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°C时V_{DSS} = 1200 V
- T_C = 25°C时I_{DDC} = 55 A
- $R_{DS(on)}$ = 39 mΩ at V_{GS} = 18 V, T_{vj} = 25°C
- 开关损耗非常低
- 短路耐受时间 3 µs
- 基准栅极阈值电压，$V_{GS(th)}$ = 4.2 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

Halogen-free
Green
Lead-free
RoHS

潜在应用

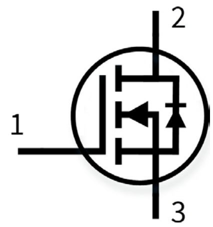
- 工业驱动
- 工业电源
- 太阳能逆变器

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



Type	Package	Marking
IMW120R040M1H	PG-TO247-3-U06	12M1H040

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

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	$R_{th(j-c)}$			0.51	0.66	K/W

2 MOSFET

表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25$ °C		1200	V
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS} = 18$ V	$T_c = 25$ °C	55	A
			$T_c = 100$ °C	39	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 18$ V		117	A
Gate-source voltage, max. transient voltage[1]	V_{GS}	$t_p \leq 0.5$ µs, $D < 0.01$		-10/23	V
Gate-source voltage, max. static voltage	V_{GS}			-7/20	V
Avalanche energy, single pulse	E_{AS}	$I_D = 18.8$ A, $V_{DD} = 50$ V, $L = 1.9$ mH		339	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 18.8$ A, $V_{DD} = 50$ V, $L = 9.5$ µH		1.68	mJ
Short-circuit withstand time	t_{SC}	$V_{DD} \leq 800$ V, $V_{DS,peak} < 1200$ V, $V_{GS(on)} = 15$ V, $T_{vj(start)} = 25$ °C		3	µs
MOSFET dv/dt robustness	dv/dt	$V_{DS} = 0...800$ V		150	V/ns
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25$ °C	227	W
			$T_c = 100$ °C	114	

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 = 19.3 A	T_{vj} = 25 °C, $V_{GS(on)}$ = 18 V		39	54.4	mΩ
			T_{vj} = 100 °C, $V_{GS(on)}$ = 18 V		54		
			T_{vj} = 175 °C, $V_{GS(on)}$ = 18 V		77		
			T_{vj} = 25 °C, $V_{GS(on)}$ = 15 V		50.4	61.5	
Gate-source threshold voltage	$V_{GS(th)}$	I_D = 10 mA, V_{DS} = V_{GS} (tested after 1 ms pulse at V_{GS} = 20 V)	T_{vj} = 25 °C	3.5	4.2	5.2	V
			T_{vj} = 175 °C		3.6		
Zero gate-voltage drain current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C			150	µA
			T_{vj} = 175 °C		2.6		
Gate leakage current	I_{GSS}	V_{DS} = 0 V	V_{GS} = 23 V			100	nA
			V_{GS} = -10 V			-100	
Forward transconductance	g_{fs}	I_D = 19.3 A, V_{DS} = 20 V			9.8		S
Internal gate resistance	$R_{G,int}$	f = 1 MHz, V_{AC} = 25 mV			2.5		Ω
Input capacitance	C_{iss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			1620		pF
Output capacitance	C_{oss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			75		pF
Reverse transfer capacitance	C_{rss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			11		pF
C_{oss} stored energy	E_{oss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			30		µJ
Total gate charge	Q_G	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, turn-on pulse			51		nC
Plateau gate charge	$Q_{GS(pl)}$	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, turn-on pulse			12.7		nC
Gate-to-drain charge	Q_{GD}	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, turn-on pulse			10.2		nC

（表格续下页……）

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 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		17		ns
			T_{vj} = 175 °C		16		
Rise time	t_r	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		6.4		ns
			T_{vj} = 175 °C		7.3		
Turn-off delay time	$t_{d(off)}$	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		20.6		ns
			T_{vj} = 175 °C		21		
Fall time	t_f	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		6.9		ns
			T_{vj} = 175 °C		6.9		
Turn-on energy	E_{on}	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		460		µJ
			T_{vj} = 175 °C		572		
Turn-off energy	E_{off}	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		153		µJ
			T_{vj} = 175 °C		167		
Total switching energy	E_{tot}	V_{DD} = 800 V, I_D = 19.3 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		699		µJ
			T_{vj} = 175 °C		971		

（表格续下页……）

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}	$T_{vj} \geq 25$ °C		1200	V
Continuous reverse drain current for $R_{th(j\text{-}c,max)}$, limited by $T_{vj(max)}$	I_{SDC}	$V_{GS} = 0$ V	$T_c = 25$ °C	54	A
			$T_c = 100$ °C	33	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0$ V		117	A

表6 特征值

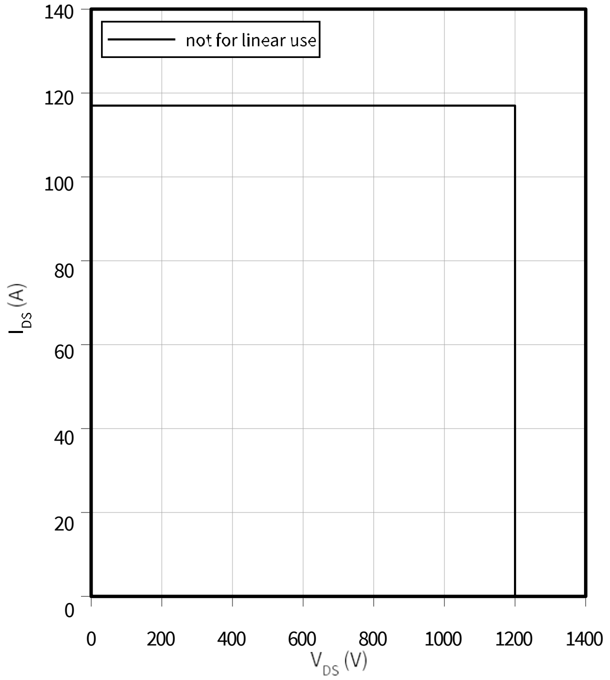
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 19.3$ A, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		3.8	5	V
			$T_{vj} = 100$ °C		3.7		
			$T_{vj} = 175$ °C		3.6		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800$ V, $I_{SD} = 19.3$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 3000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		160		nC
			$T_{vj} = 175$ °C		293		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800$ V, $I_{SD} = 19.3$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 3000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		36		A
			$T_{vj} = 175$ °C		57		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800$ V, $I_{SD} = 19.3$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 3000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		30		µJ
			$T_{vj} = 175$ °C		120		
Virtual junction temperature	T_{vj}			-55		175	°C

4 特性图

Reverse bias safe operating area (RBSOA)

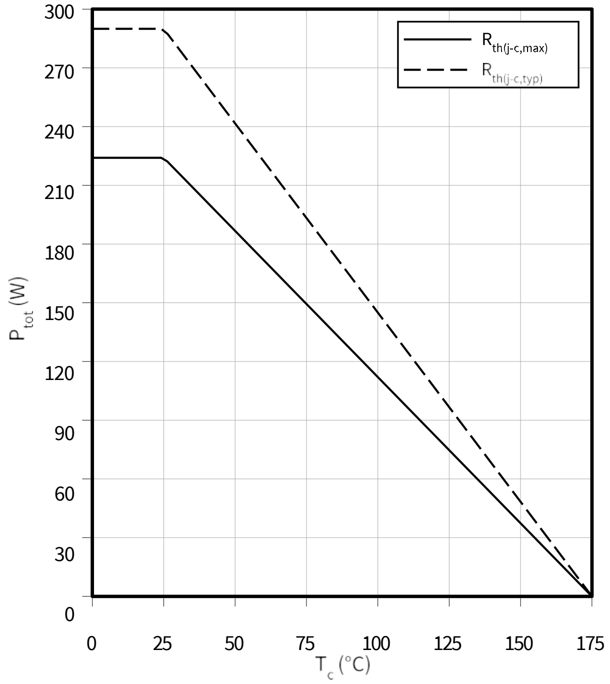
$I_{DS} = f(V_{DS})$

$T_{vj} \leq 175\ °C$, $V_{GS} = 0/18\ V$, $T_c = 25\ °C$



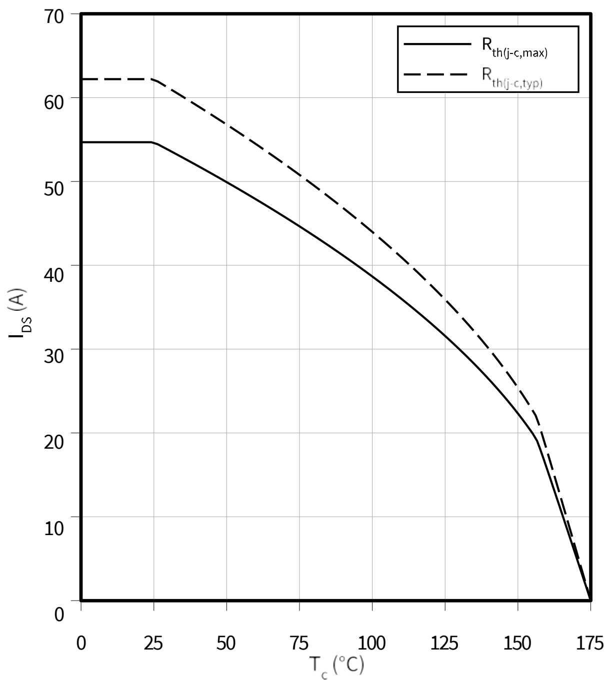
Power dissipation as a function of case temperature limited by bond wire

$P_{tot} = f(T_c)$



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

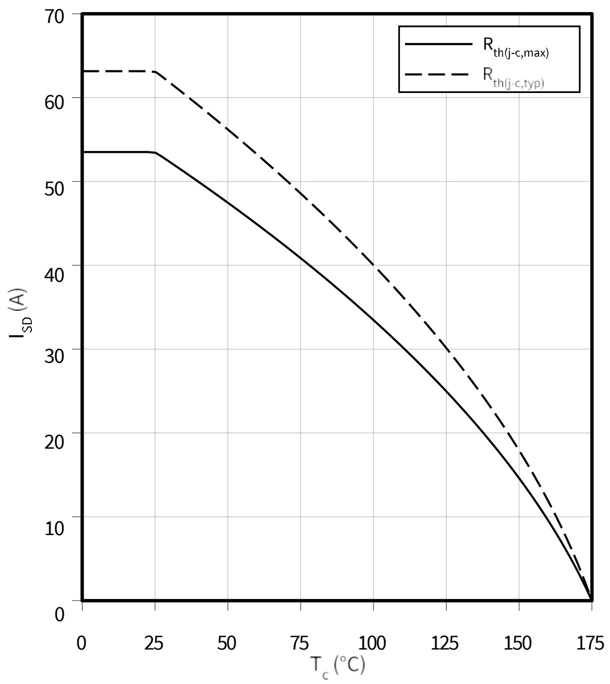
$I_{DS} = f(T_c)$

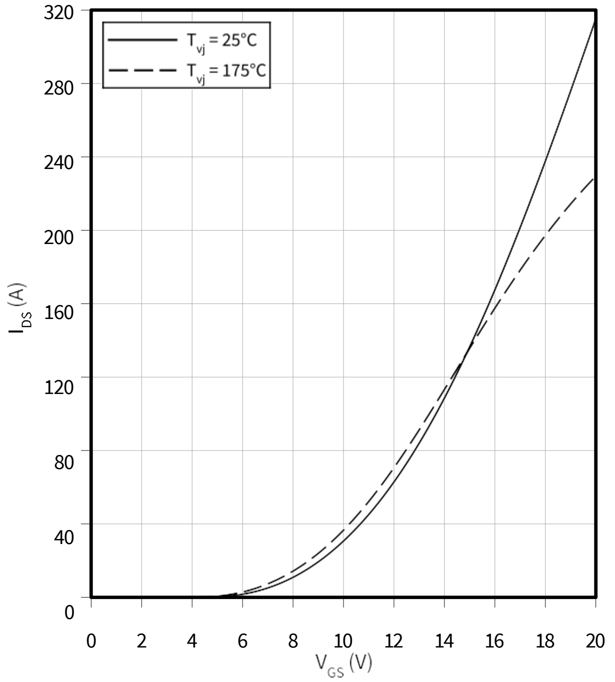
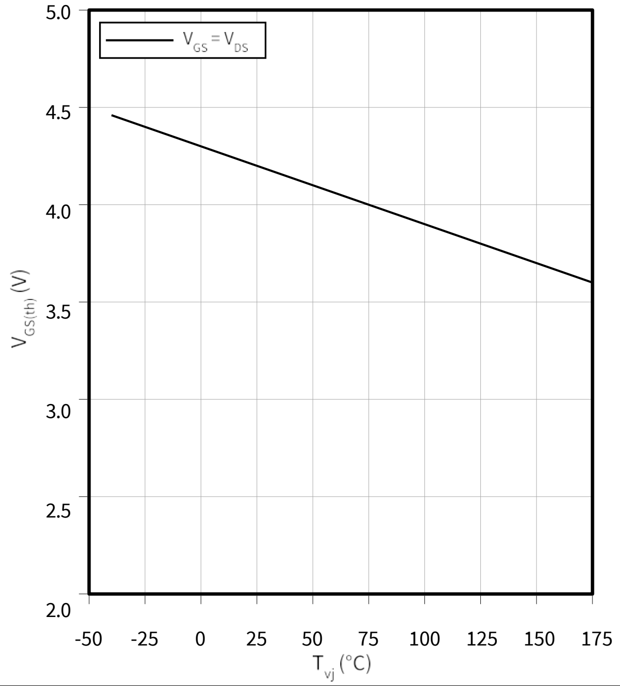
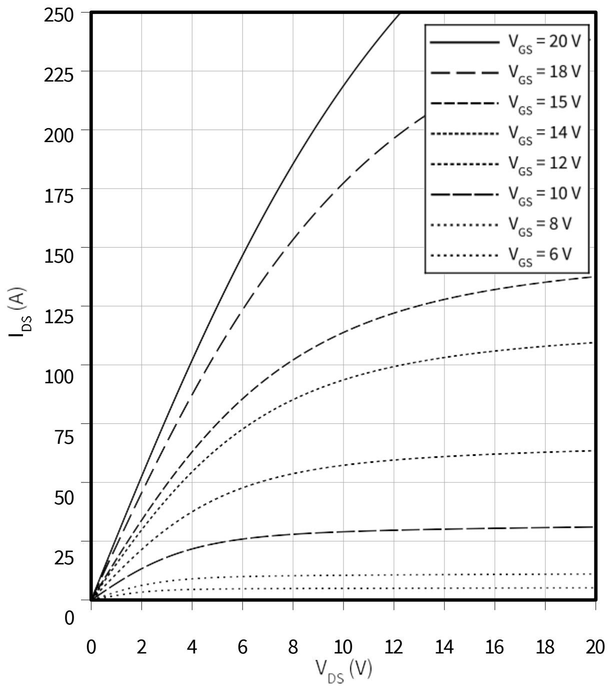
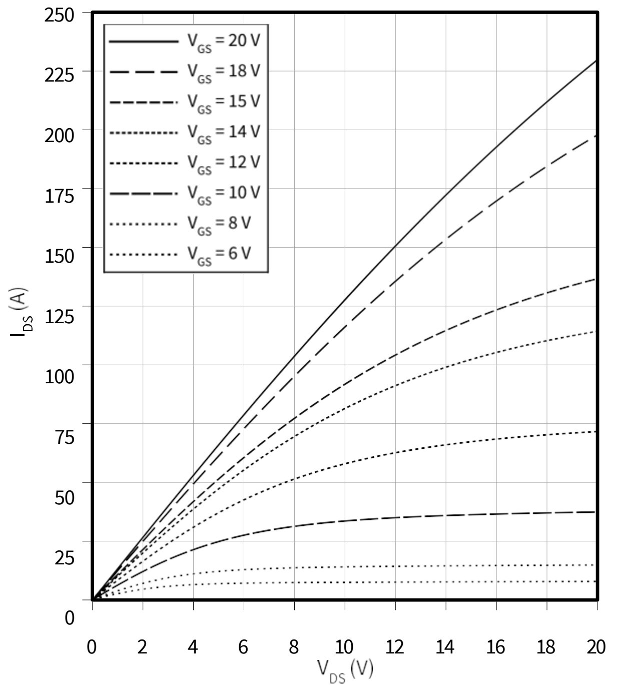


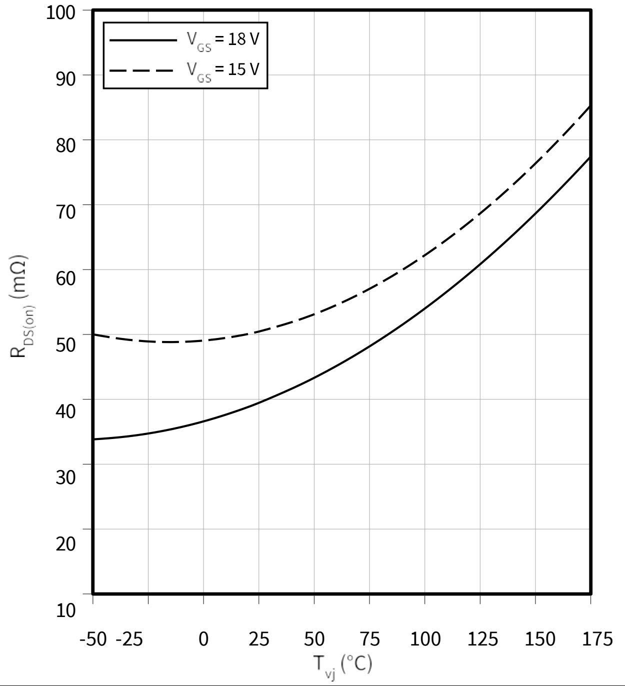
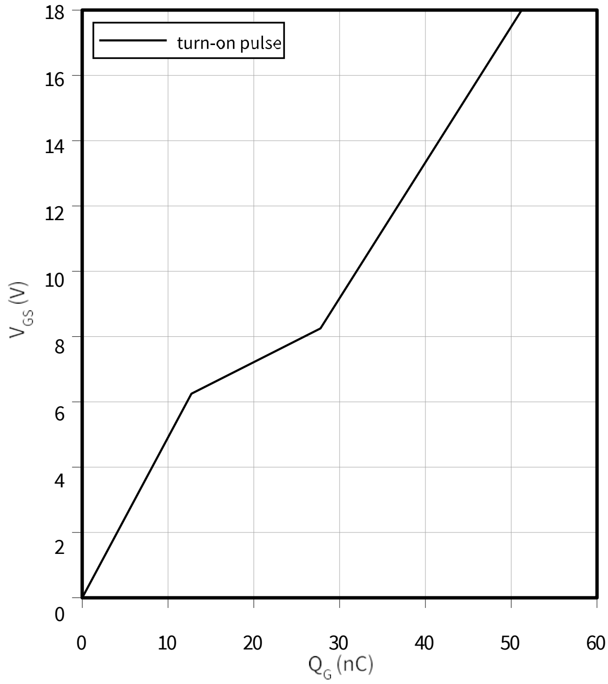
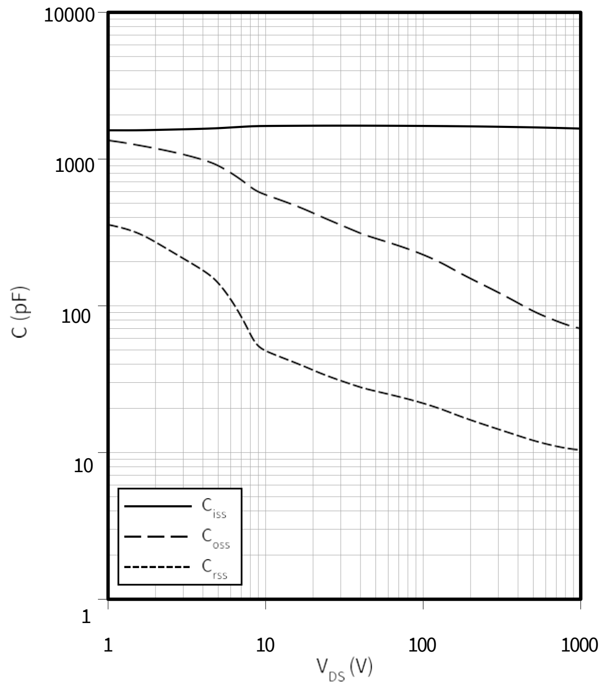
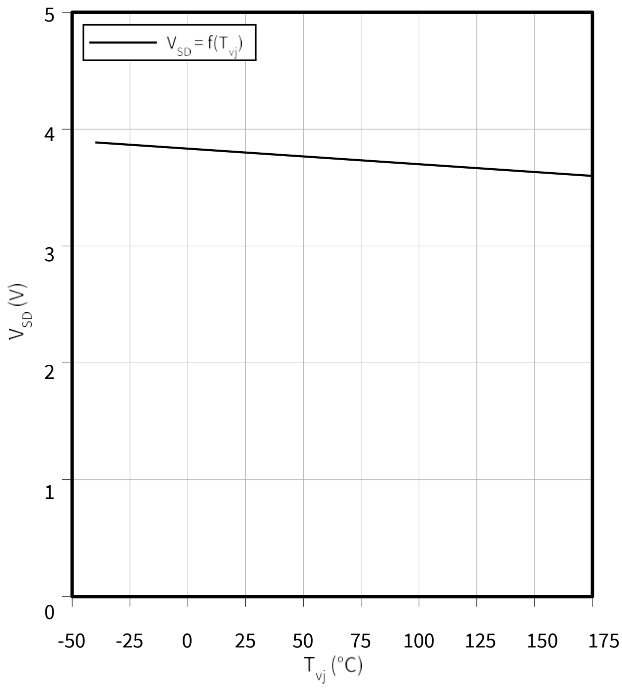
Maximum source to drain current as a function of case temperature limited by bond wire

$I_{SD} = f(T_c)$

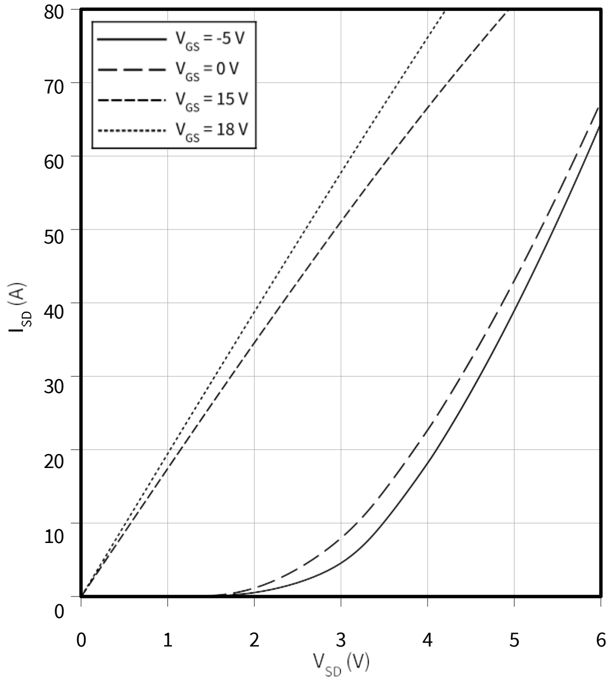
$V_{GS} = 0\ V$

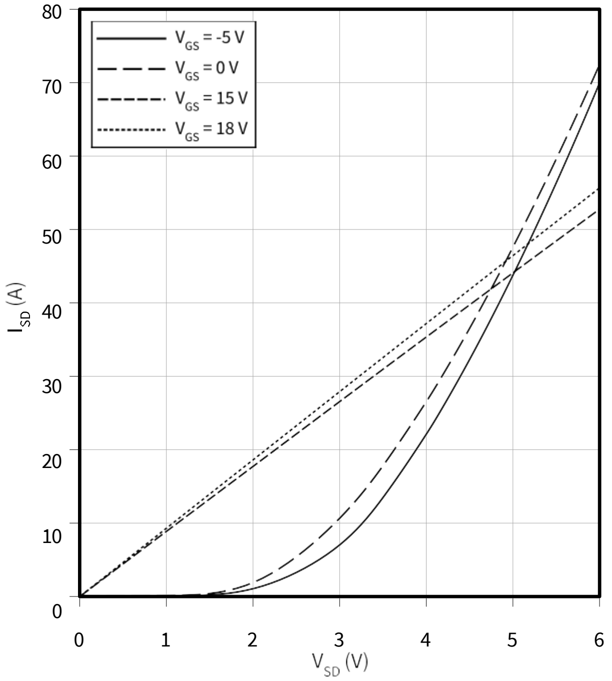


Typical transfer characteristic $I_{DS} = f(V_{GS})$ $V_{DS} = 20$ V, $t_p = 20$ µs	**Typical gate-source threshold voltage as a function of junction temperature** $V_{GS(th)} = f(T_{vj})$ $I_D = 8.3$ mA
	
Typical output characteristic, V_{GS} as parameter $I_{DS} = f(V_{DS})$ $T_{vj} = 25$ °C, $t_p = 20$ µs	**Typical output characteristic, V_{GS} as parameter** $I_{DS} = f(V_{DS})$ $T_{vj} = 175$ °C, $t_p = 20$ µs
	

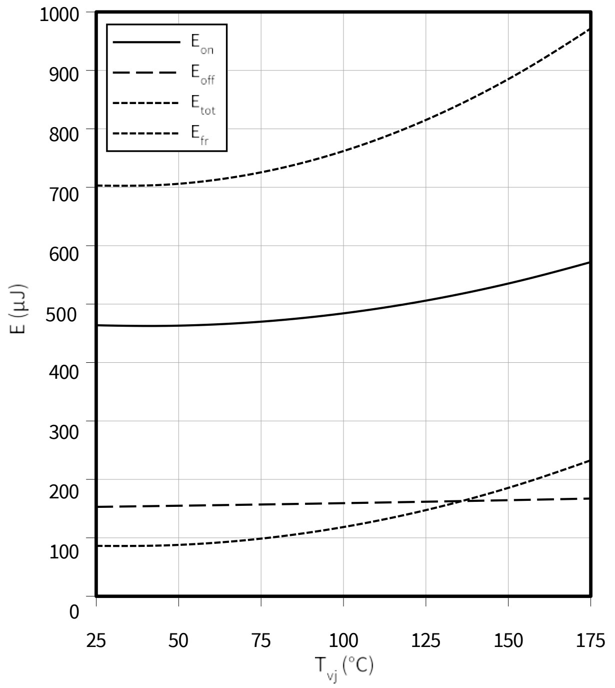
Typical on-state resistance as a function of junction temperature $R_{DS(on)} = f(T_{vj})$ $I_D = 19.3$ A	**Typical gate charge** $V_{GS} = f(Q_G)$ $I_D = 19.3$ A, $V_{DS} = 800$ V
	
Typical capacitance as a function of drain-source voltage $C = f(V_{DS})$ $f = 100$ kHz, $V_{GS} = 0$ V	**Typical reverse drain voltage as function of junction temperature** $V_{SD} = f(T_{vj})$ $I_{SD} = 19.3$ A, $V_{GS} = 0$ V
	

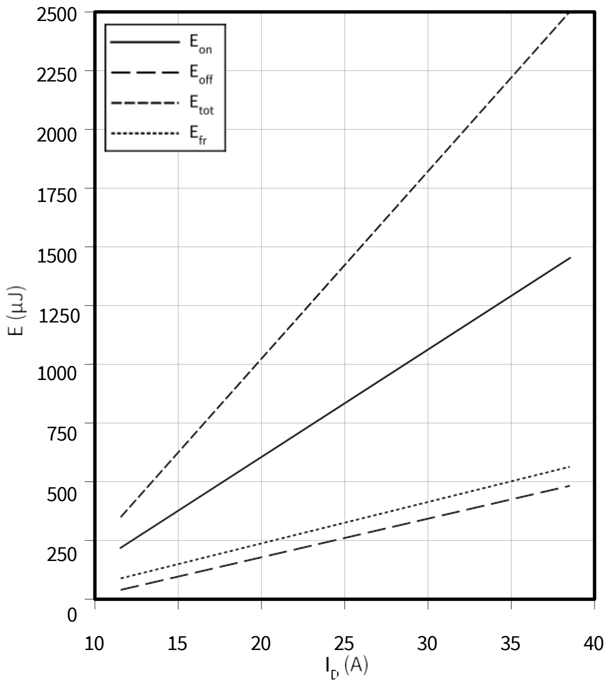
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter	Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter
$I_{SD} = f(V_{SD})$	$I_{SD} = f(V_{SD})$
$T_{vj} = 25$ °C, $t_p = 20$ µs	$T_{vj} = 175$ °C, $t_p = 20$ µs

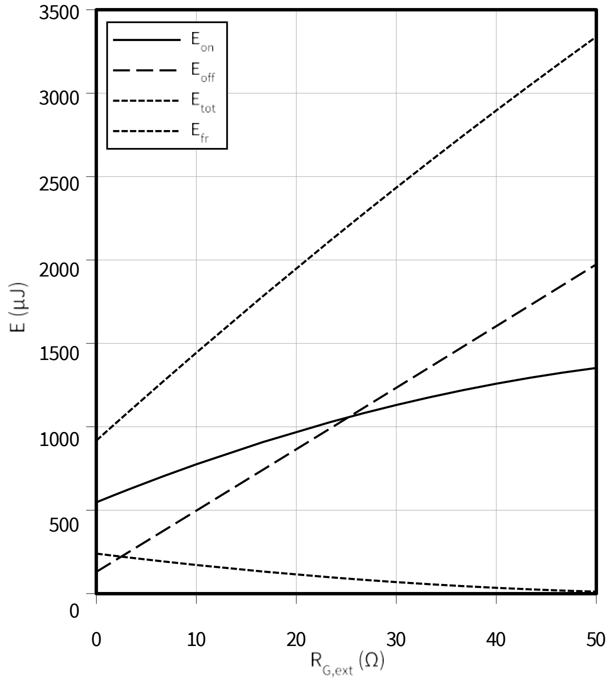
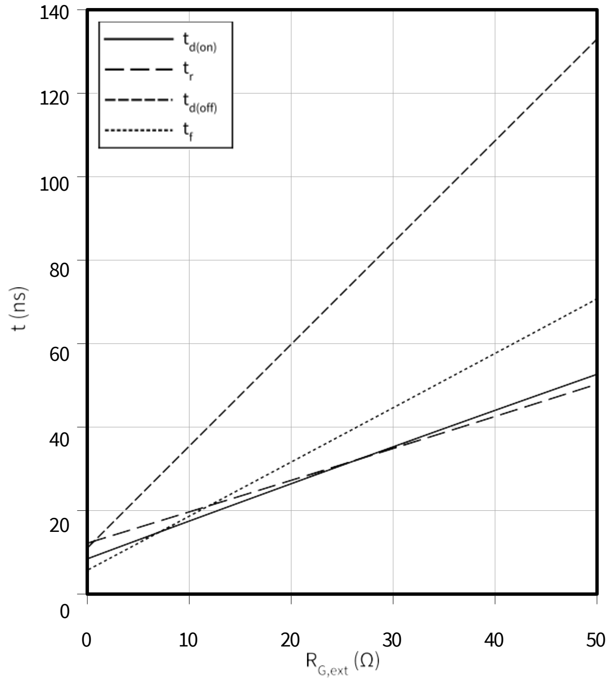
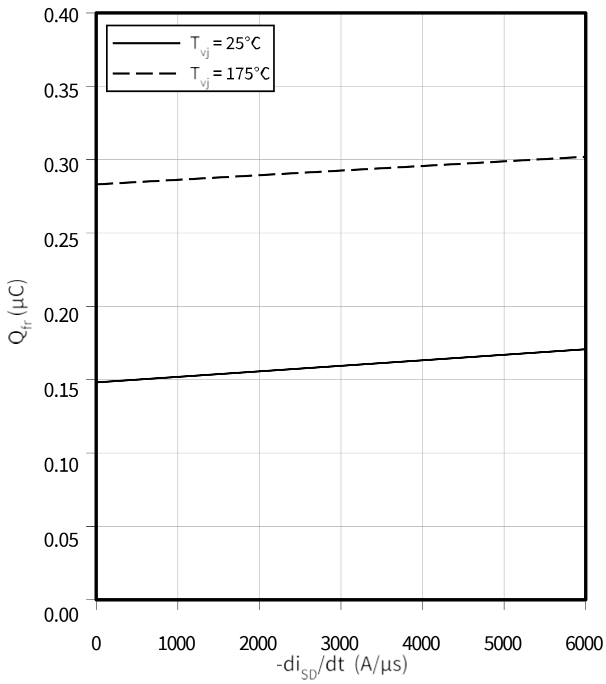
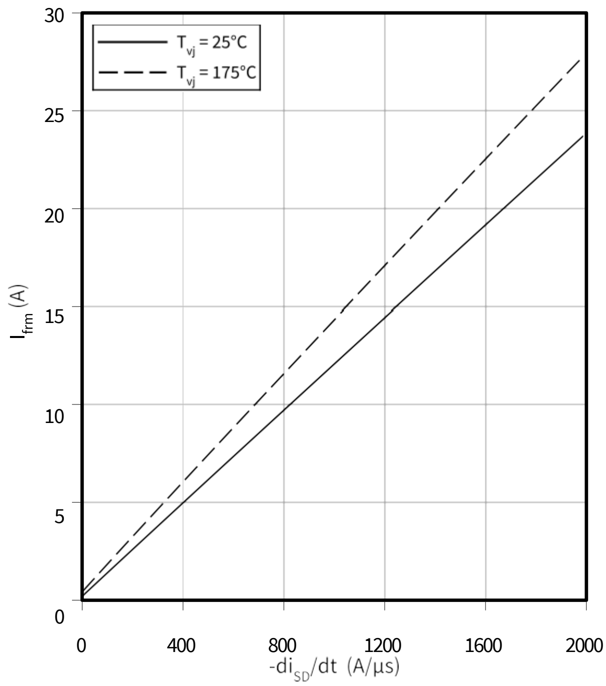




Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V	Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V
$E = f(T_{vj})$	$E = f(I_D)$
$V_{GS} = 0/18$ V, $I_D = 19.3$ A, $R_{G,ext} = 2$ Ω, $V_{DD} = 800$ V	$V_{GS} = 0/18$ V, $T_{vj} = 175$ °C, $R_{G,ext} = 2$ Ω, $V_{DD} = 800$ V



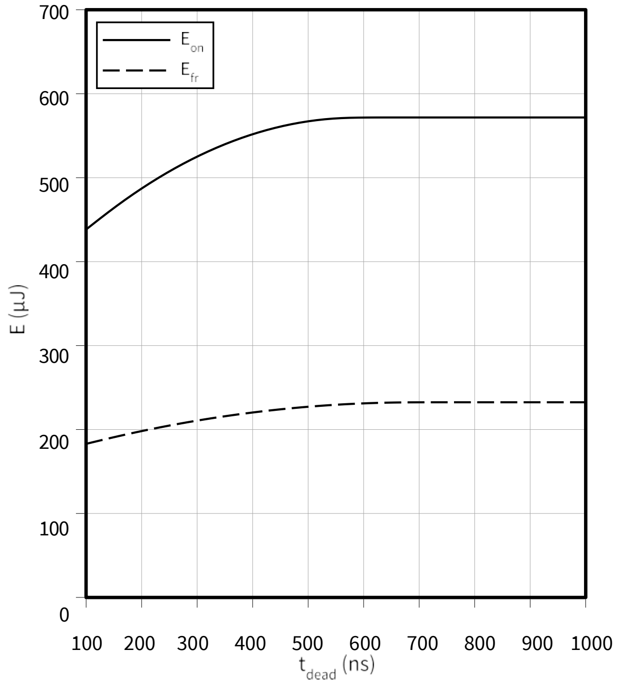


Typical switching energy losses as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V	Typical switching times as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V
$E = f(R_{G,ext})$	$t = f(R_{G,ext})$
V_{GS} = 0/18 V, I_D = 19.3 A, T_{vj} = 175 °C, V_{DD} = 800 V	V_{GS} = 0/18 V, I_D = 19.3 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	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
$Q_{fr} = f(-di_{SD}/dt)$	$I_{frm} = f(-di_{SD}/dt)$
V_{GS} = 0/18 V, I_{SD} = 19.3 A, V_{DD} = 800 V	V_{GS} = 0/18 V, I_{SD} = 19.3 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 V

$E = f(t_{dead})$

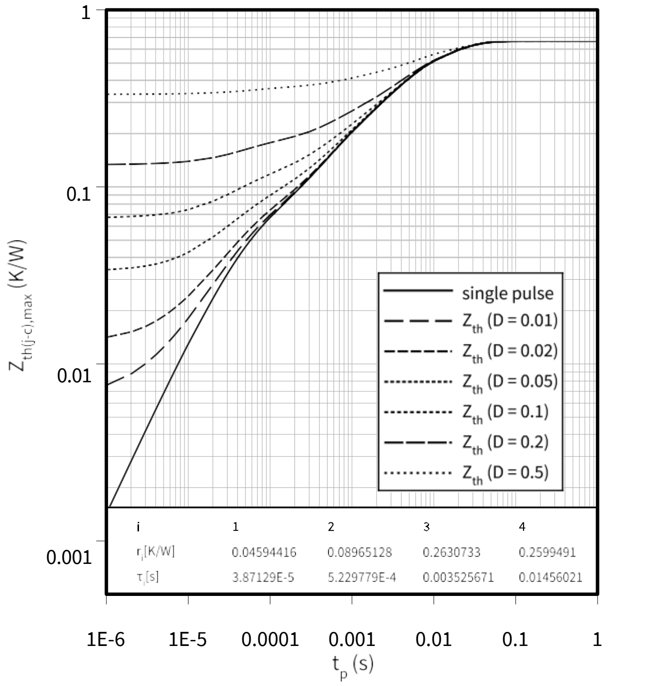
V_{GS} = -5/18 V, I_D = 19.3 A, T_{vj} = 175 °C, V_{DD} = 800 V



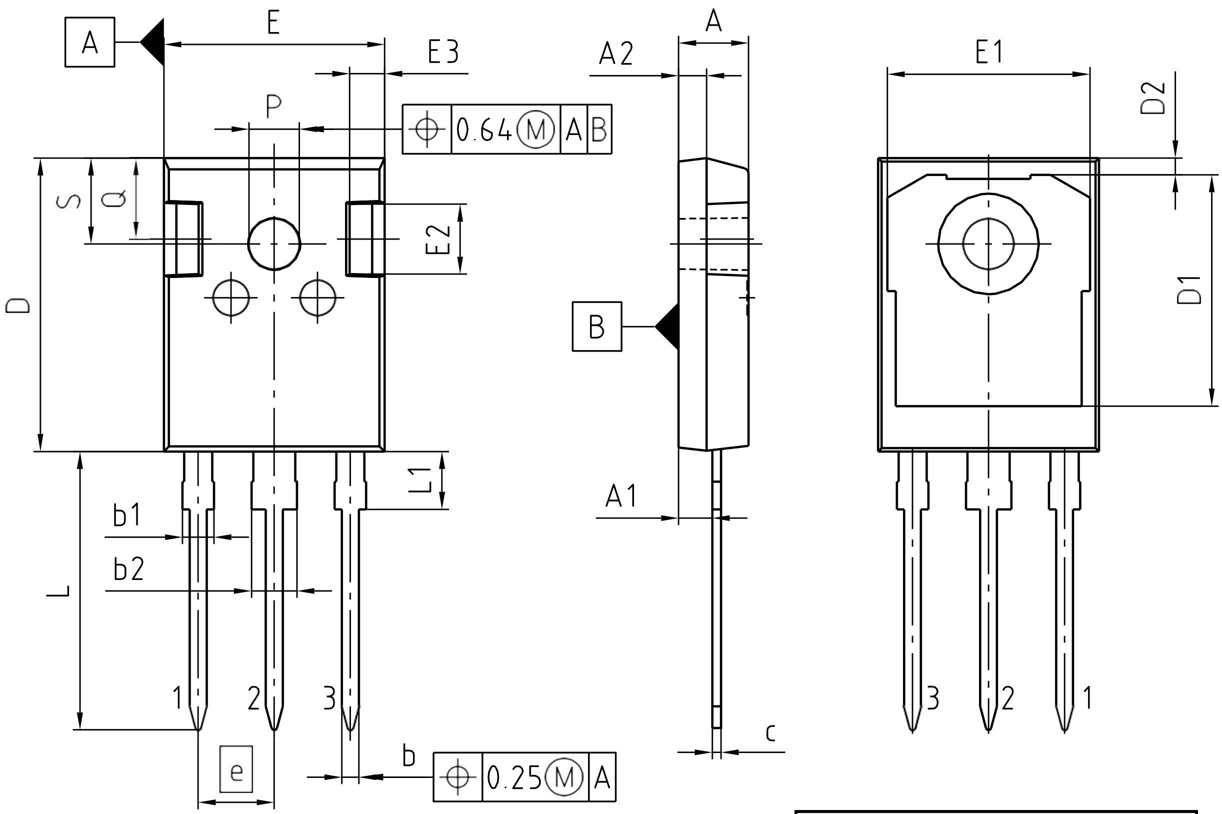
Max. transient thermal impedance (MOSFET/diode)

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

$D = t_p/T$



5 封装外形



PACKAGE - GROUP NUMBER:	PG-TO247-3-U06	
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

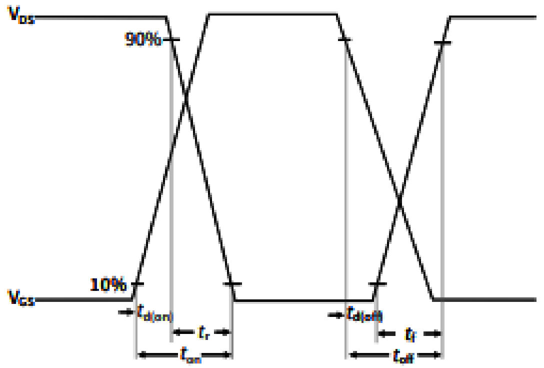


Figure A. **Definition of switching times**

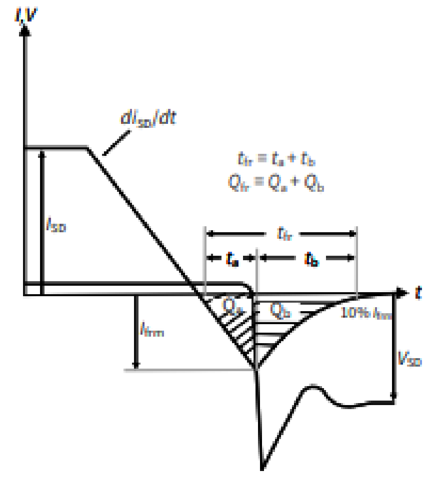


Figure B. **Definition of body diode switching characteristics**

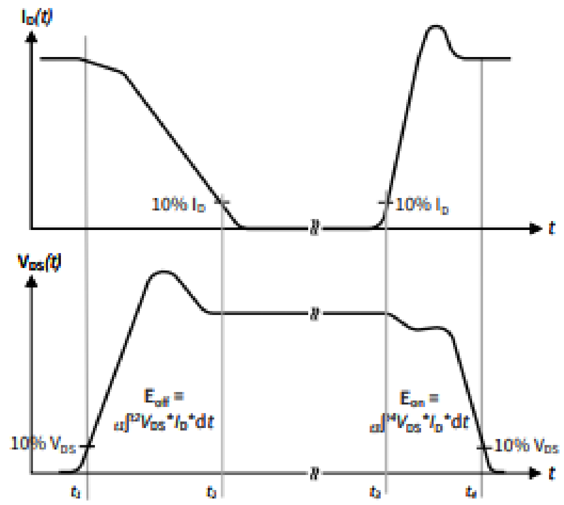


Figure C. **Definition of switching losses**

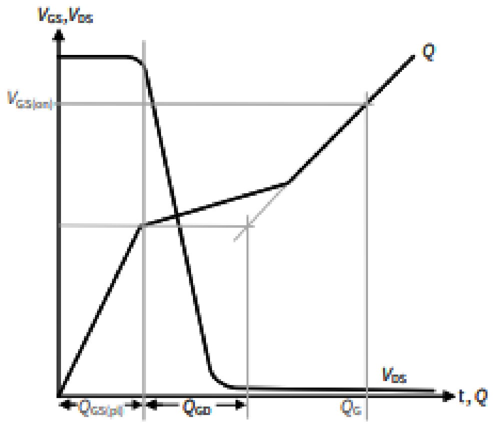


Figure D. **Definition of QGD**

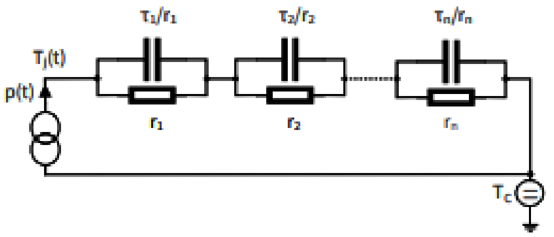


Figure E. **Thermal equivalent circuit**

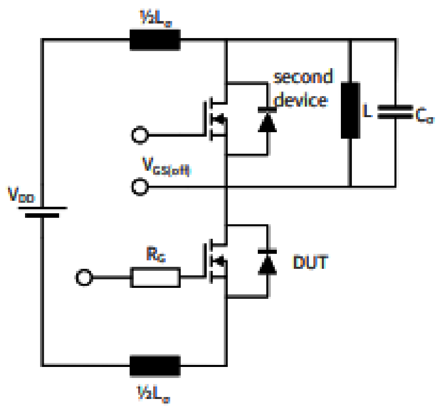


Figure F. **Dynamic test circuit**
Parasitic inductance L_σ,
Parasitic capacitor C_σ,

修订记录

Document revision	Date of release	Description of changes
1.00	2022-02-02	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 V to V_{DD}= 800 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 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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Edition 2025-07-28
Published by

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