

最终数据手册

英飞凌工业用CoolSiC™ 1200 V SiC 沟槽 MOSFET：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

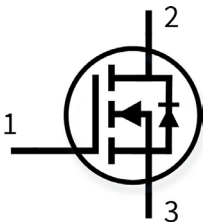
- 符合JEDEC47/20/22相关测试的工业应用要求
- 另请注意有关功率和热循环的应用说明 AN2019-05

描述

- 1 - 栅极
- 2 - 漏极
- 3 - 来源



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



Type	Package	Marking
IMW120R020M1H	PG-TO247-3-U06	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}	$t_p \leq 0.5\text{ }\mu\text{s}$, $D < 0.001$		-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
MOSFET dv/dt robustness	dv/dt	$V_{DS} = 0 \dots 800\text{ V}$		150	V/ns
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。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	$R_{DS(on)}$	$I_D = 41\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $V_{GS(on)} = 18\text{ V}$		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	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse			109		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse			27.1		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, 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	$t_{d(on)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	23		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$	21		
Rise time	t_r	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	21.9		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$	28.2		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	29		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$	32		
Fall time	t_f	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	16.5		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$	16.4		
Turn-on energy	E_{on}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1050		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$	1273		
Turn-off energy	E_{off}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	400		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$	444		
Total switching energy	E_{tot}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2\ \Omega$, $R_{GS(off)} = 2\ \Omega$, $L_\sigma = 15\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1627		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$	2194		

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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

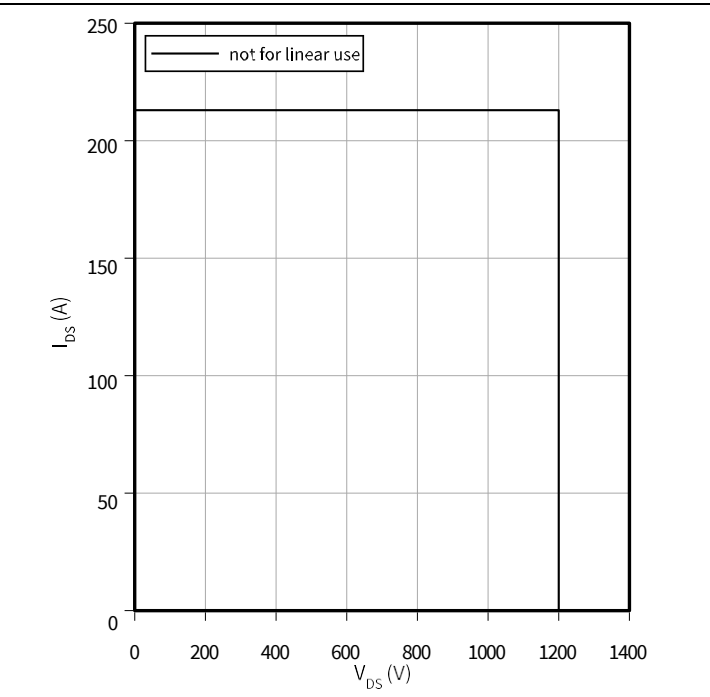
表6 特征值

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	$T_{vj} = 25\text{ °C}$		17		A
			$T_{vj} = 175\text{ °C}$		21		
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	$T_{vj} = 25\text{ °C}$		177		μJ
			$T_{vj} = 175\text{ °C}$		477		
Virtual junction temperature	T_{vj}			-55		175	°C

4 特性图

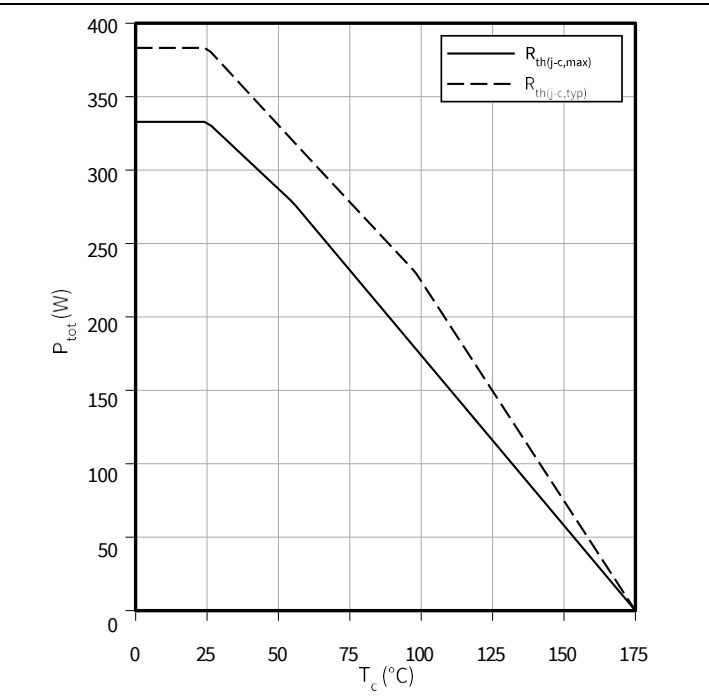
Reverse bias safe operating area (RBSOA)

$I_{DS} = f(V_{DS})$
 $T_{vj} \leq 175\text{ }^{\circ}\text{C}$, $V_{GS} = 0/18\text{ V}$, $T_c = 25\text{ }^{\circ}\text{C}$



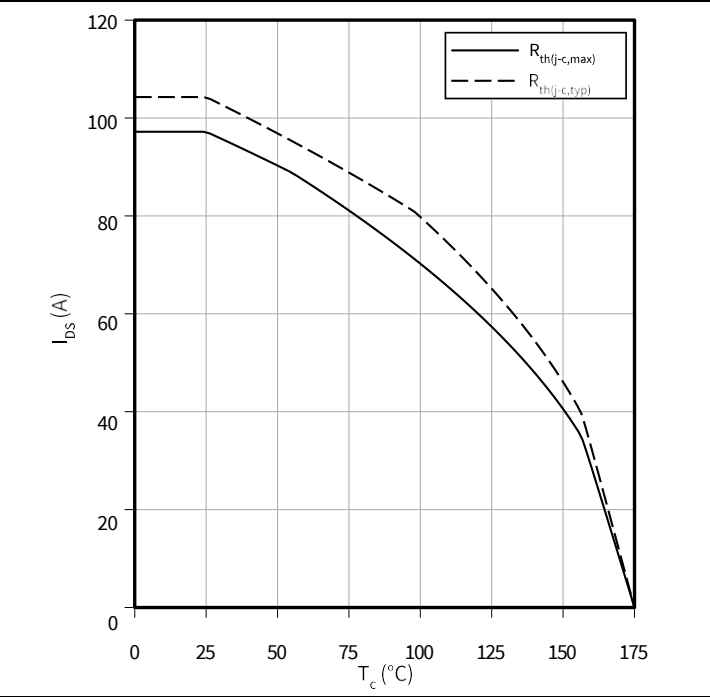
Power dissipation as a function of case temperature limited by bond wire

$P_{tot} = f(T_c)$



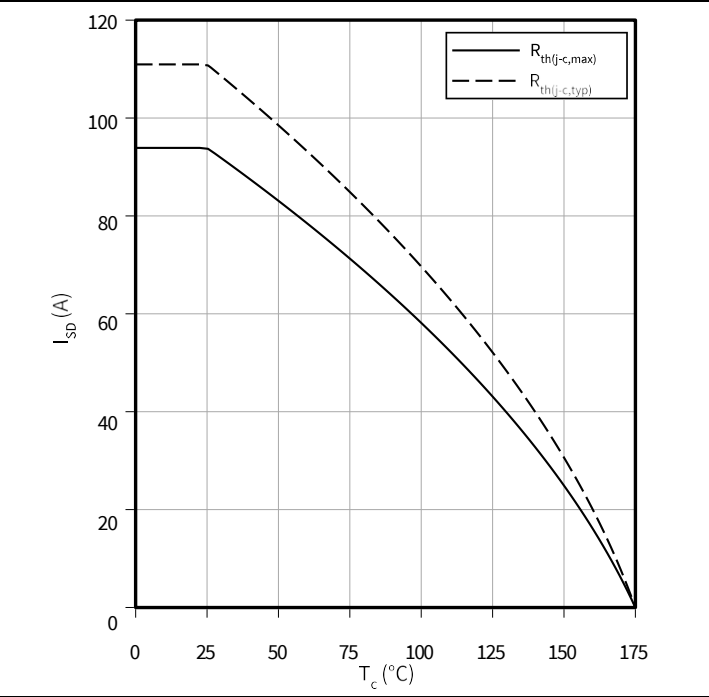
Maximum DC drain to source current as a function of case temperature limited by bond wire

$I_{DS} = f(T_c)$



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

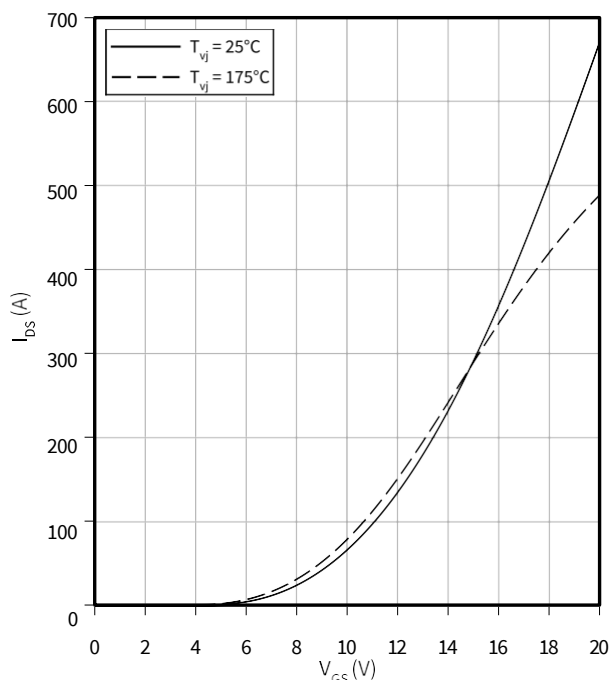
$I_{SD} = f(T_c)$
 $V_{GS} = 0\text{ V}$



Typical transfer characteristic

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

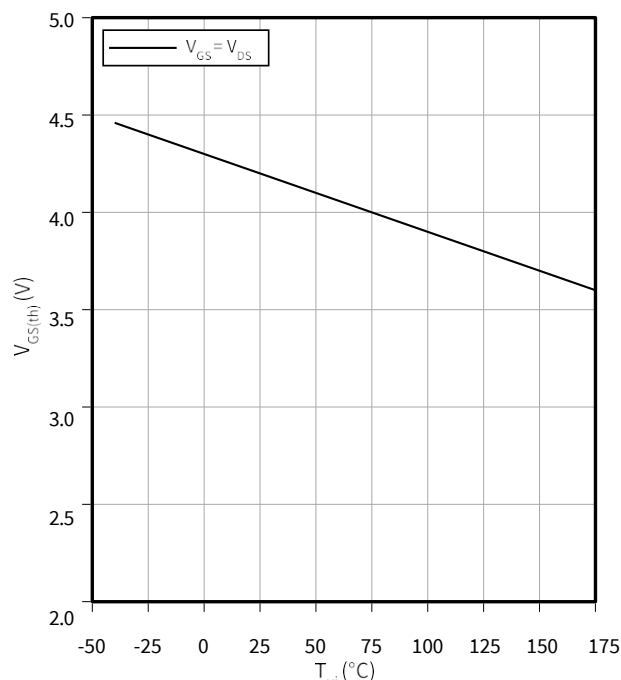
$V_{DS} = 20 \text{ V}$, $t_p = 20 \mu\text{s}$



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

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

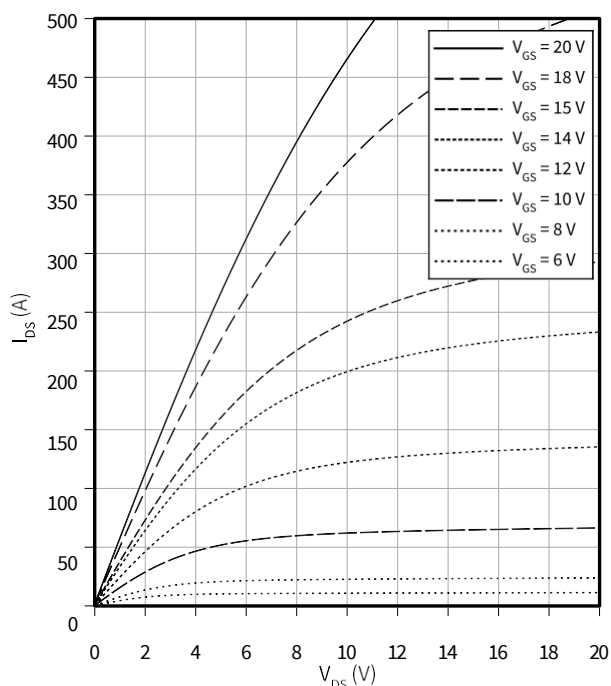
$I_D = 17.6 \text{ mA}$



Typical output characteristic, V_{GS} as parameter

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

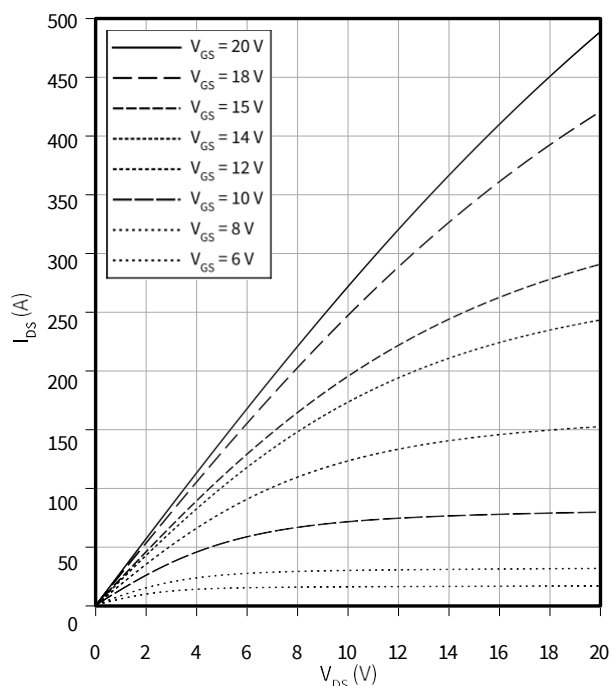
$T_{vj} = 25^\circ\text{C}$, $t_p = 20 \mu\text{s}$



Typical output characteristic, V_{GS} as parameter

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

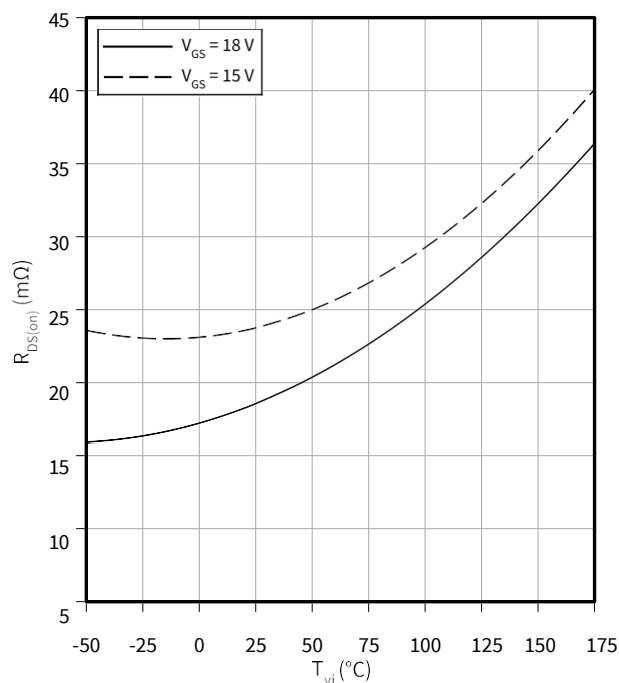
$T_{vj} = 175^\circ\text{C}$, $t_p = 20 \mu\text{s}$



Typical on-state resistance as a function of junction temperature

$$R_{DS(on)} = f(T_{vj})$$

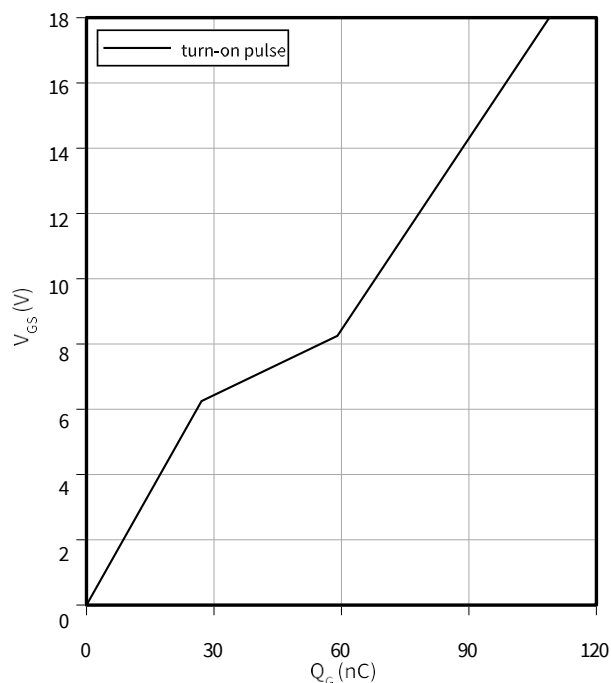
$I_D = 41\text{ A}$



Typical gate charge

$$V_{GS} = f(Q_G)$$

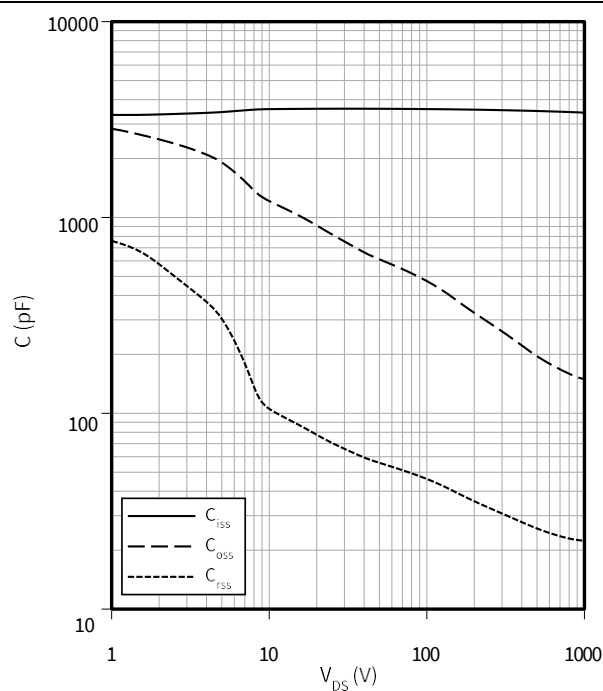
$I_D = 41\text{ A}, V_{DS} = 800\text{ V}$



Typical capacitance as a function of drain-source voltage

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

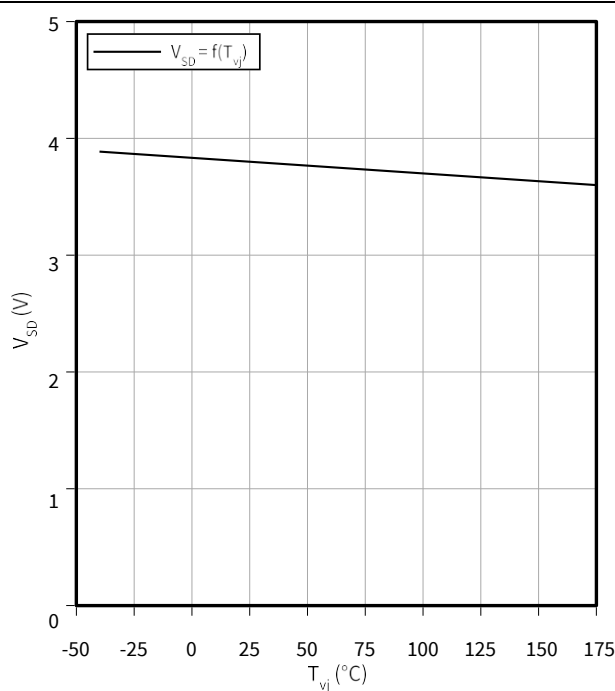
$f = 100\text{ kHz}, V_{GS} = 0\text{ V}$



Typical reverse drain voltage as function of junction temperature

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

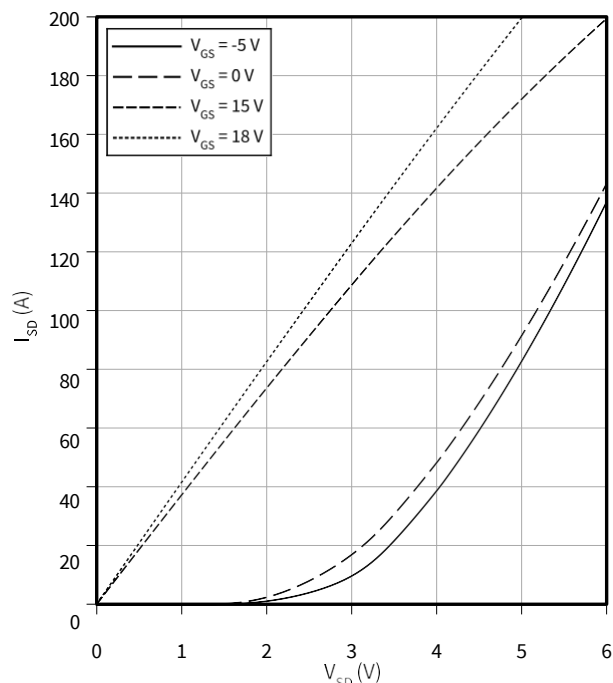
$I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}$



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

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

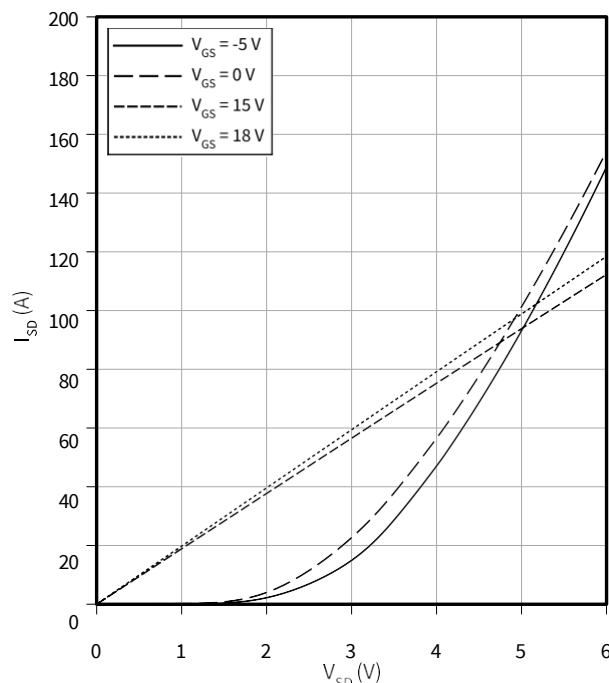
$T_{vj} = 25\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

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

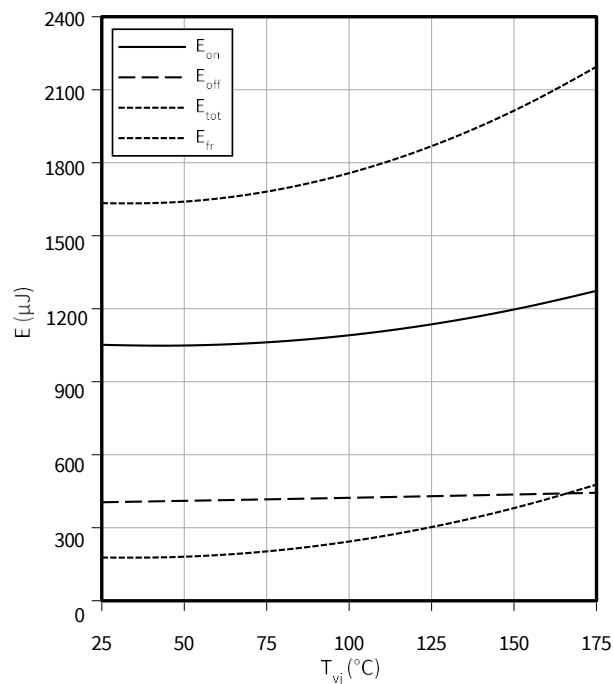
$T_{vj} = 175\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

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

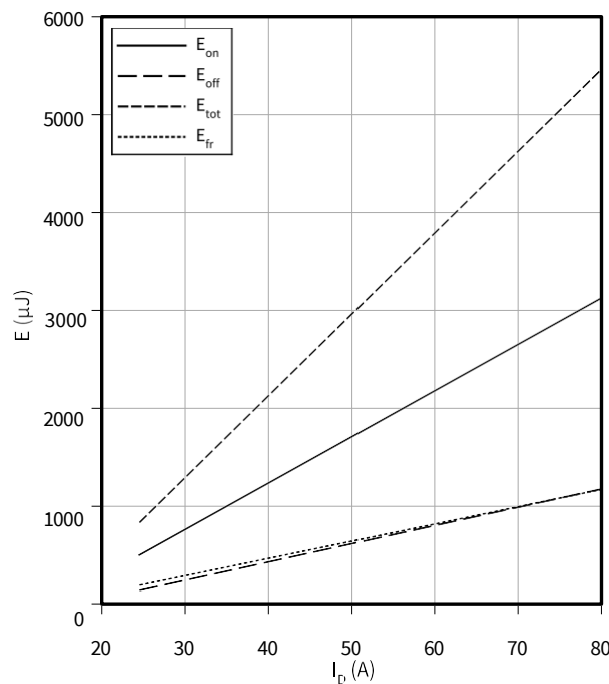
$I_D = 41\text{ A}$, $R_{G,ext} = 2\text{ }\Omega$, $V_{GS} = 0/18\text{ V}$, $V_{DD} = 800\text{ V}$



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

$$E = f(I_D)$$

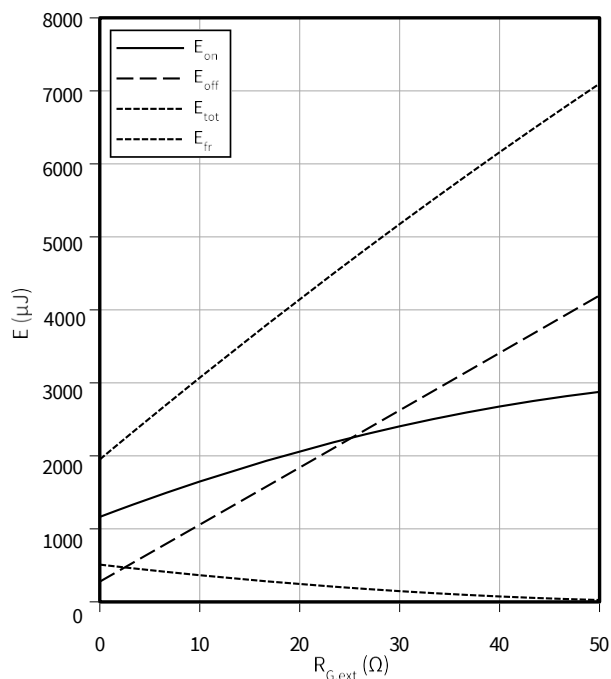
$V_{GS} = 0/18\text{ V}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

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

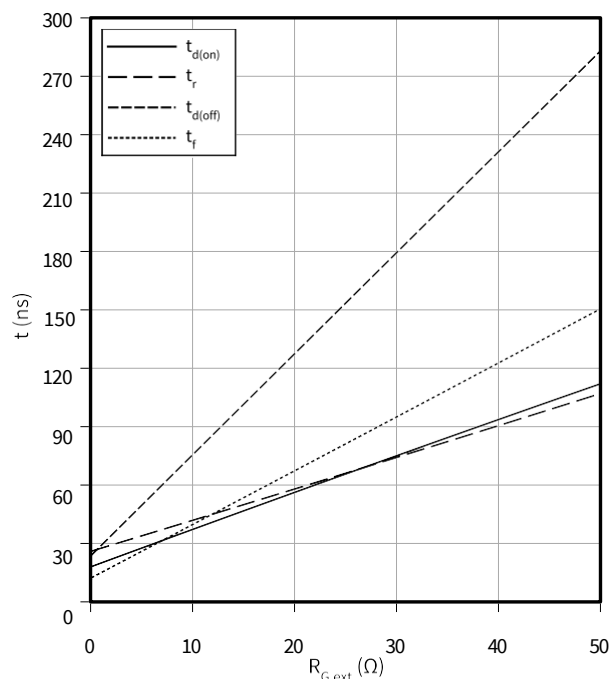
$V_{GS} = 0/18$ V, $I_D = 41$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

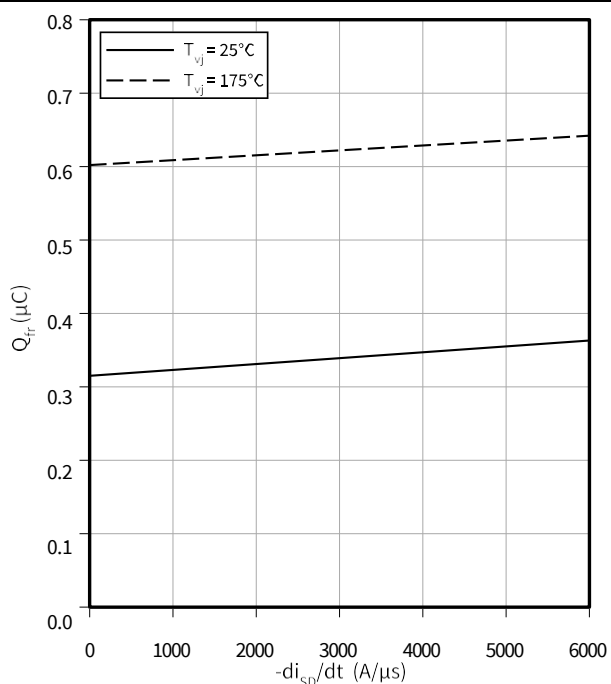
$V_{GS} = 0/18$ V, $I_D = 41$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

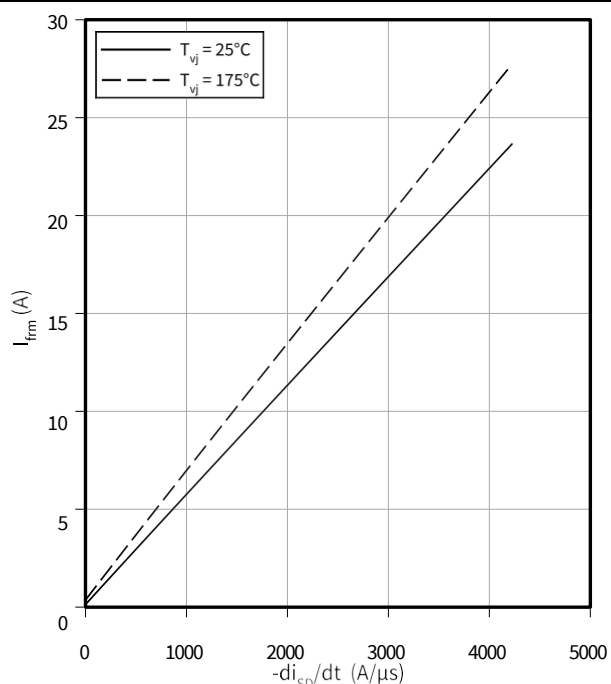
$V_{GS} = 0/18$ V, $I_{SD} = 41$ A, $V_{DD} = 800$ V



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

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

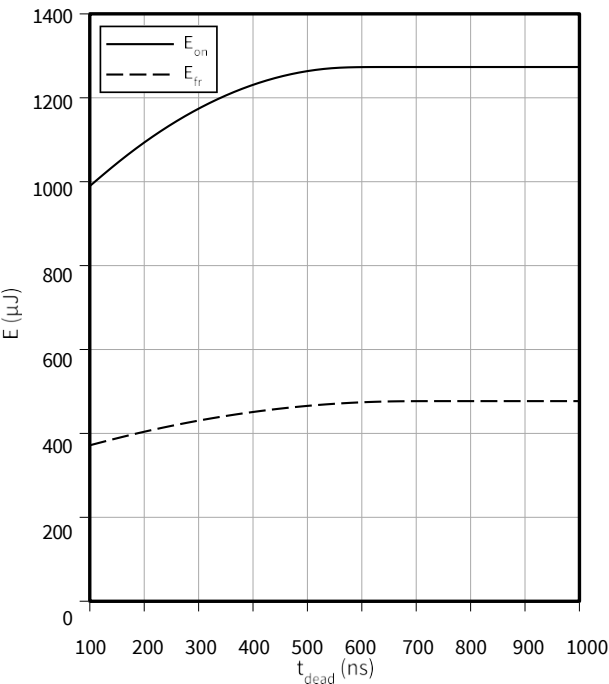
$V_{GS} = 0/18$ V, $I_{SD} = 41$ A, $V_{DD} = 800$ V



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

$E = f(t_{dead})$

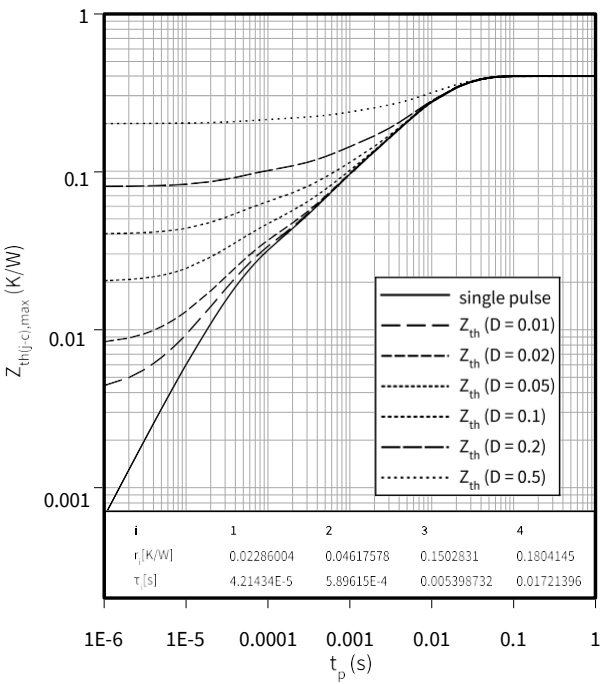
$V_{GS} = -5/18\text{ V}$, $I_D = 41\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

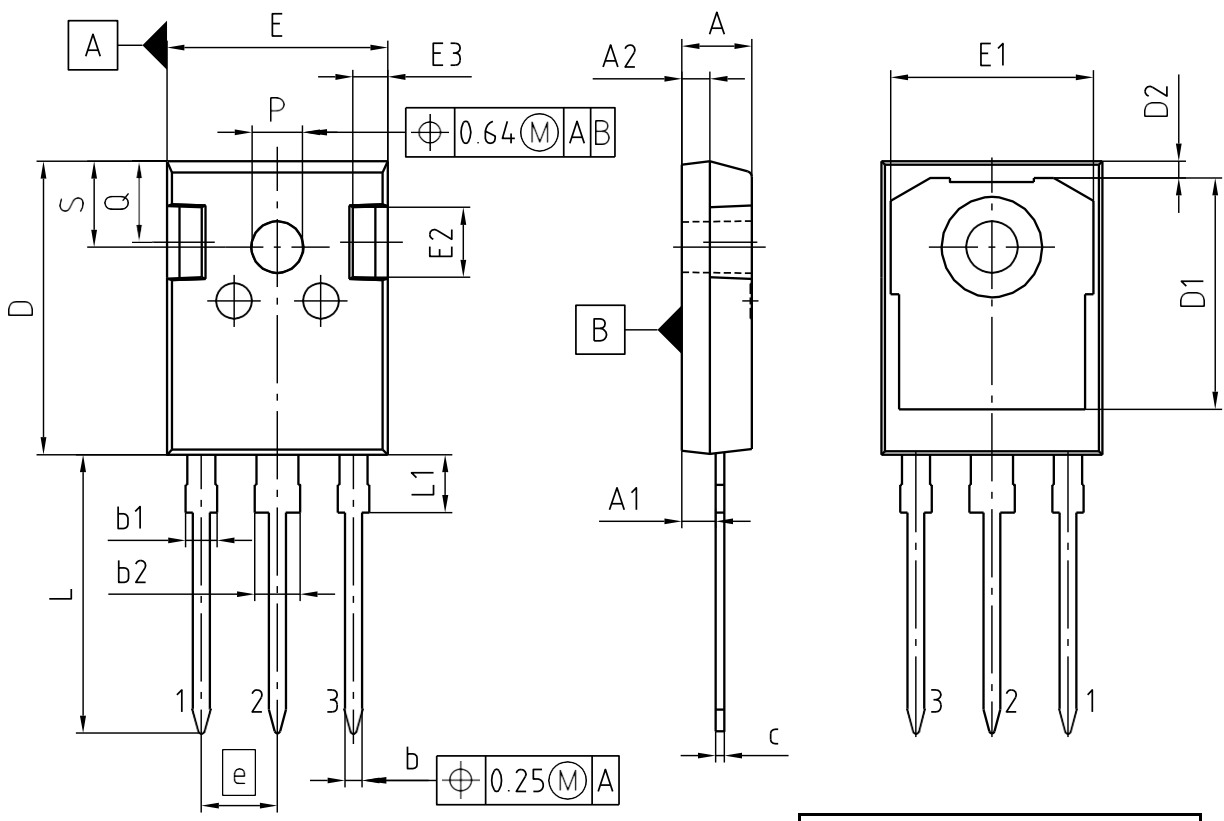
$Z_{th(j-c),max} = f(t_p)$

$D = t_p/T$



5 封装外形

5 封装外形



PACKAGE - GROUP PG-T0247-3-U06		
NUMBER:		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.83	5.21
A1	2.27	2.54
A2	1.85	2.16
b	1.07	1.33
b1	1.90	2.41
b2	2.87	3.38
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.35
E	15.70	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	2.60
e	5.44	
N	3	
L	19.80	20.32
L1	4.10	4.47
øP	3.50	3.70
Q	5.49	6.00
S	6.04	6.30

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

图 1

6 测试条件

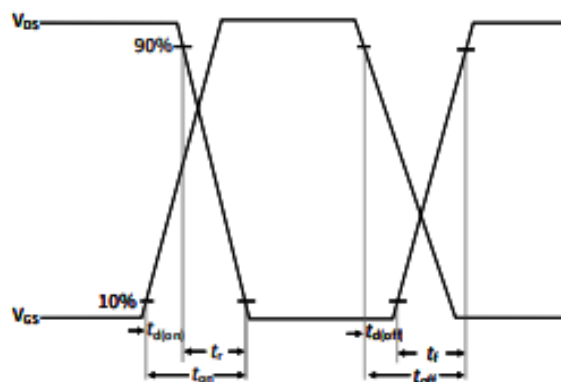


Figure A. Definition of switching times

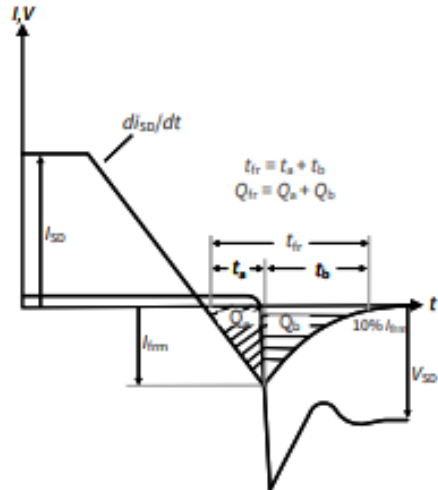


Figure B. Definition of body diode switching characteristics

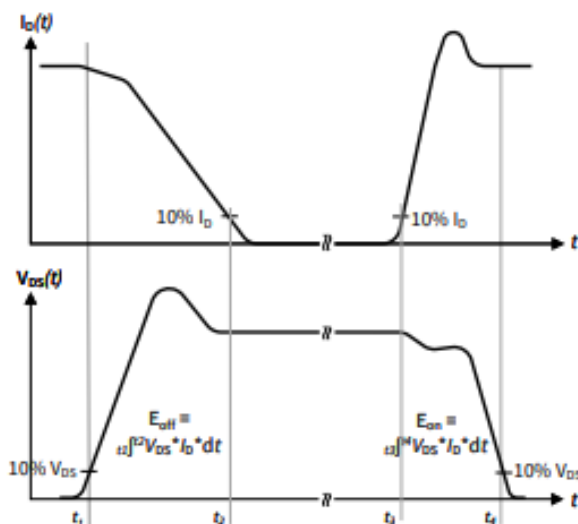


Figure C. Definition of switching losses

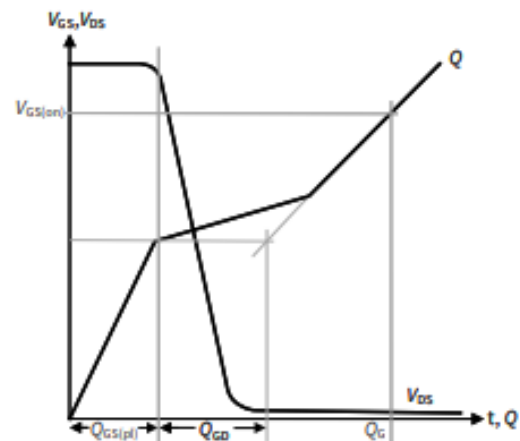


Figure D. Definition of QGD

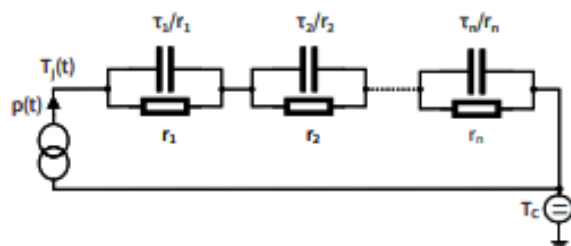


Figure E. Thermal equivalent circuit

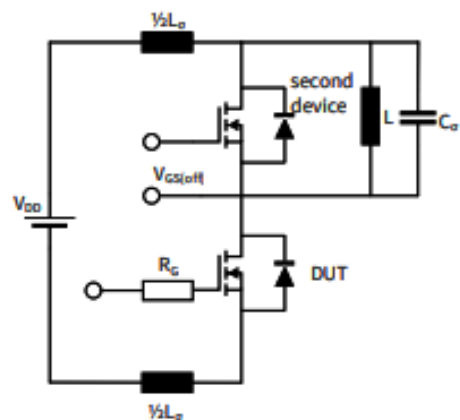


Figure F. Dynamic test circuit
Parasitic inductance L_{σ} ,
Parasitic capacitor C_{σ}

修订记录

修订记录

Document revision	Date of release	Description of changes
1.00	2022-02-02	Final datasheet
1.10	2022-08-12	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 "Typical reverse drain current as a function of reverse drain voltage, V_{GS} as parameter", on page 11
1.20	2023-02-20	Correction of I_{DSS} in table 4 on page 4 Editorial changes
1.30	2023-05-08	Correction of gate charge values in Table 4
1.40	2024-11-15	Updated package name Corrected forward transconductance g_{fs} in Table 4 Corrected diagram "Typical output characteristic, V_{GS} as parameter" Corrected diagram "Typical transfer characteristic" Editorial changes



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erratum@infineon.com

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