

最终数据手册

英飞凌工业用CoolSiC™ 1200 V SiC 沟槽MOSFET：采用 .XT 互连技术的碳化硅 MOSFET

特性

- $T_{vj} = 25^{\circ}\text{C}$ 时 $V_{DSS} = 1200\text{ V}$
- $I_{DDC} = 98\text{ A}$ at $T_c = 25^{\circ}\text{C}$
- $R_{DS(on)} = 19\text{ m}\Omega$ at $V_{GS} = 18\text{ V}$, $T_{vj} = 25^{\circ}\text{C}$
- 开关损耗非常低
- 短路耐受时间 $3\text{ }\mu\text{s}$
- 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
- 英飞凌.XT 互连技术, 实现、行业领先的热性能

潜在应用

- 通用驱动器 (GPD)
- 电动汽车充电桩
- 在线式UPS/工业UPS
- 组串式逆变器
- 太阳能优化器

产品验证

- 符合JEDEC47/20/22相关测试的工业应用要求

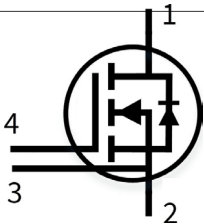
描述

- 1 - 漏极
- 2 - 来源
- 3 - 开尔文检测
- 4 - 栅极

注：源极和开尔文传感触点引脚不可互换，互换可能会导致故障（仅适用于 4 pin及TO263-7L封装）



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



Type	Package	Marking
IMZA120R020M1H	PG-TO247-4-U02	12M1H020

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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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}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw, Maximum of mounting processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			0.31	0.4	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}	$V_{GS} = 18\text{ V}$	$T_c = 25\text{ °C}$	98	A
			$T_c = 100\text{ °C}$	71	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 18\text{ V}$		213	A
Gate-source voltage, max. transient voltage ¹⁾	V_{GS}	$t_p \leq 0.5\text{ }\mu\text{s}$, $D < 0.01$		-10/23	V
Gate-source voltage, max. static voltage	V_{GS}			-7/20	V
Avalanche energy, single pulse	E_{AS}	$I_D = 40.1\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 0.9\text{ mH}$		721	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 40.1\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 4.5\text{ }\mu\text{H}$		3.58	mJ
Short-circuit withstand time	t_{SC}	$V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $V_{GS(on)} = 15\text{ V}$, $T_{vj(start)} = 25\text{ °C}$		3	μs
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25\text{ °C}$	375	W
			$T_c = 100\text{ °C}$	188	

1) 重要提示：正、负栅极源电压的选择会影响器件的长期行为。必须考虑应用说明 AN2018-09 中描述的设计指南，以确保设备在计划的使用寿命内正常运行。

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	$R_{DS(on)}$	$I_D = 41\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $V_{GS(on)} = 18\text{ V}$		19	26.9	mΩ
			$T_{vj} = 100\text{ }^{\circ}\text{C}$, $V_{GS(on)} = 18\text{ V}$		25		
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $V_{GS(on)} = 18\text{ V}$		36		
			$T_{vj} = 25\text{ }^{\circ}\text{C}$, $V_{GS(on)} = 15\text{ V}$		23.7	30	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 17.6\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$)	$T_{vj} = 25\text{ }^{\circ}\text{C}$	3.5	4.2	5.2	V
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		3.6		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$			320	μA
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		5.4		
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$	$V_{GS} = 23\text{ V}$			100	nA
			$V_{GS} = -10\text{ V}$			-100	
Forward transconductance	g_{fs}	$I_D = 41\text{ A}$, $V_{DS} = 20\text{ V}$			20.9		S
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$			1.8		Ω
Input capacitance	C_{iss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			3460		pF
Output capacitance	C_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			159		pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			23		pF
C_{oss} stored energy	E_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			65		μJ
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = -2/18\text{ V}$, turn-on pulse			109		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = -2/18\text{ V}$, turn-on pulse			27.1		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = -2/18\text{ V}$, turn-on pulse			21.8		nC

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表 4 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	36		ns
			$T_{vj} = 175\text{ °C}$	34		
Rise time	t_r	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	13.7		ns
			$T_{vj} = 175\text{ °C}$	15.5		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	43.8		ns
			$T_{vj} = 175\text{ °C}$	46		
Fall time	t_f	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	14.8		ns
			$T_{vj} = 175\text{ °C}$	14.7		
Turn-on energy	E_{on}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	400		μJ
			$T_{vj} = 175\text{ °C}$	650		
Turn-off energy	E_{off}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	108		μJ
			$T_{vj} = 175\text{ °C}$	115		
Total switching energy	E_{tot}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 1\ \Omega$, $R_{GS(off)} = 1\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	570		μJ
			$T_{vj} = 175\text{ °C}$	1020		

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表 4 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Virtual junction temperature	T_{vj}		-55		175	°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手册中所述最大额定值的 80%。

该芯片技术的特征高达 200 kV/μs。测量的 dv/dt 受到测量测试设置和封装的限制。

动态测试电路见图 F。

3 体二极管 (MOSFET)

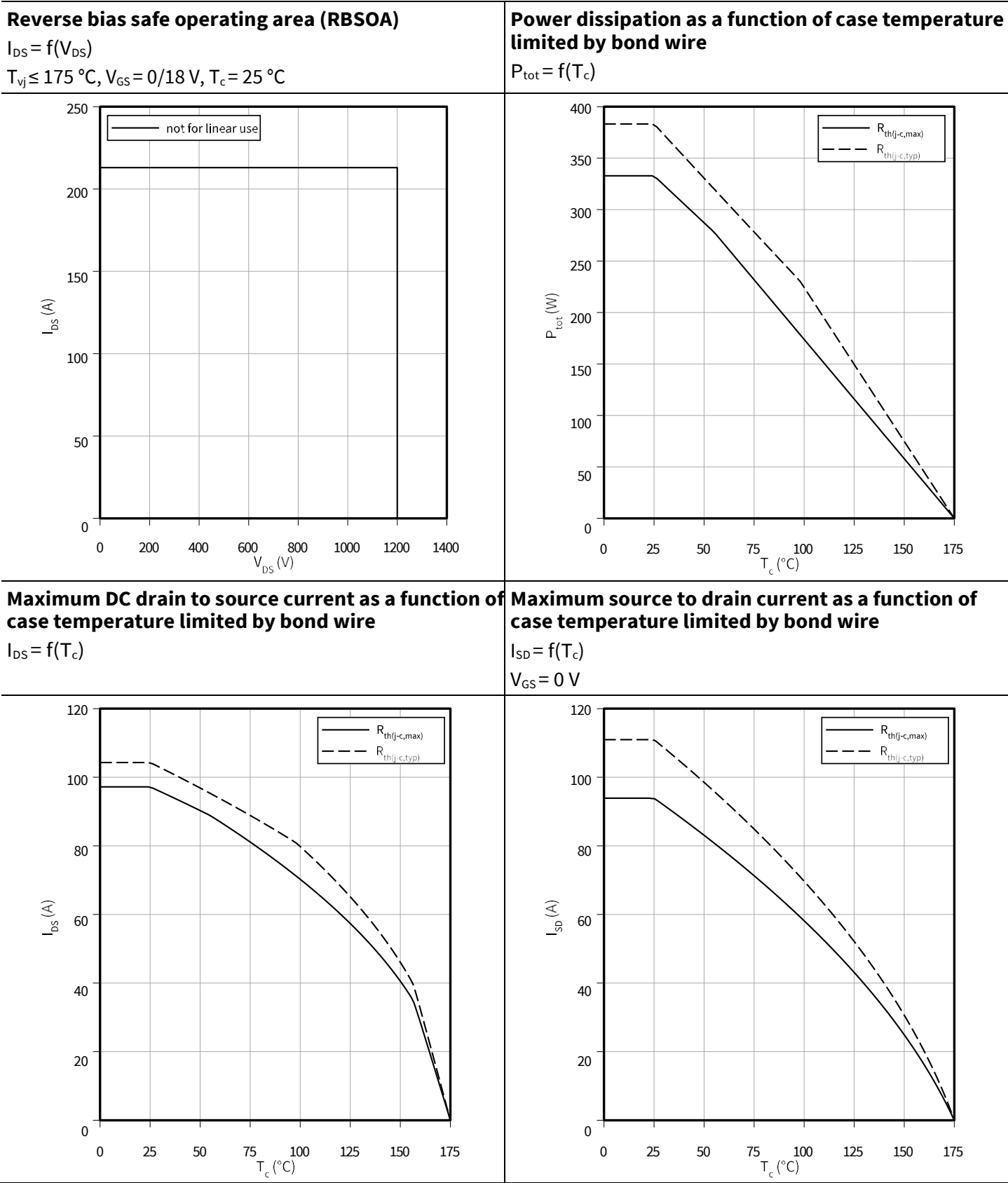
表 5 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25\text{ °C}$		1200	V
Continuous reverse drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{SDC}	$V_{GS} = 0\text{ V}$	$T_c = 25\text{ °C}$	94	A
			$T_c = 100\text{ °C}$	58	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0\text{ V}$		213	A

表 6 特征值

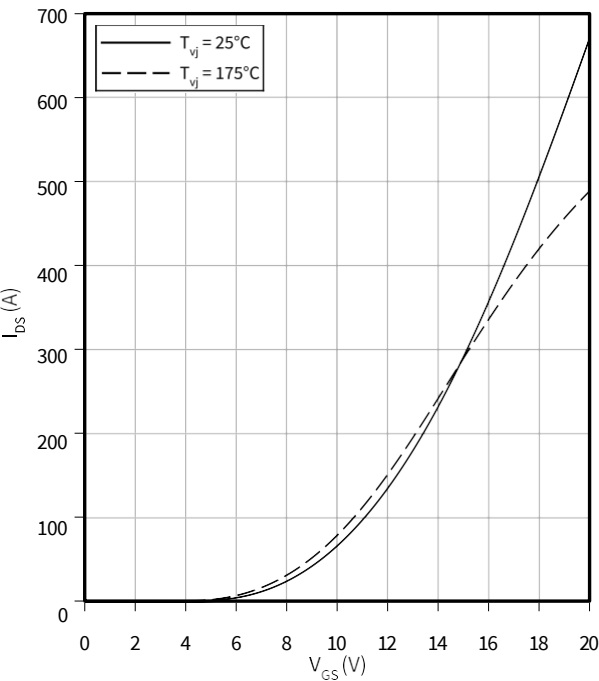
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		3.8	5	V
			$T_{vj} = 100\text{ °C}$		3.7		
			$T_{vj} = 175\text{ °C}$		3.6		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V}, I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}, -di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$		340		nC
			$T_{vj} = 175\text{ °C}$		622		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V}, I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}, -di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$		14		A
			$T_{vj} = 175\text{ °C}$		23		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800\text{ V}, I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}, -di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$		63		μJ
			$T_{vj} = 175\text{ °C}$		254		
Virtual junction temperature	T_{vj}			-55		175	°C

4 特性图



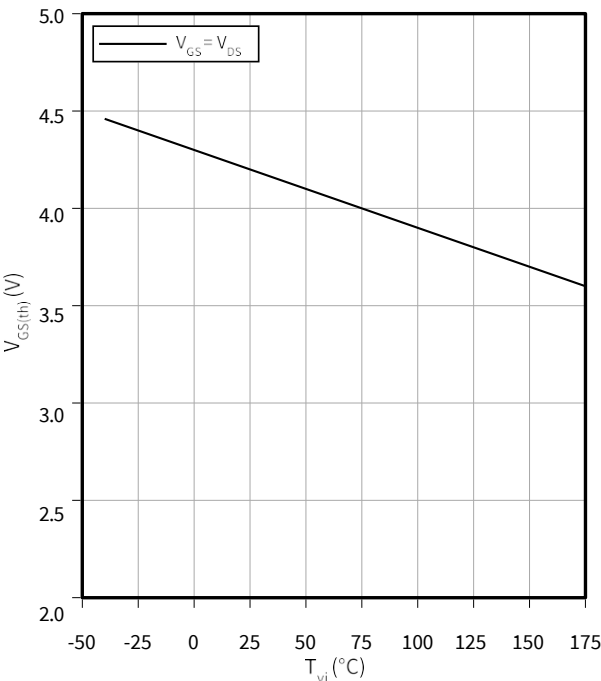
Typical transfer characteristic

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



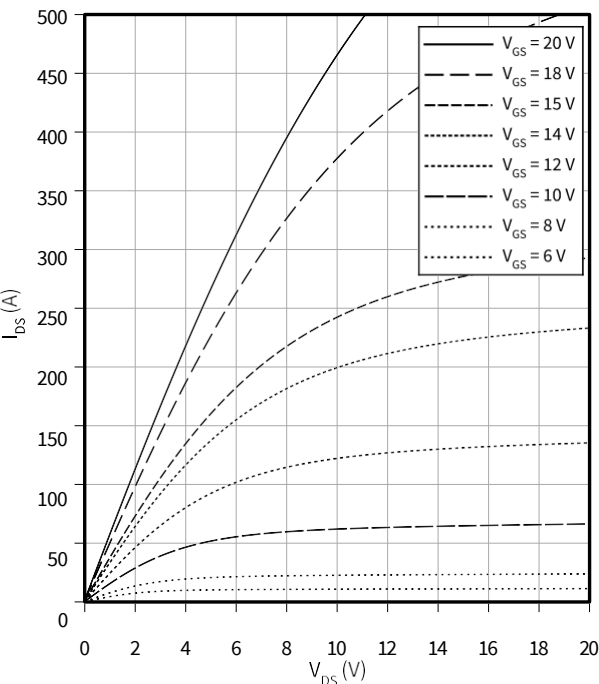
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 17.6\text{ mA}$



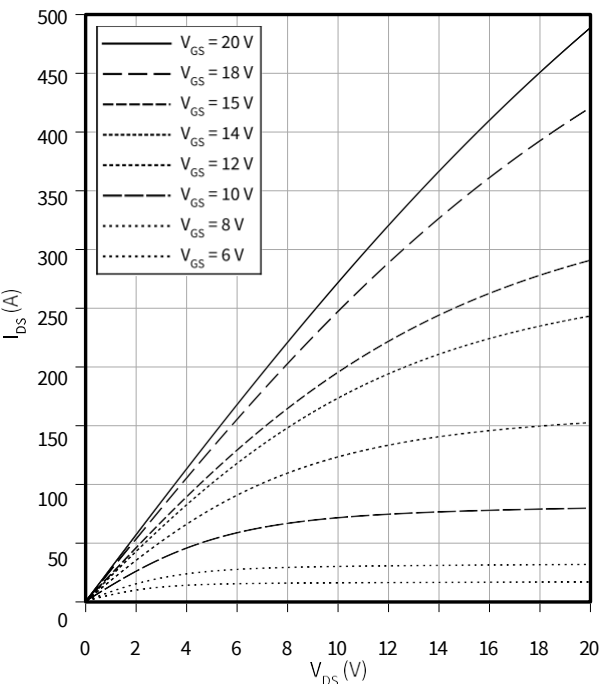
Typical output characteristic, V_{GS} as parameter

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



Typical output characteristic, V_{GS} as parameter

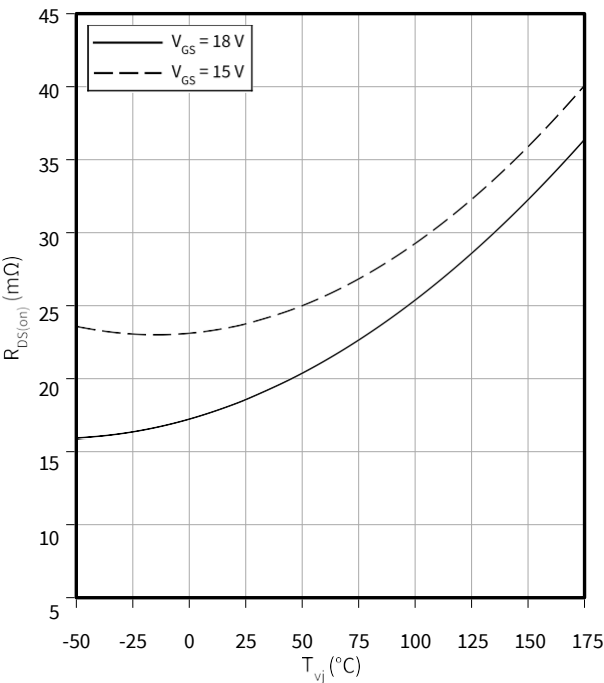
$I_{DS} = f(V_{DS})$
 $T_{vj} = 175\text{ }^\circ\text{C}$, $t_p = 20\text{ }\mu\text{s}$





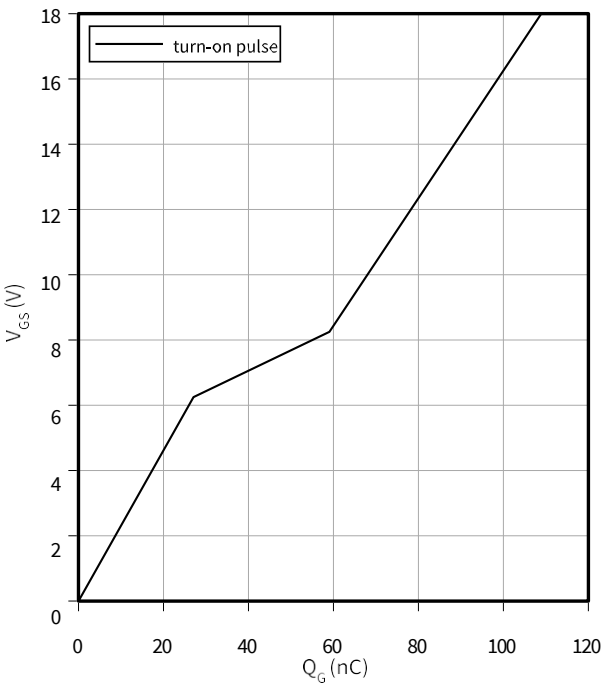
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 41\text{ A}$



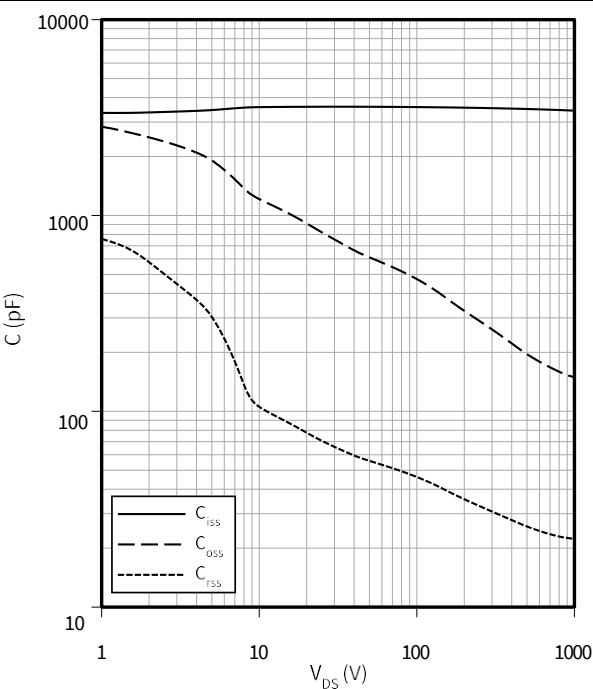
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 41\text{ A}, V_{DS} = 800\text{ V}$



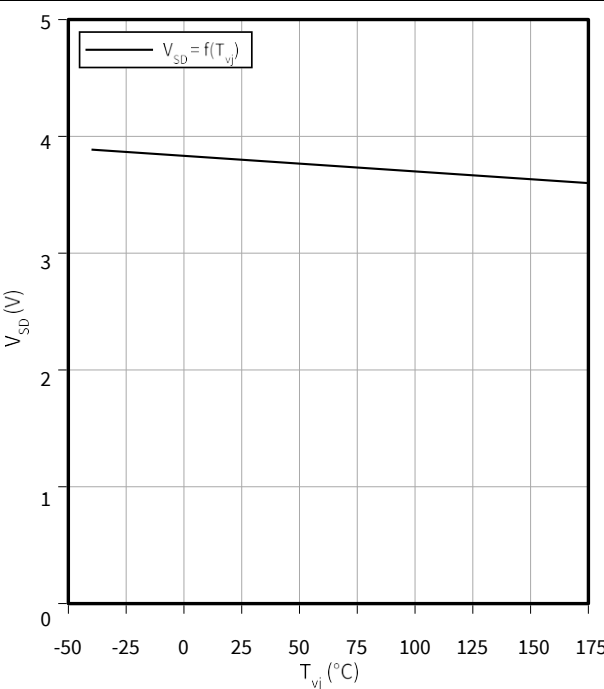
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as function of junction temperature

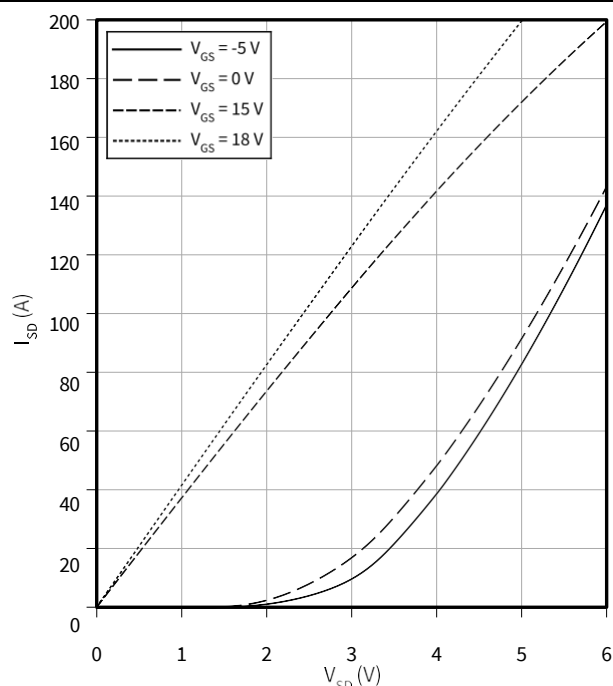
$V_{SD} = f(T_{vj})$
 $I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}$



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

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

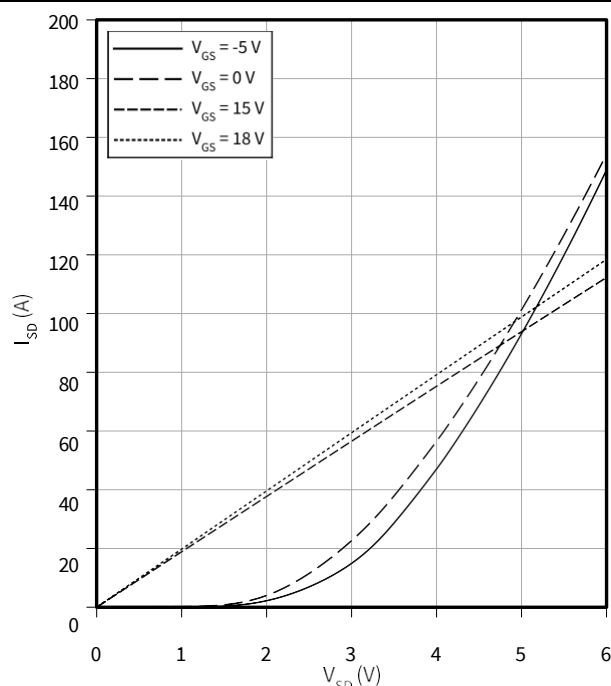
$T_{vj} = 25\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

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

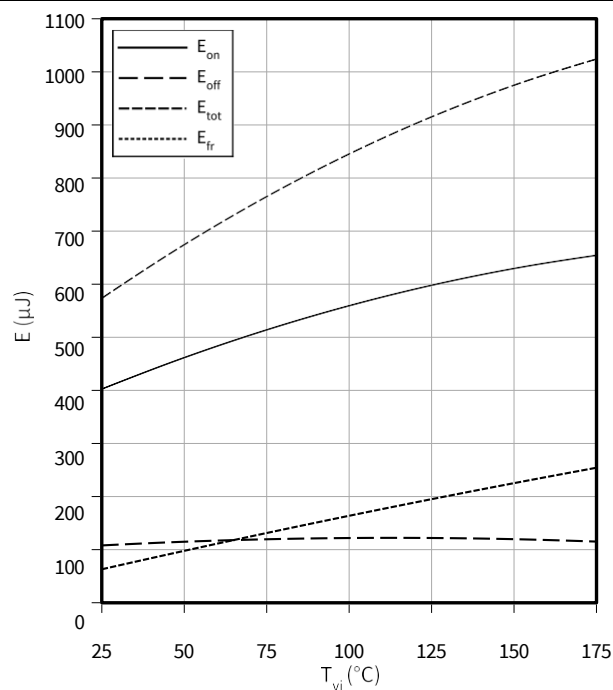
$T_{vj} = 175\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

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

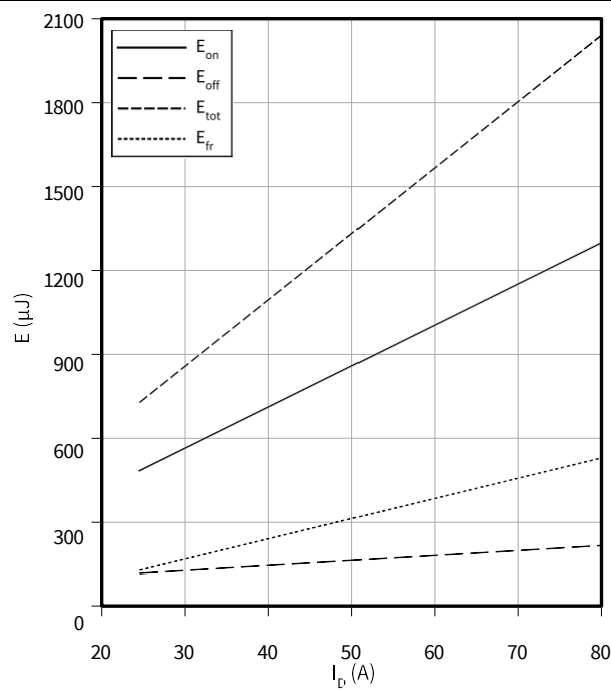
$V_{GS} = 0/18\text{ V}$, $I_D = 41\text{ A}$, $R_{G,ext} = 1\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

$$E = f(I_D)$$

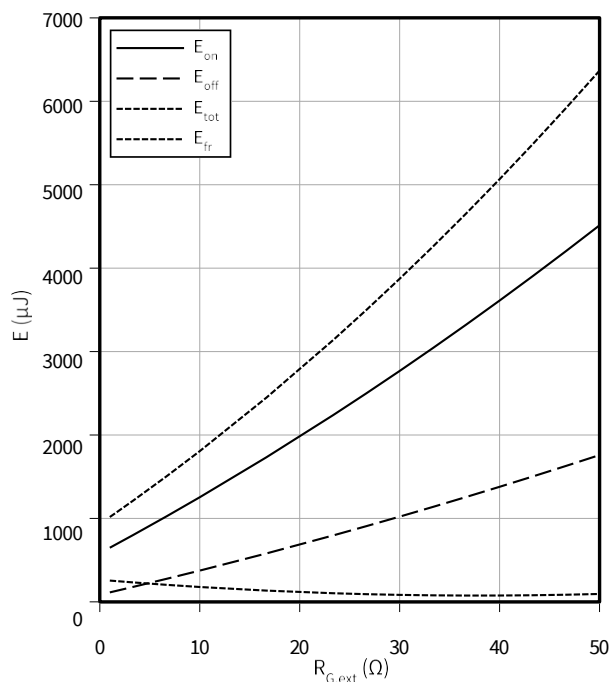
$V_{GS} = 0/18\text{ V}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 1\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

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

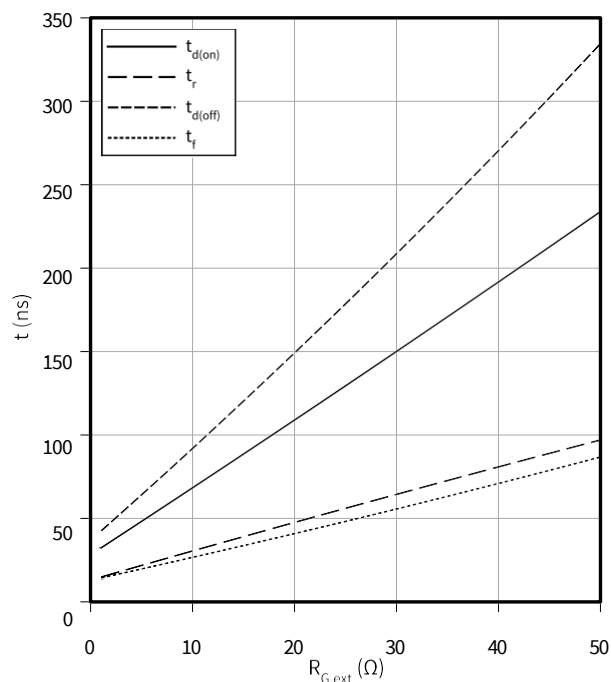
$V_{GS} = 0/18$ V, $I_D = 41$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

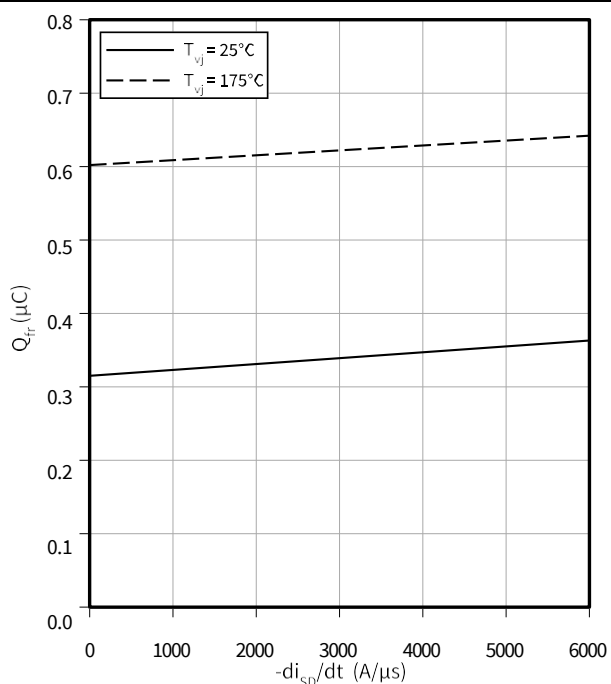
$V_{GS} = 0/18$ V, $I_D = 41$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

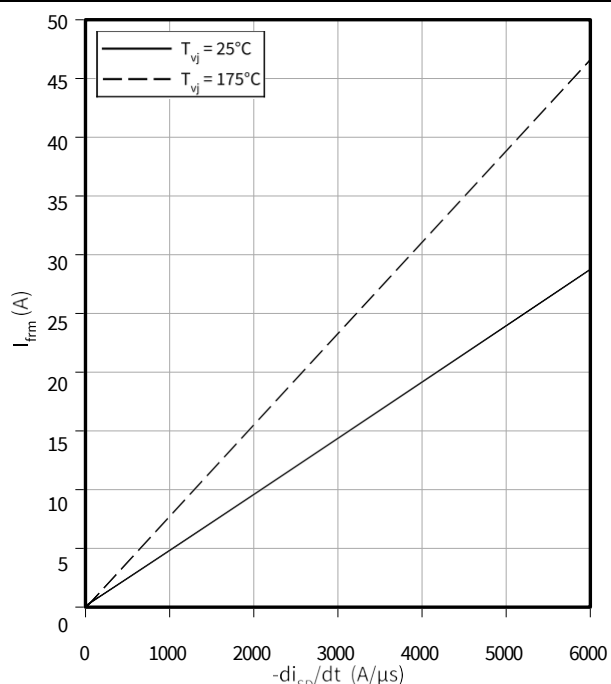
$V_{GS} = 0/18$ V, $I_{SD} = 41$ A, $V_{DD} = 800$ V



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

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

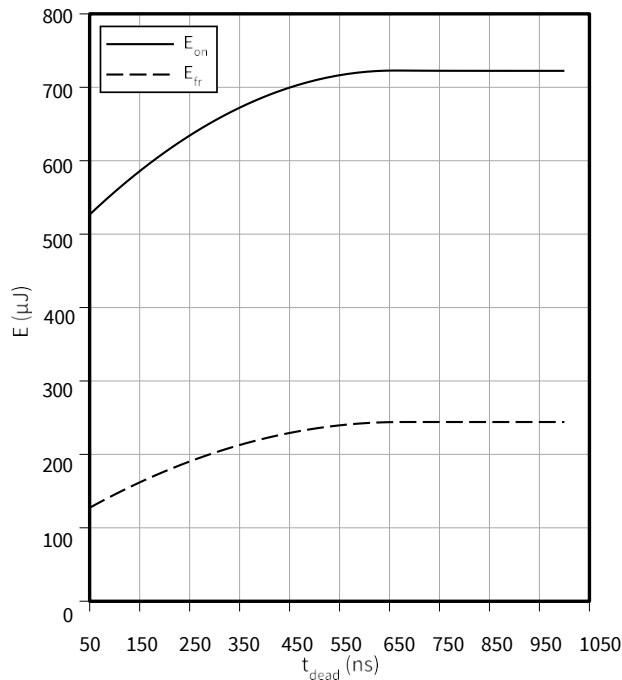
$V_{GS} = 0/18$ V, $I_{SD} = 41$ A, $V_{DD} = 800$ V



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

$E = f(t_{dead})$

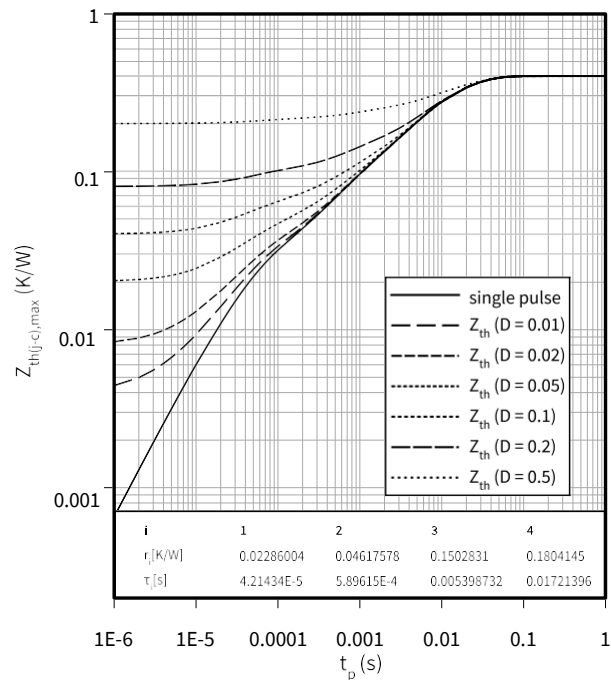
$I_D = 41\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{GS} = -5/18\text{ V}$, $V_{DD} = 800\text{ V}$



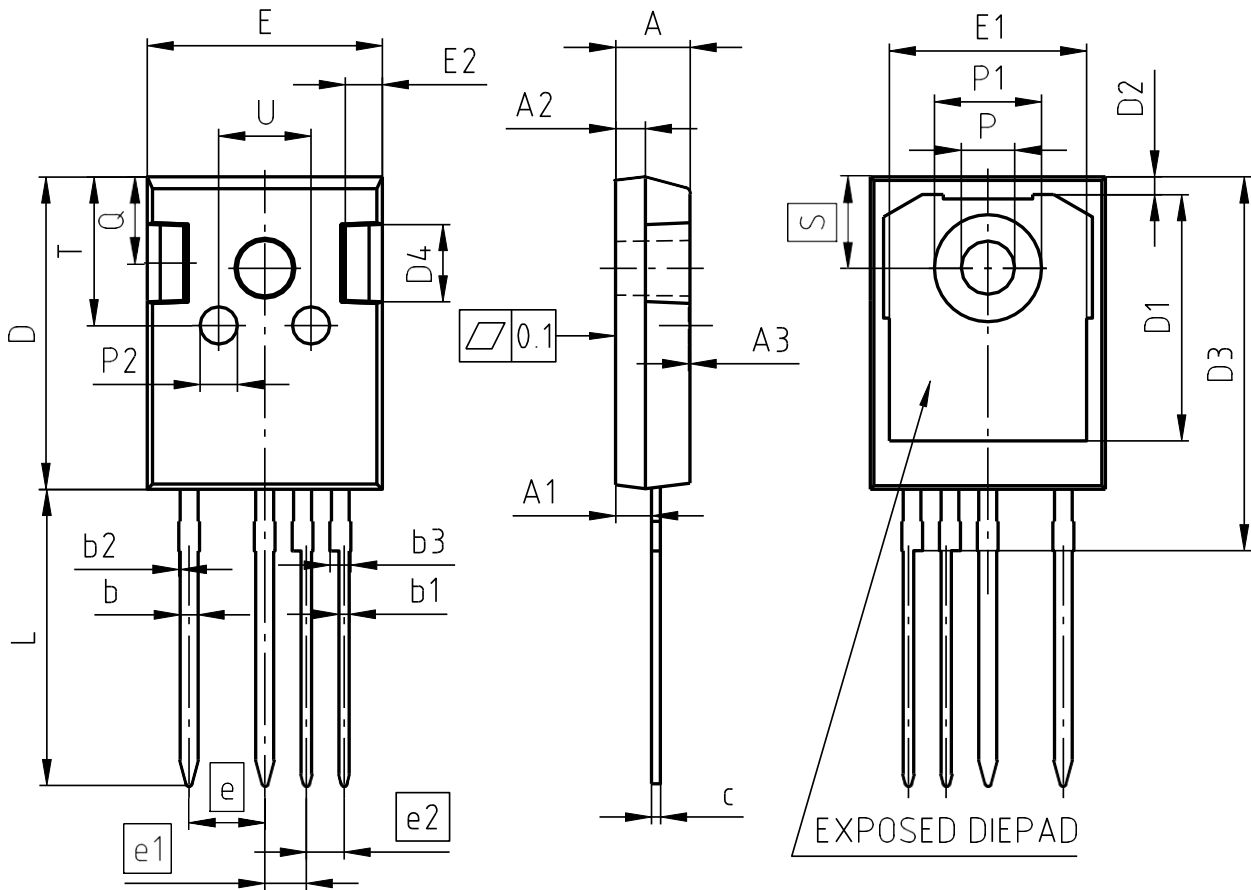
Max. transient thermal impedance (MOSFET/diode)

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

$D = t_p/T$



5 封装外形



NOTES:
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH
OR PROTRUSIONS.

PACKAGE - GROUP PG-TO247-4-U02					
NUMBER:					
DIMENSIONS	MILLIMETERS		DIMENSIONS	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	4.90	5.10	E	15.70	15.90
A1	2.31	2.51	E1	13.10	13.50
A2	1.90	2.10	E2	2.40	2.60
A3	0.05	0.25	e	5.08	
b	1.10	1.30	e1	2.79	
b1	0.65	0.79	e2	2.54	
b2	---	0.20	N	4	
b3	1.34	1.44	L	19.80	20.10
c	0.58	0.66	øP	3.50	3.70
D	20.90	21.10	øP1	7.00	7.40
D1	16.25	16.85	øP2	2.40	2.60
D2	1.05	1.35	Q	5.60	6.00
D3	24.97	25.27	S	6.15	
D4	4.90	5.10	T	9.80	10.20
			U	6.00	6.40

图 1

6 测试条件

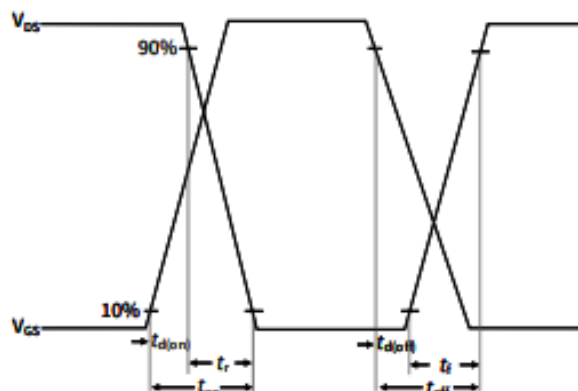


Figure A. Definition of switching times

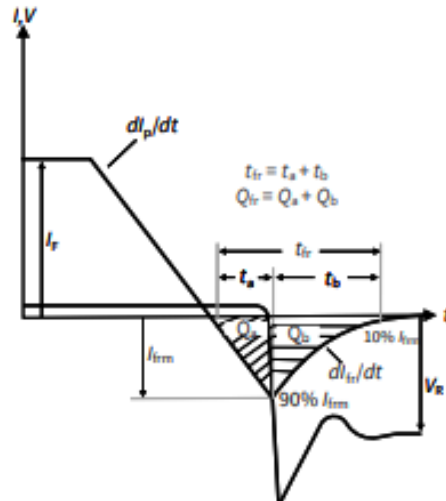


Figure B. Definition of diode switching characteristics

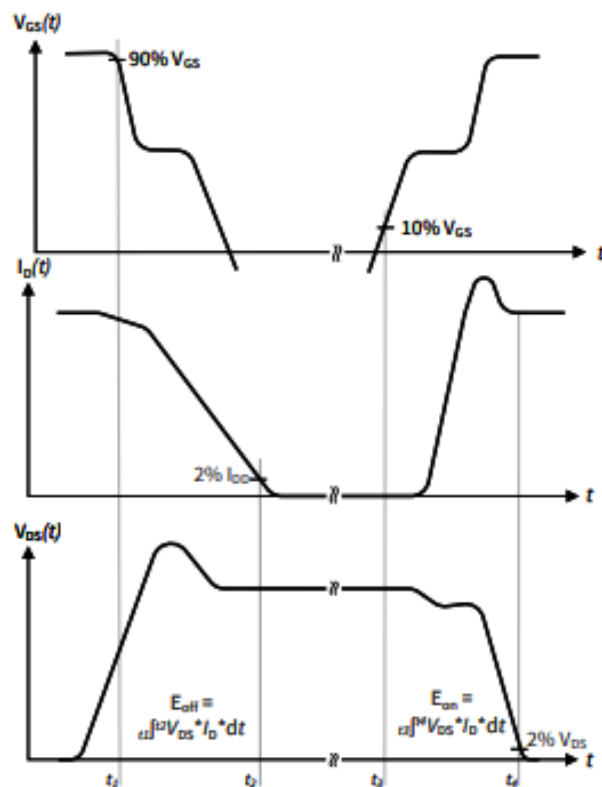


Figure C. Definition of switching losses

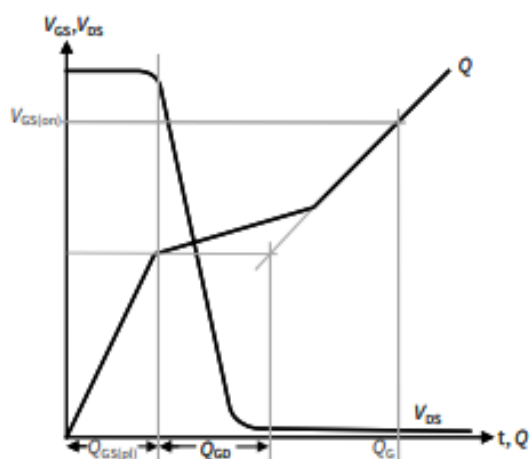


Figure D. Definition of QGD

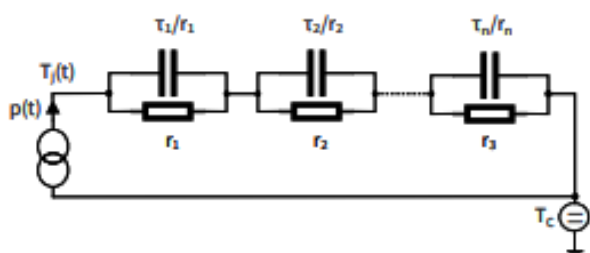


Figure E. Thermal equivalent circuit

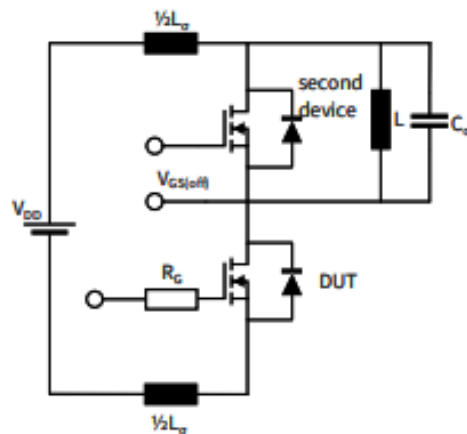


Figure F. Dynamic test circuit
Parasitic inductance L_σ ,
Parasitic capacitor C_σ

修订记录

修订记录

Document revision	Date of release	Description of changes
1.00	2022-02-03	Final datasheet
1.10	2022-08-10	Change of test condition of dynamic capacitances in Table 4, "Characteristic values" (C_{iss}, C_{oss}, C_{rss}): $V_{DD} = 25\text{ V}$ to $V_{DD} = 800\text{ V}$ Correction of unit of "Input capacitance" C_{iss} from nF to pF Change of V_{GS} "Gate-source voltage, max. static voltage" in Table 2, "Maximum rated values" from -5/20 V to -7/20 V Editorial changes in "Features" on page 1 Editorial changes in "Package" on page 1 Correction of unit of x-axis at diagram "Max. transient thermal impedance (MOSFET/diode)" from μs to s, on page 13 Correction of diagram "Max. transient thermal impedance (MOSFET/diode)", on page 13
1.20	2023-05-08	Correction of gate charge values in Table 4 Editorial changes
1.30	2024-11-15	Updated package name Corrected forward transconductance g_{fs} in Table 4 Corrected switching energies in Table 4 Corrected diagram "Typical output characteristic, V_{GS} as parameter" Corrected diagram "Typical transfer characteristic" Editorial changes



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