D = 17.5 \text{ A}, V_{DD} = 50 \text{ V}, L = 7.2 \text{ }\mu\text{H}$	1.1	mJ	
Short-circuit withstand time	t_{SC}	$V_{DD} \leq 800 \text{ V}, V_{DS,peak} < 1200 \text{ V}, V_{GS(on)} = 15 \text{ V}, T_{vj(start)} = 25 \text{ °C}$	2	μs	
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25 \text{ °C}$	288	W
			$T_c = 100 \text{ °C}$	144	

1) 已通过设计验证。

2) **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	$V_{GS(on)}$		15...18	V
Recommended turn-off gate voltage	$V_{GS(off)}$		-5...0	V

表4 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 17.5\text{ A}$	$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		39.6		mΩ
			$T_{vj} = 150\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		80.7	104	
			$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		93.7		
			$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 15\text{ V}$		49.4		
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 5.5\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$)	$T_{vj} = 25\text{ °C}$	3.5	4.2	5.1	V
			$T_{vj} = 175\text{ °C}$		3.2		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			150	μA
			$T_{vj} = 175\text{ °C}$		2.6		
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$	$V_{GS} = 23\text{ V}$			120	nA
			$V_{GS} = -10\text{ V}$			-120	
Forward transconductance	g_{fs}	$I_D = 17.5\text{ A}$, $V_{DS} = 20\text{ V}$		5.9		S	
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$		6.5		Ω	
Input capacitance	C_{iss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		1.66		nF	
Output capacitance	C_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		55		pF	
Reverse transfer capacitance	C_{rss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		4.7		pF	
C_{oss} stored energy	E_{oss}	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$, Calculated based on C_{oss}		23		μJ	
Output charge	Q_{oss}	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$, Calculated based on C_{oss}		85.2		nC	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$		71.9		pF	
Effective output capacitance, time related	$C_{o(tr)}$	$I_D = \text{constant}$, $V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$		107		pF	

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表 4 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = -2/18\text{ V}$, turn-on pulse		42.4		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = -2/18\text{ V}$, turn-on pulse		10.8		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = -2/18\text{ V}$, turn-on pulse		8.9		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	7		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		5.6	
Rise time	t_r	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	4.4		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		3.9	
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	15.7		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		18.4	
Fall time	t_f	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	6.6		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		7.8	
Turn-on energy	E_{on}	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	160		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		321	
Turn-off energy	E_{off}	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	41		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		63	

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3 体二极管 (MOSFET)

表 4 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy ¹⁾	E_{tot}	$V_{DD} = 800\text{ V}$, $I_D = 17.5\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	216		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$	424		
Virtual junction temperature	T_{vj}		-55		175	$^\circ\text{C}$
Virtual junction temperature	$T_{vj(over)}$	overload, cumulative max. 100 h ²⁾			200	$^\circ\text{C}$

1) 包括 E_{fr}

2) 最多 5000 次循环。最大 ΔT 限制为 100 K。

注：芯片技术的特征是高达 200 kV/ μs 。测量的 dV/dt 受到测量测试设置和封装的限制。

除非另有规定，特性均为 $T_{vj} = 25^\circ\text{C}$ 。

3 体二极管 (MOSFET)

表 5 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25\text{ }^\circ\text{C}$	1200	V
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0\text{ V}$	117	A

表 6 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 17.5\text{ A}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	4.2	5.5	V
			$T_{vj} = 100\text{ }^\circ\text{C}$	4.1		
			$T_{vj} = 175\text{ }^\circ\text{C}$	4		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V}$, $I_{SD} = 17.5\text{ A}$, $V_{GS} = 0\text{ V}$, $-di_{SD}/dt = 1000\text{ A}/\mu\text{s}$, Q_{fr} includes also Q_C	$T_{vj} = 25\text{ }^\circ\text{C}$	0.14		μC
			$T_{vj} = 175\text{ }^\circ\text{C}$	0.52		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V}$, $I_{SD} = 17.5\text{ A}$, $V_{GS} = 0\text{ V}$, $-di_{SD}/dt = 1000\text{ A}/\mu\text{s}$, Q_{fr} includes also Q_C	$T_{vj} = 25\text{ }^\circ\text{C}$	8.3		A
			$T_{vj} = 175\text{ }^\circ\text{C}$	12.4		

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表6 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800\text{ V}$, $I_{SD} = 17.5\text{ A}$, $V_{GS} = 0\text{ V}$, $-di_{SD}/dt = 1000\text{ A}/\mu\text{s}$, Q_{fr} includes also Q_c	$T_{vj} = 25\text{ °C}$		15		μJ
			$T_{vj} = 175\text{ °C}$		40		
Virtual junction temperature	T_{vj}		-55		175	$^{\circ}\text{C}$	
Virtual junction temperature	$T_{vj(over)}$	overload, cumulative max. 100 h ¹⁾			200	$^{\circ}\text{C}$	

1) 最多 5000 次循环。最大 ΔT 限制为 100 K。

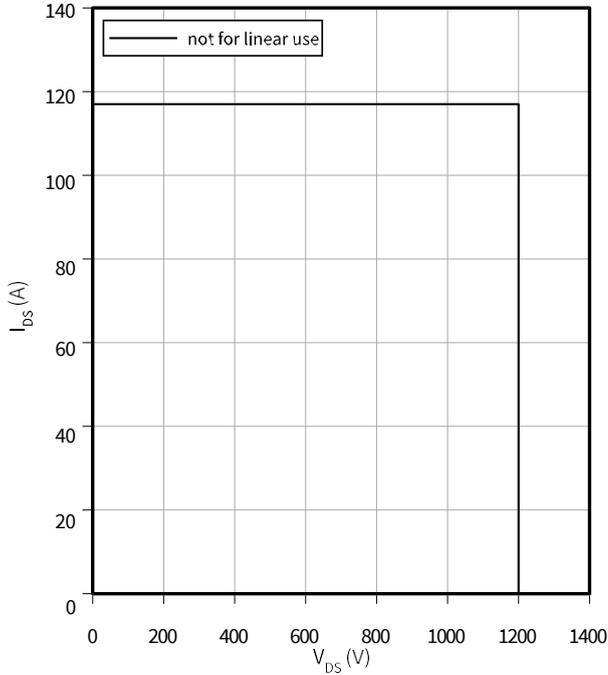
4 特性图

4 特性图

Reverse bias safe operating area (RBSOA)

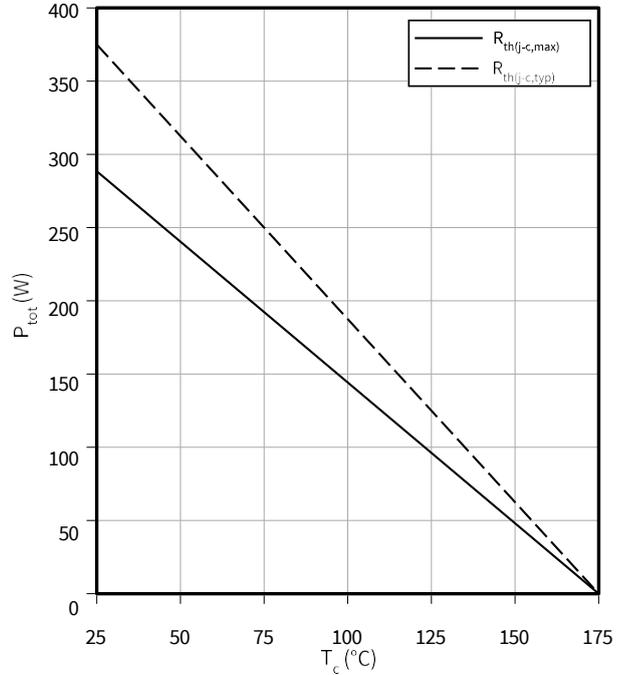
$I_{DS} = f(V_{DS})$

$T_{vj} \leq 200\text{ }^\circ\text{C}$, $V_{GS} = 0/18\text{ V}$, $T_c = 25\text{ }^\circ\text{C}$



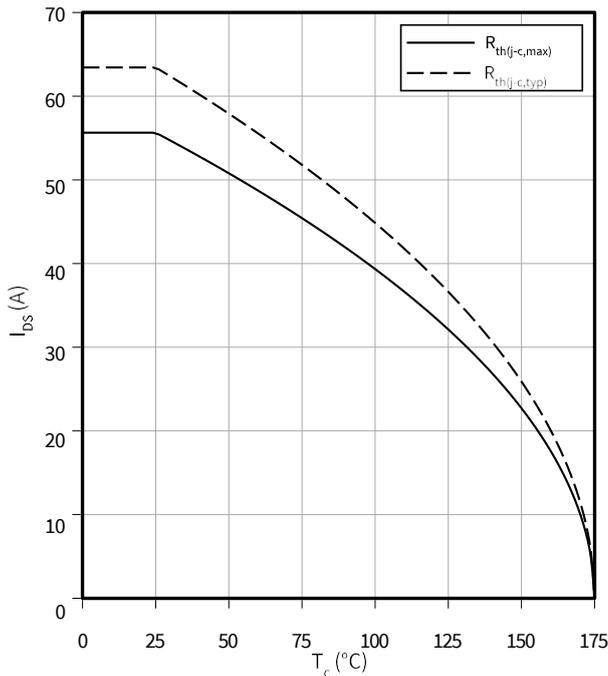
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



Maximum DC drain to source current as a function of case temperature limited by bond wire

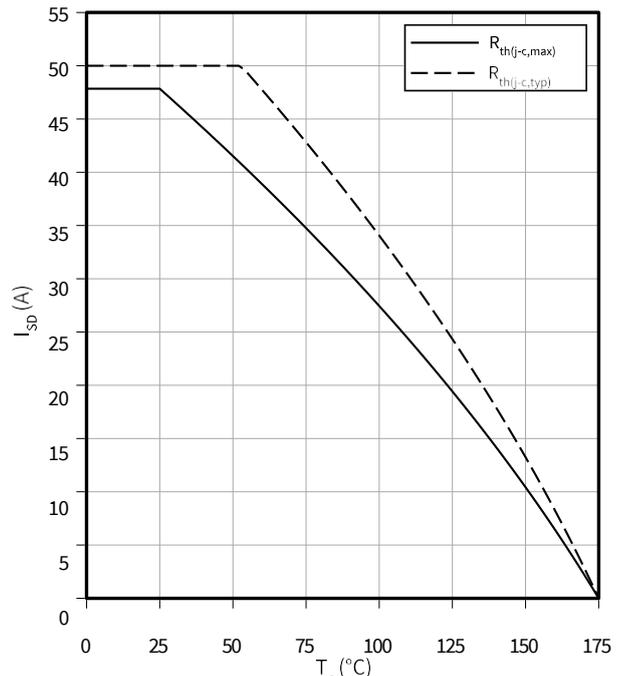
$I_{DS} = f(T_c)$



Maximum source to drain current as a function of case temperature limited by bond wire

$I_{SD} = f(T_c)$

$V_{GS} = 0\text{ V}$

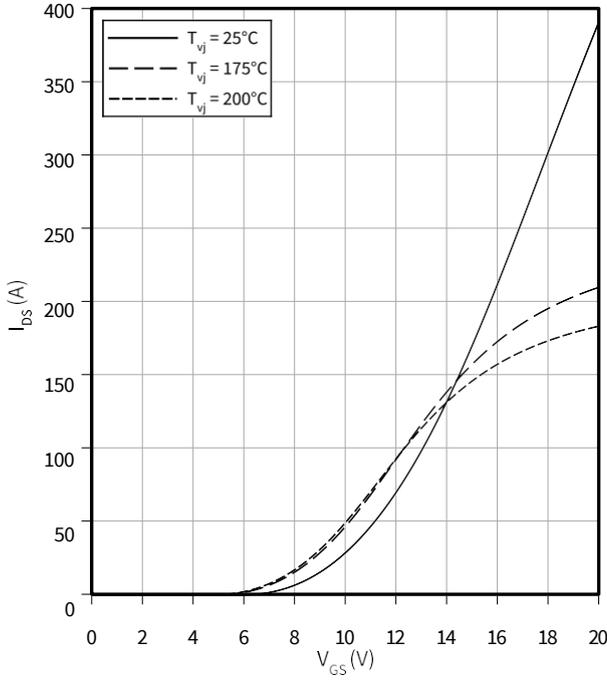


4 特性图

Typical transfer characteristic

$I_{DS} = f(V_{GS})$

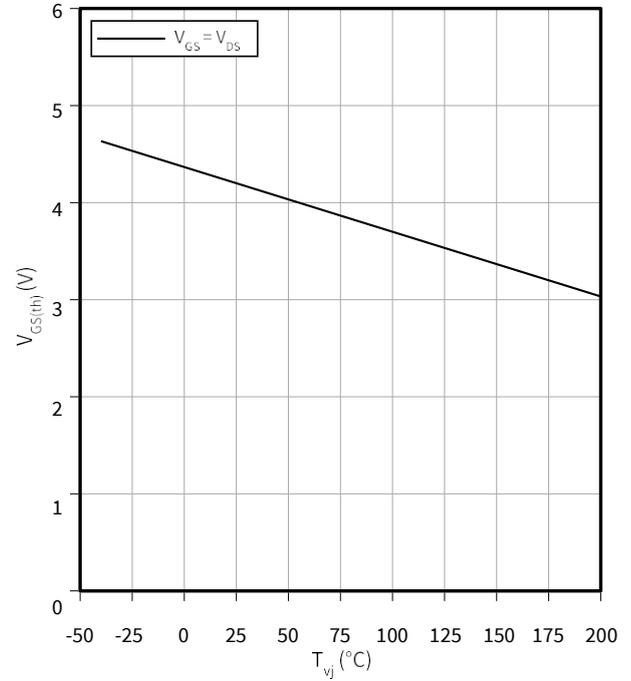
$V_{DS} = 20 \text{ V}$, $t_p = 20 \mu\text{s}$



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

$V_{GS(th)} = f(T_{vj})$

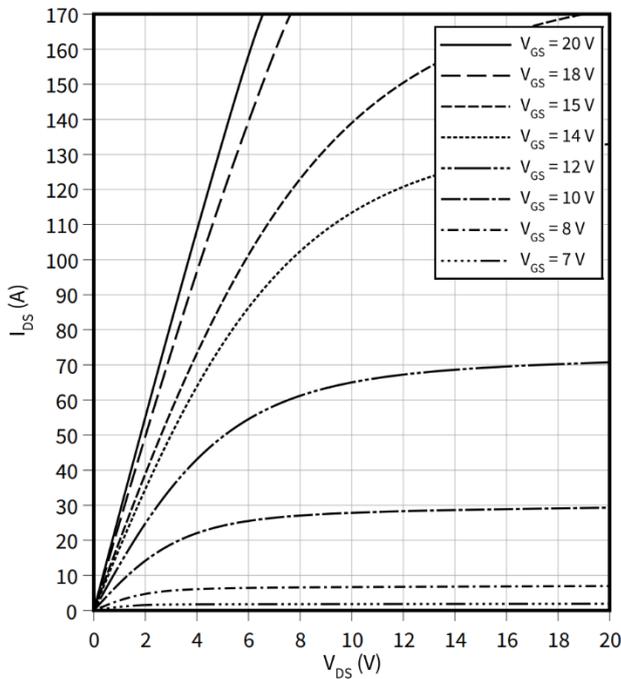
$I_D = 5.5 \text{ mA}$



Typical output characteristic, V_{GS} as a parameter

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

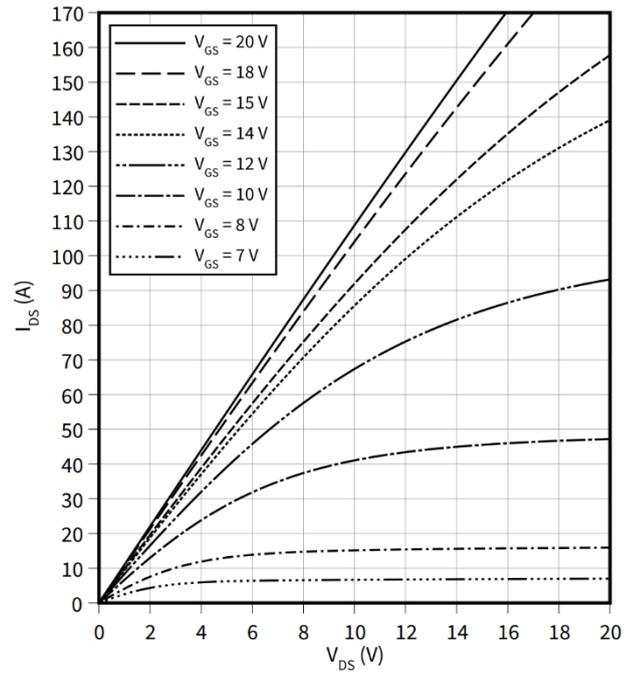
$T_{vj} = 25 \text{ °C}$, $t_p = 20 \mu\text{s}$



Typical output characteristic, V_{GS} as a parameter

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

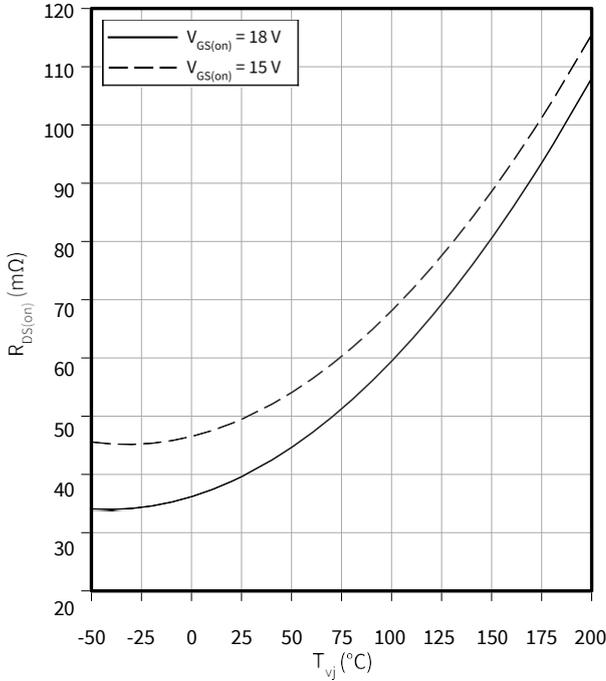
$T_{vj} = 175 \text{ °C}$, $t_p = 20 \mu\text{s}$



4 特性图

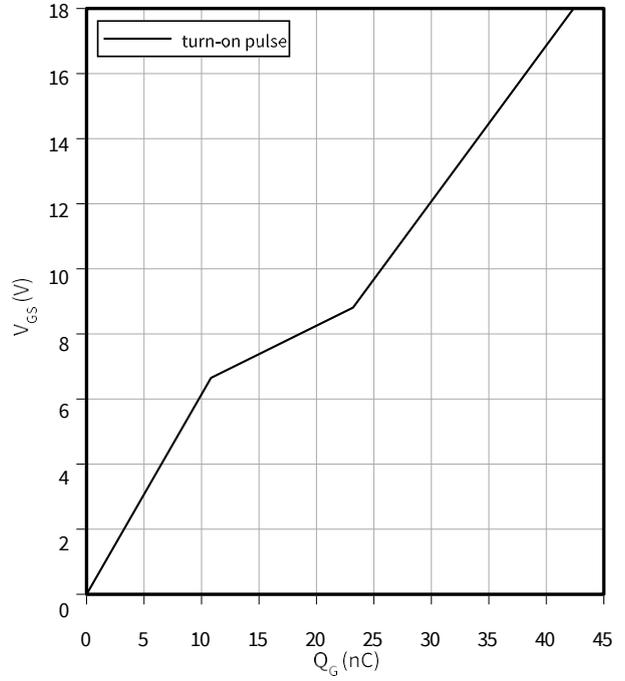
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 17.5 \text{ A}$



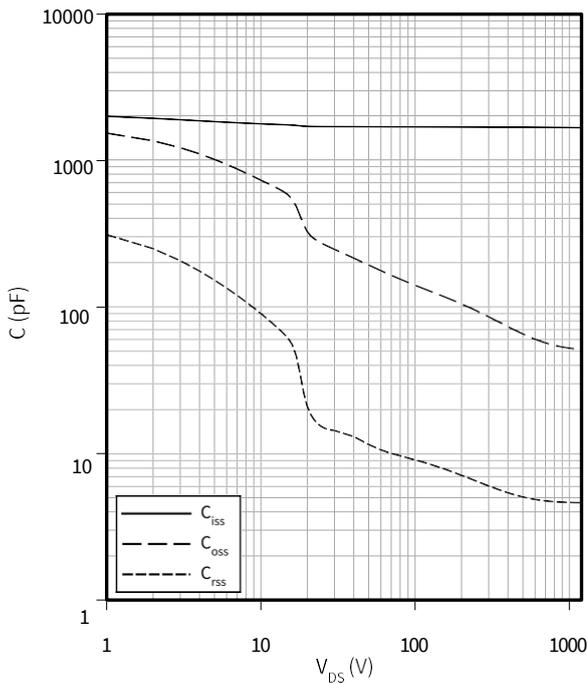
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 17.5 \text{ A}, V_{DS} = 800 \text{ V}$



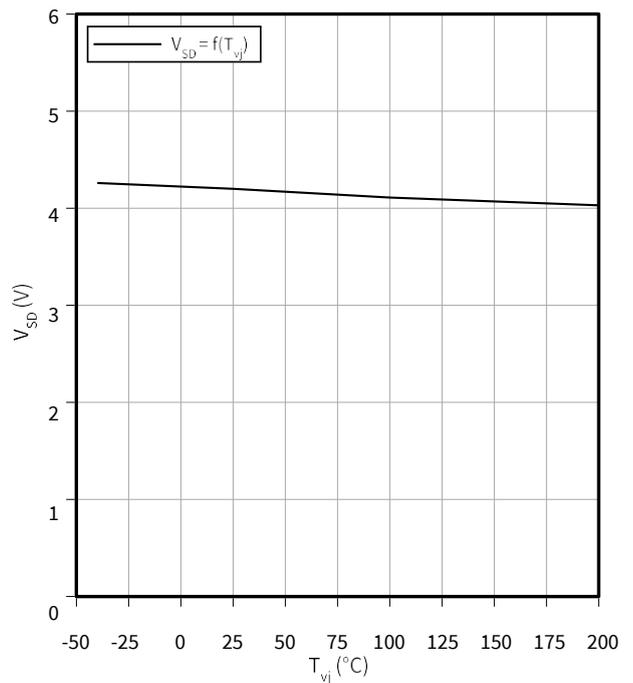
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as a function of junction temperature

$V_{SD} = f(T_{vj})$
 $I_{SD} = 17.5 \text{ A}, V_{GS} = 0 \text{ V}$

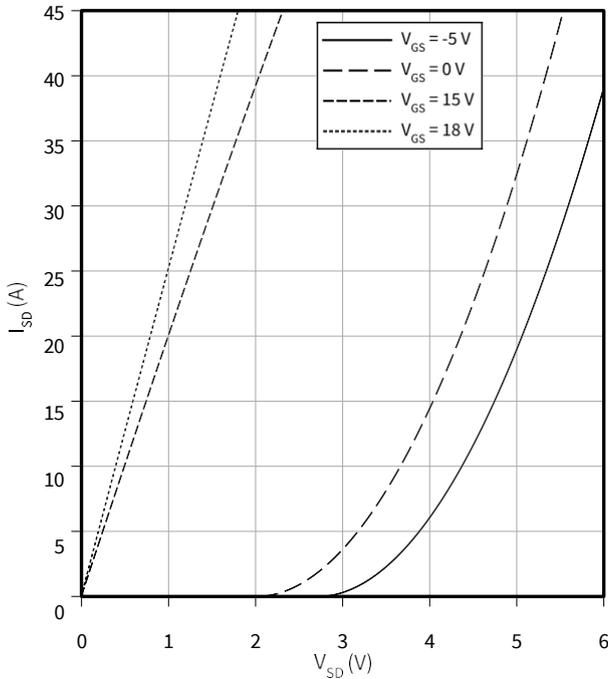


4 特性图

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

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

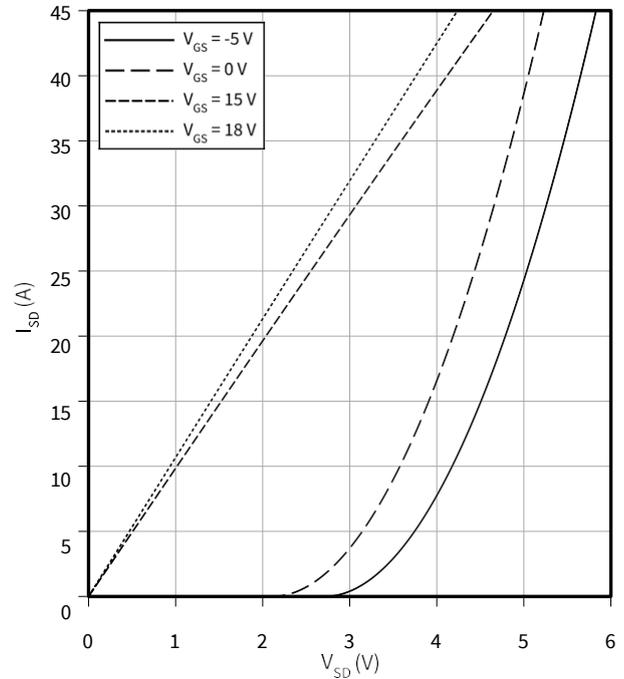
$T_{vj} = 25\text{ °C}$, $t_p = 20\ \mu\text{s}$



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

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

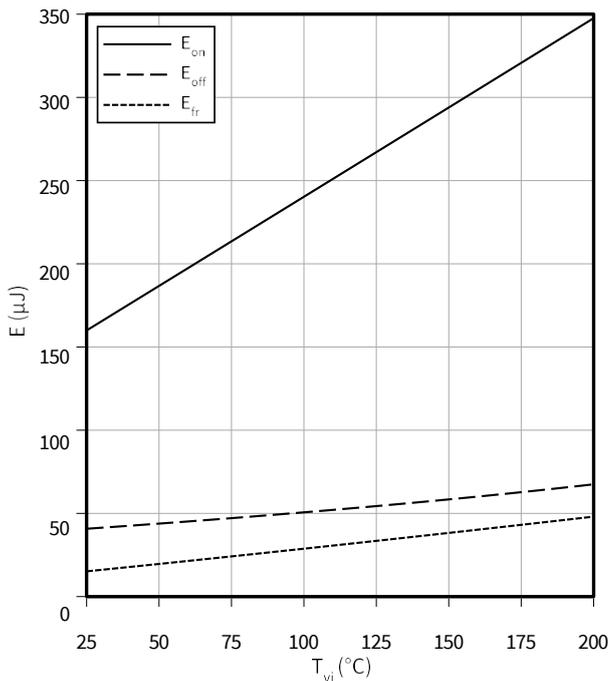
$T_{vj} = 175\text{ °C}$, $t_p = 20\ \mu\text{s}$



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

$E = f(T_{vj})$

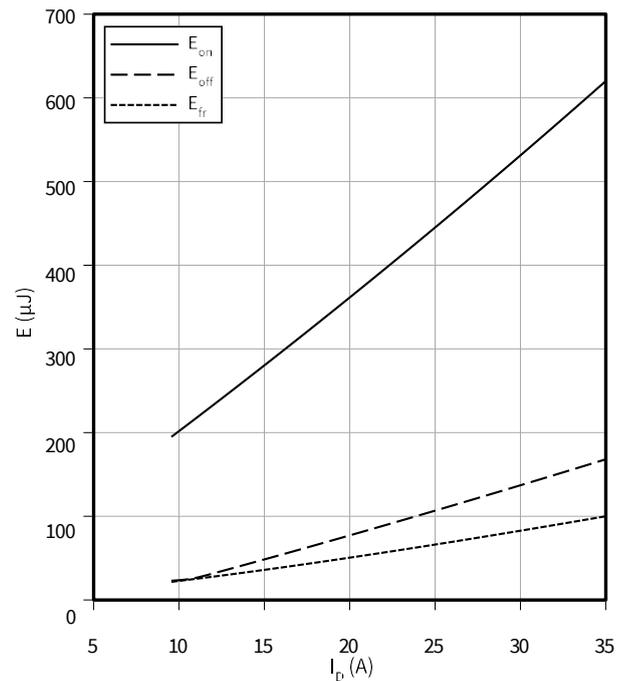
$V_{GS} = 0/18\text{ V}$, $I_D = 17.5\text{ A}$, $R_{G,ext} = 2.3\ \Omega$, $V_{DD} = 800\text{ V}$



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

$E = f(I_D)$

$V_{GS} = 0/18\text{ V}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2.3\ \Omega$, $V_{DD} = 800\text{ V}$

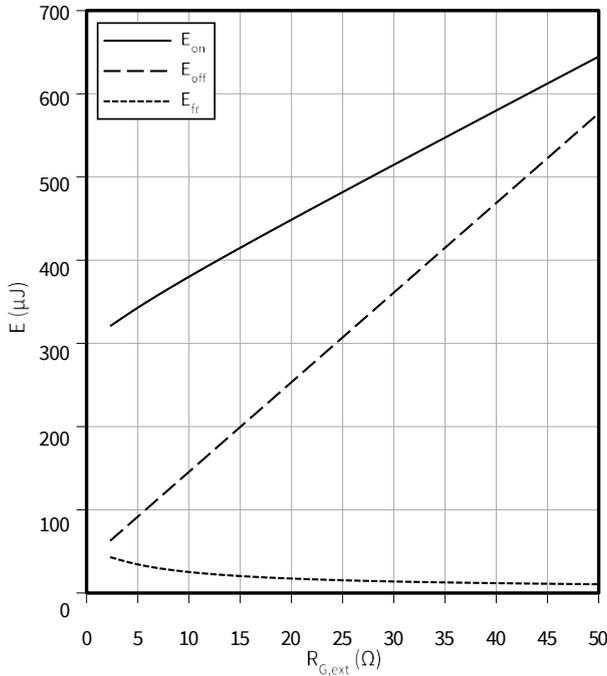


4 特性图

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

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

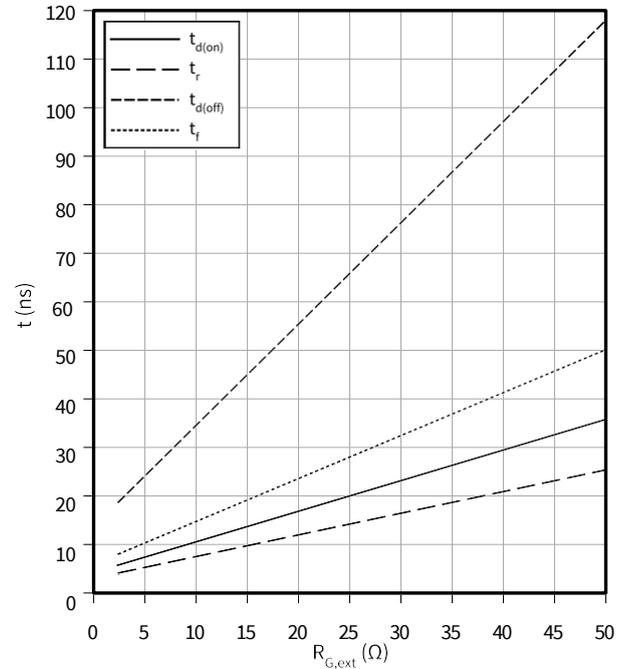
$V_{GS} = 0/18\text{ V}$, $I_D = 17.5\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



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

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

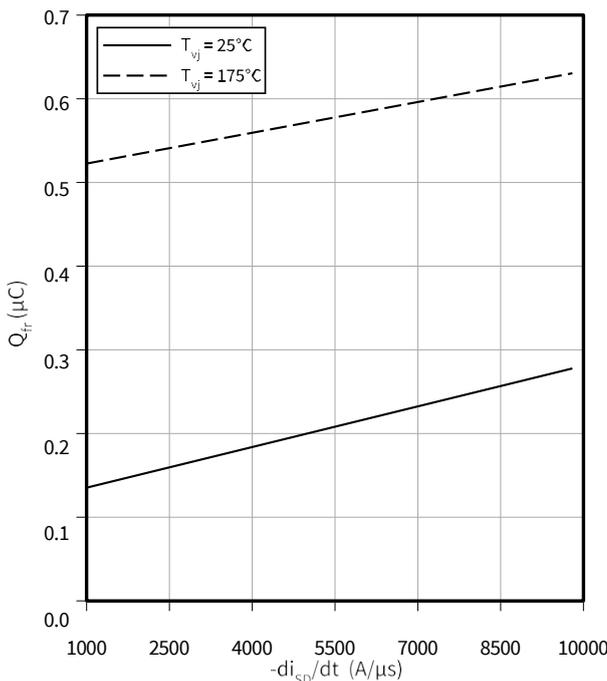
$V_{GS} = 0/18\text{ V}$, $I_D = 17.5\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



Typical reverse recovery charge as a function of reverse drain current slope, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$Q_{fr} = f(-di_{SD}/dt)$

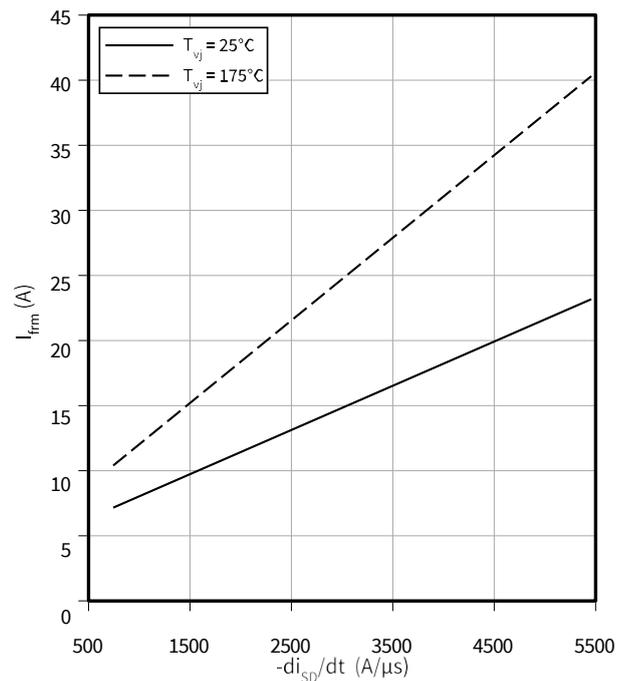
$V_{GS} = 0/18\text{ V}$, $I_{SD} = 17.5\text{ A}$, $V_{DD} = 800\text{ V}$



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

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

$V_{GS} = 0/18\text{ V}$, $I_{SD} = 17.5\text{ A}$, $V_{DD} = 800\text{ V}$



4 特性图

Typical switching energy as a function of dead time / blanking time, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = -5\text{ V}$

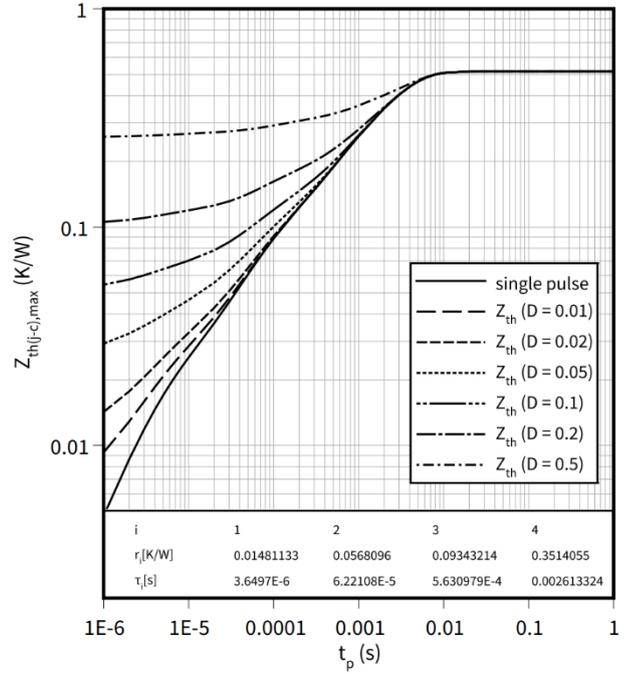
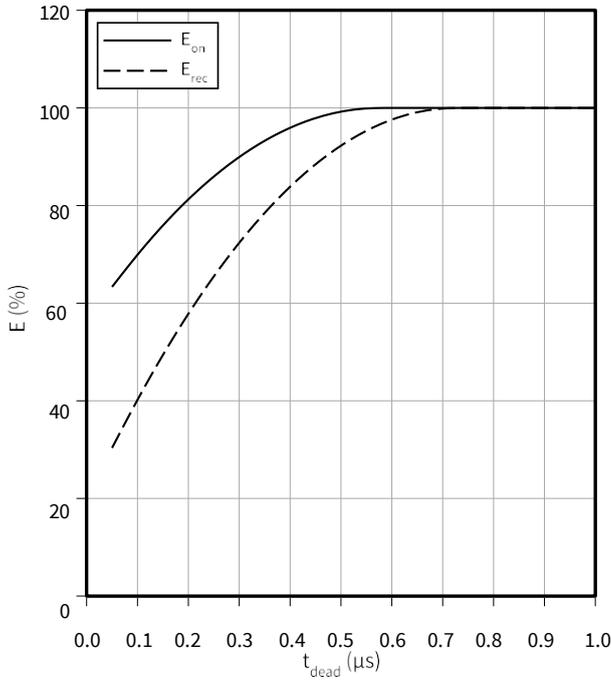
$$E = f(t_{\text{dead}})$$

$V_{GS} = 0/18\text{ V}$, $I_D = 17.5\text{ A}$, $T_{vj} = 175\text{ °C}$, $R_{G,\text{ext}} = 2.3\text{ }\Omega$ $V_{DD} = 800\text{ V}$

Max. transient thermal impedance (MOSFET/diode)

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

$$D = t_p/T$$



5 封装外形

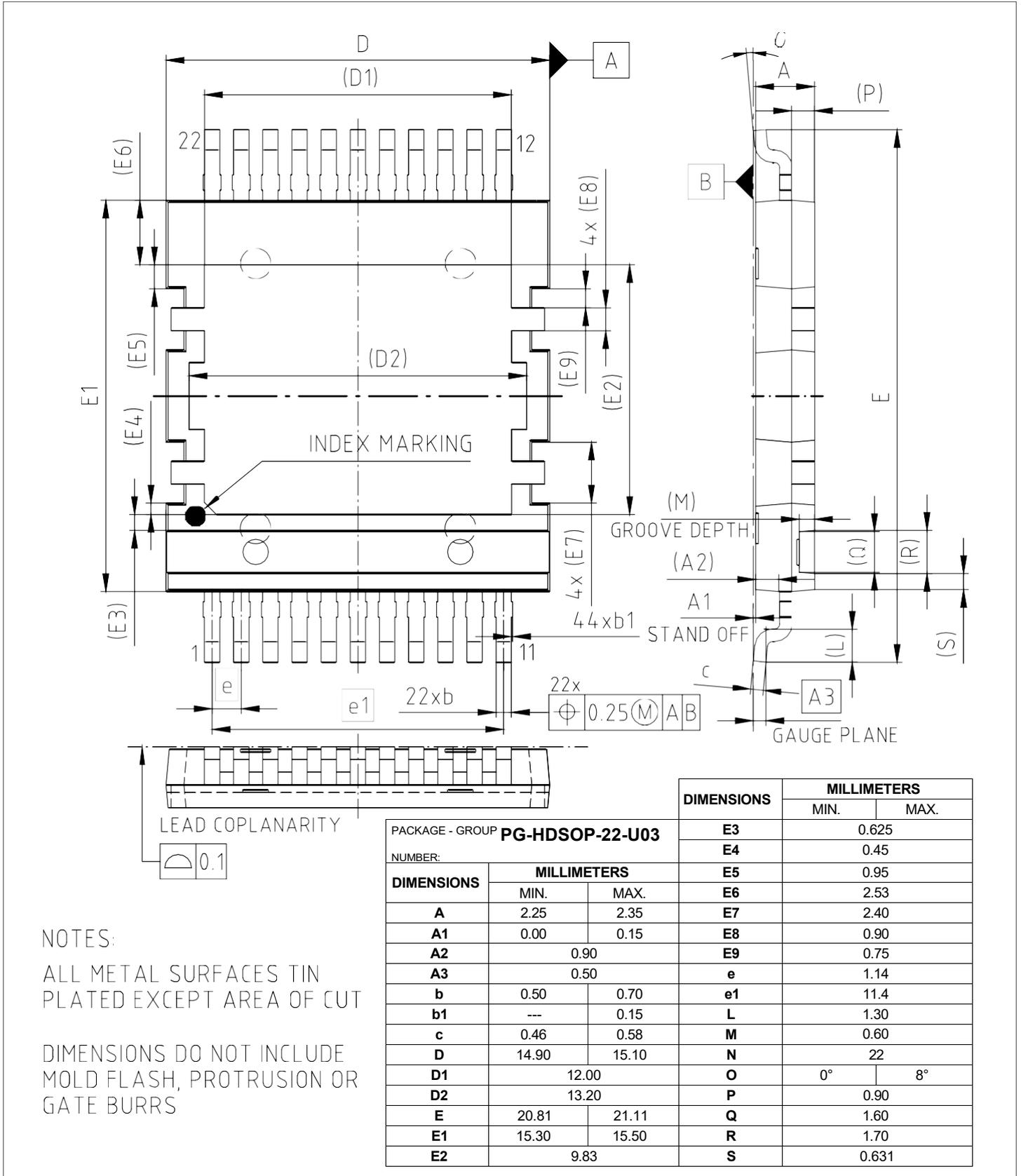


图 1

6 测试条件

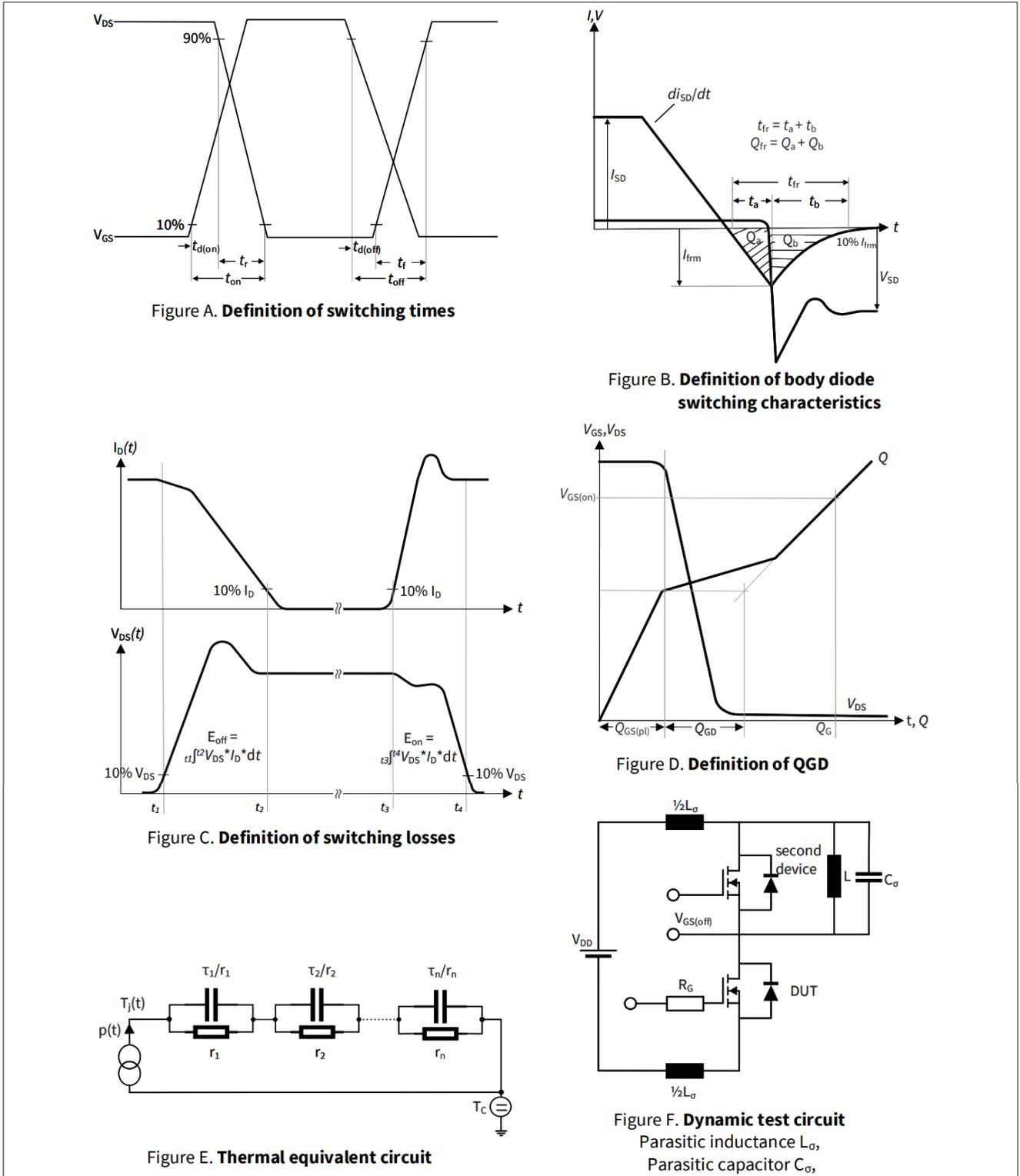


图 2

修订记录

修订记录

Document revision	Date of release	Description of changes
0.10	2023-11-13	Target datasheet
0.20	2024-11-20	Updated values Added diagrams
1.00	2024-12-12	Final datasheet



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版本 2025-12-24

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