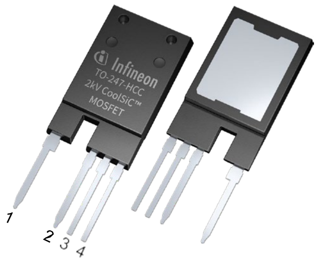
英飞凌工业用CoolSiC™ 2000 V SiC 沟槽MOSFET：采用 .XT 互连技术的碳化硅 MOSFET



特点

- V_{DSS} = 2000 V at T_{vj} = 25°C
- I_{DCC} = 48 A at T_c = 25°C
- $R_{DS(on)}$ = 50 mΩ at V_{GS} = 18 V, T_{vj} = 25°C
- 开关损耗非常低
- 基准栅极阈值电压，$V_{GS(th)}$ = 4.5 V
- 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

- 组串式逆变器
- 太阳能优化器
- 电动汽车充电

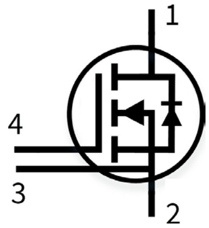
产品验证

- 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 - 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）



Type	Package	Marking
IMYH200R050M1H	PG-TO247-4-PLUS-NT14	20M1H050

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
Thermal resistance, junction-ambient	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			0.33	0.43	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		2000	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	48	A
			$T_c = 100$ °C	34	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 18$ V		102	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
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25$ °C	348	W
			$T_c = 100$ °C	174	

1) **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 Min.	Typ.	Max.	Unit
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 20$ A	$T_{vj} = 25$ °C, $V_{GS(on)} = 18$ V		50	64	mΩ
			$T_{vj} = 100$ °C, $V_{GS(on)} = 18$ V		85		
			$T_{vj} = 175$ °C, $V_{GS(on)} = 18$ V		150		
			$T_{vj} = 25$ °C, $V_{GS(on)} = 15$ V		54	70	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 12.1$ mA, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20$ V)	$T_{vj} = 25$ °C	3.5	4.5	5.5	V
			$T_{vj} = 175$ °C		3.6		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 2000$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C			300	µA
			$T_{vj} = 175$ °C		10		
Gate leakage current	I_{GSS}	$V_{DS} = 0$ V	$V_{GS} = 23$ V			100	nA
			$V_{GS} = -10$ V			-100	
Forward transconductance	g_{fs}	$I_D = 20$ A, $V_{DS} = 20$ V			10		S
Internal gate resistance	$R_{G,int}$	$f = 100$ kHz, $V_{AC} = 25$ mV			8		Ω
Input capacitance	C_{iss}	$V_{DD} = 1200$ V, $V_{GS} = 0$ V, $f = 100$ kHz, $V_{AC} = 25$ mV			2425		pF
Output capacitance	C_{oss}	$V_{DD} = 1200$ V, $V_{GS} = 0$ V, $f = 100$ kHz, $V_{AC} = 25$ mV			81		pF
Reverse transfer capacitance	C_{rss}	$V_{DD} = 1200$ V, $V_{GS} = 0$ V, $f = 100$ kHz, $V_{AC} = 25$ mV			5		pF
C_{oss} stored energy	E_{oss}	$V_{DD} = 1200$ V, $V_{GS} = 0$ V, $f = 100$ kHz, $V_{AC} = 25$ mV			57		µJ
Total gate charge	Q_G	$V_{DD} = 1200$ V, $I_D = 20$ A, $V_{GS} = -2/18$ V, turn-on pulse			82		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 1200$ V, $I_D = 20$ A, $V_{GS} = -2/18$ V, turn-on pulse			22		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 1200$ V, $I_D = 20$ A, $V_{GS} = -2/18$ V, turn-on pulse			11.1		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 1200$ V, $I_D = 20$ A, $V_{GS} = -2/18$ V, $R_{GS(on)} = 2$ Ω, $R_{GS(off)} = 2$ Ω, $L_\sigma = 15$ nH, diode: body diode at $V_{GS} = -2$ V	$T_{vj} = 25$ °C		17		ns
			$T_{vj} = 175$ °C		19		

（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} = 1200 V, I_D = 20 A, V_{GS} = -2/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -2 V	T_{vj} = 25 °C		9		ns
			T_{vj} = 175 °C		10		
Turn-off delay time	$t_{d(off)}$	V_{DD} = 1200 V, I_D = 20 A, V_{GS} = -2/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -2 V	T_{vj} = 25 °C		36		ns
			T_{vj} = 175 °C		51		
Fall time	t_f	V_{DD} = 1200 V, I_D = 20 A, V_{GS} = -2/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -2 V	T_{vj} = 25 °C		12		ns
			T_{vj} = 175 °C		13		
Turn-on energy	E_{on}	V_{DD} = 1200 V, I_D = 20 A, V_{GS} = -2/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -2 V	T_{vj} = 25 °C		830		µJ
			T_{vj} = 175 °C		1220		
Turn-off energy	E_{off}	V_{DD} = 1200 V, I_D = 20 A, V_{GS} = -2/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -2 V	T_{vj} = 25 °C		160		µJ
			T_{vj} = 175 °C		170		
Total switching energy	E_{tot}	V_{DD} = 1200 V, I_D = 20 A, V_{GS} = -2/18 V, $R_{GS(on)}$ = 2 Ω, $R_{GS(off)}$ = 2 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -2 V	T_{vj} = 25 °C		1270		µJ
			T_{vj} = 175 °C		1950		
Virtual junction temperature	T_{vj}			-55		175	°C

注： *该芯片技术的特征高达100 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

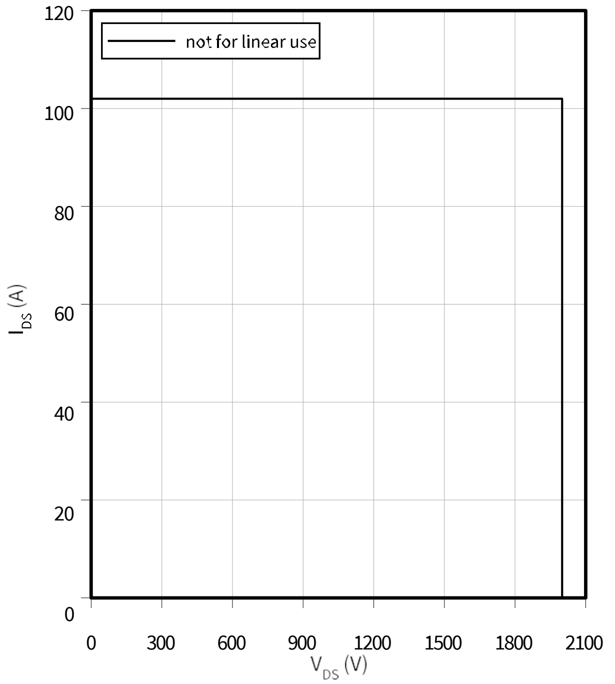
Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25$ °C		2000	V
Continuous reverse drain current for $R_{th(j\text{-}c,max)}$, limited by $T_{vj(max)}$	I_{SDC}	$V_{GS} = 0$ V	$T_c = 25$ °C	49	A
			$T_c = 100$ °C	39	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0$ V		64	A

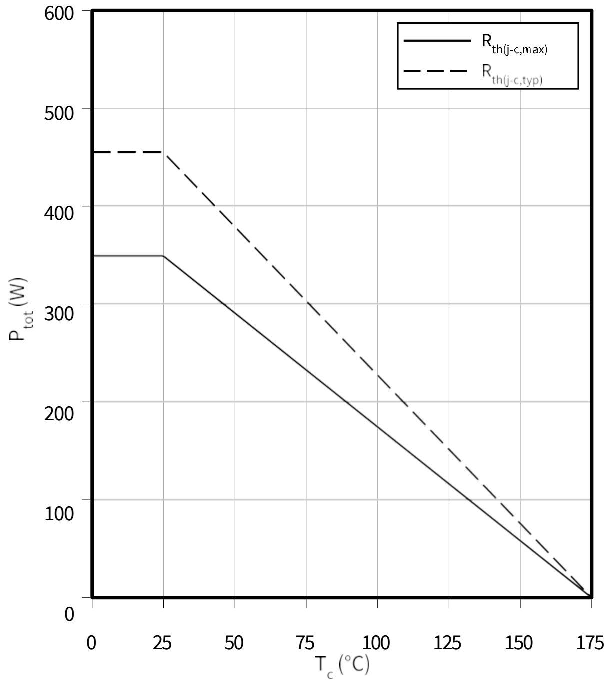
表6 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 20$ A, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		3.7	5.5	V
			$T_{vj} = 100$ °C		3.6		
			$T_{vj} = 175$ °C		3.5		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 1200$ V, $I_{SD} = 20$ A, V_{GS}=-2 V, $R_{GS(on)} = 2$ Ω, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		500		nC
			$T_{vj} = 175$ °C		988		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 1200$ V, $I_{SD} = 20$ A, V_{GS}=-2 V, $di_{SD}/dt = 750$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		14		A
			$T_{vj} = 175$ °C		16		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 1200$ V, $I_{SD} = 20$ A, V_{GS}=-2 V, $R_{GS(on)} = 2$ Ω, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		280		µJ
			$T_{vj} = 175$ °C		560		
Virtual junction temperature	T_{vj}			-55		175	°C

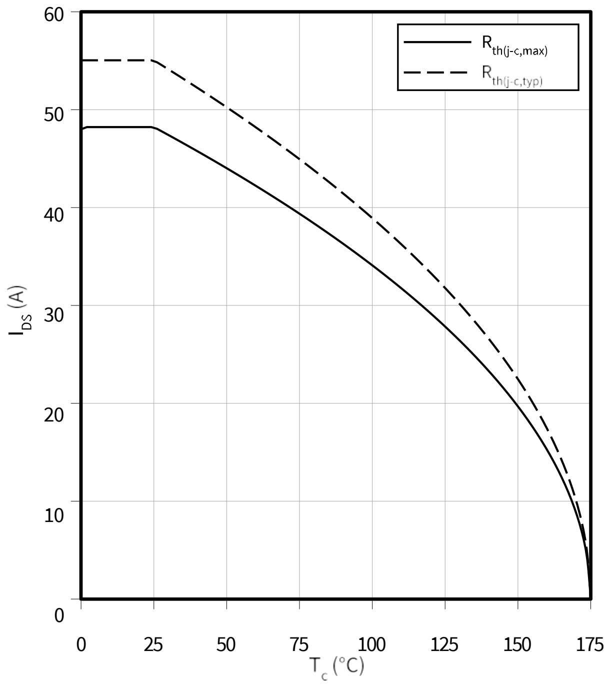
4 特性图

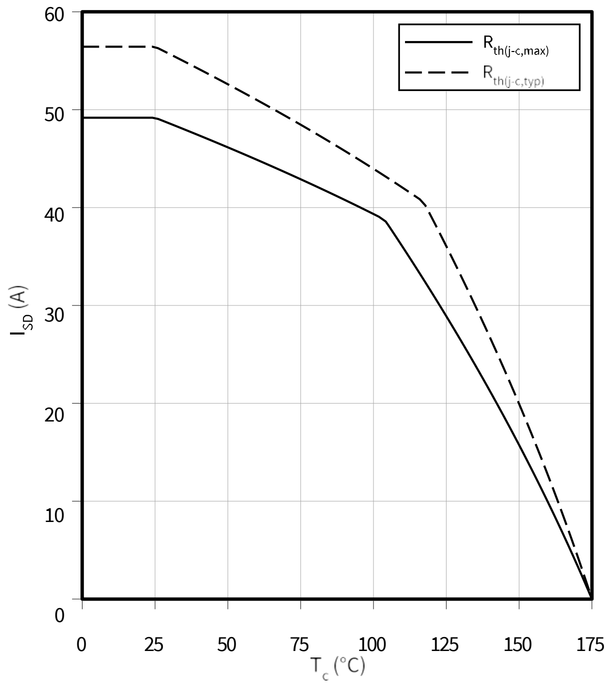
Reverse bias safe operating area (RBSOA) $I_{DS} = f(V_{DS})$ $T_{vj} \leq 175$ °C, $V_{GS} = 0/18$ V, $T_c = 25$ °C	Power dissipation as a function of case temperature limited by bond wire $P_{tot} = f(T_c)$





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

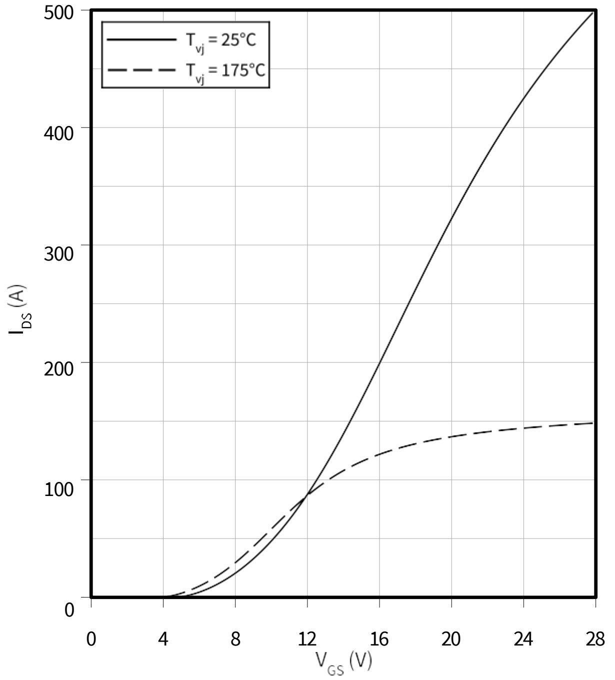




Typical transfer characteristic

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

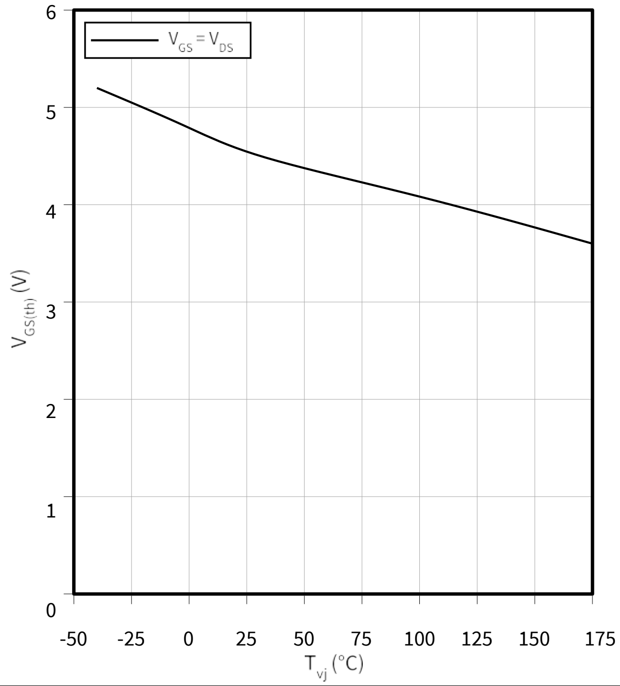
$V_{DS} = 20$ V, $t_p = 20$ µs



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

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

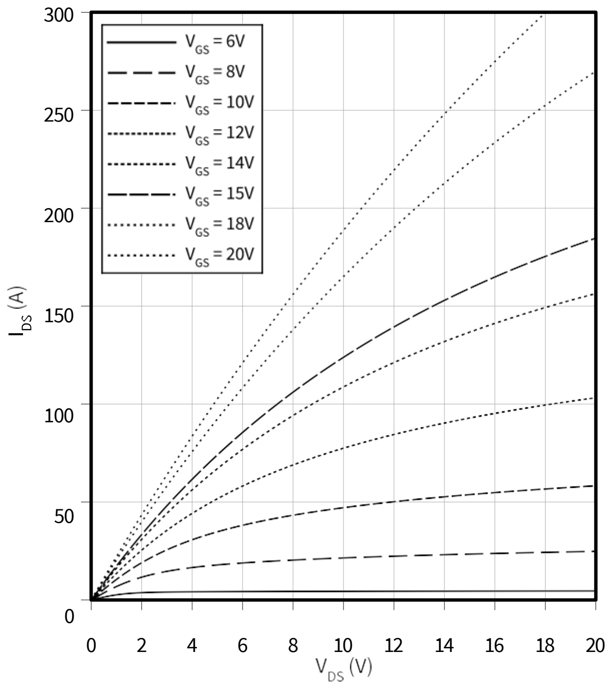
$I_D = 12.1$ mA



Typical output characteristic, V_{GS} as parameter

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

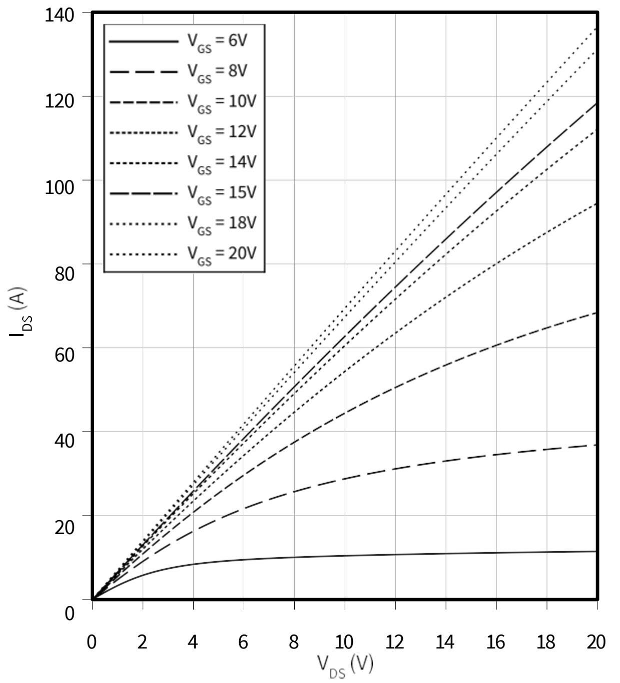
$T_{vj} = 25$ °C, $t_p = 20$ µs



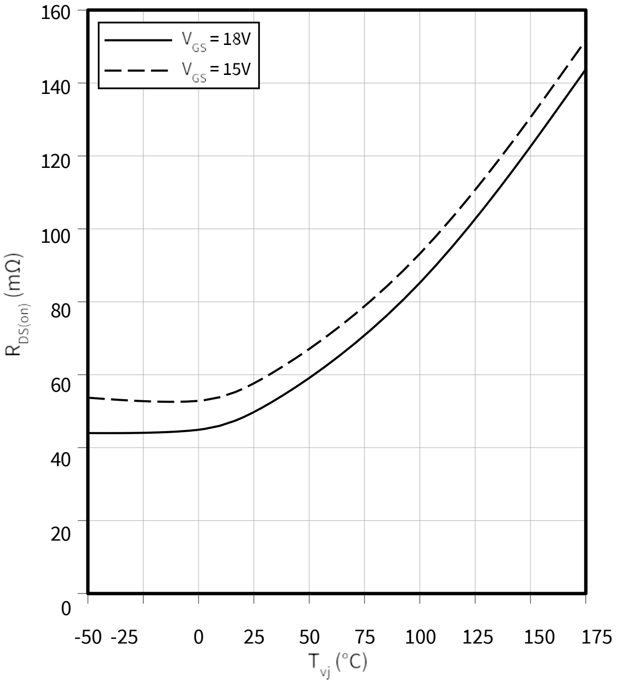
Typical output characteristic, V_{GS} as parameter

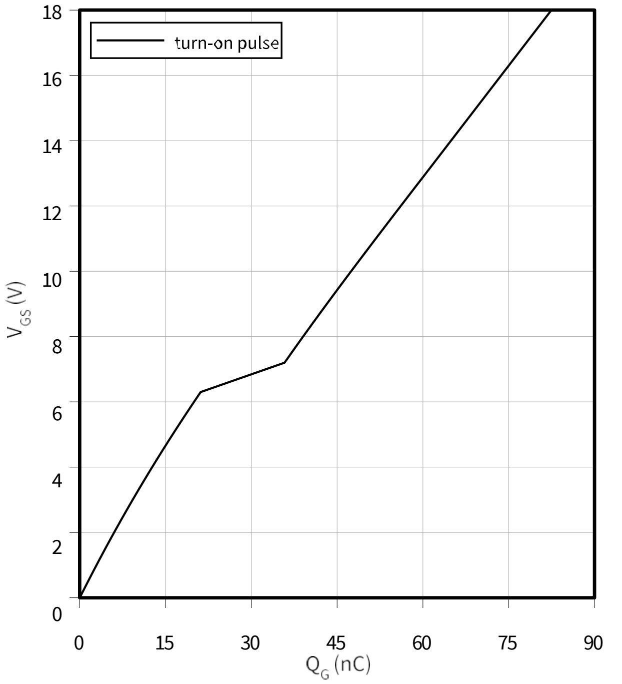
$I_{DS} = f(V_{DS})$

$T_{vj} = 175$ °C, $t_p = 20$ µs

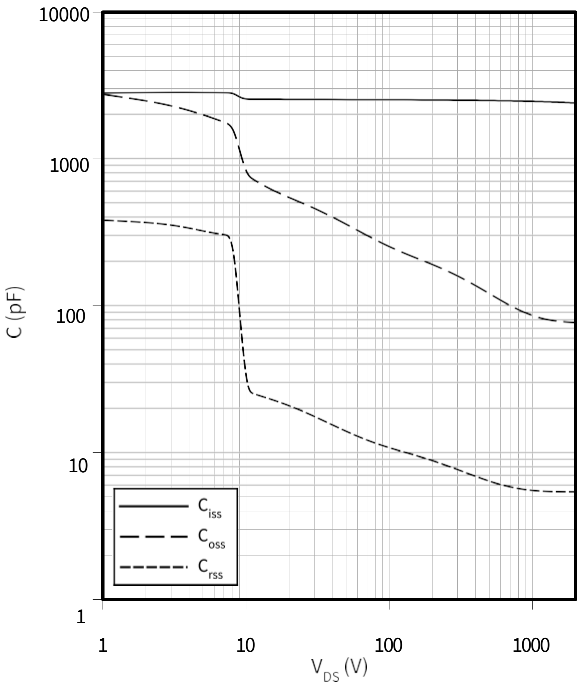


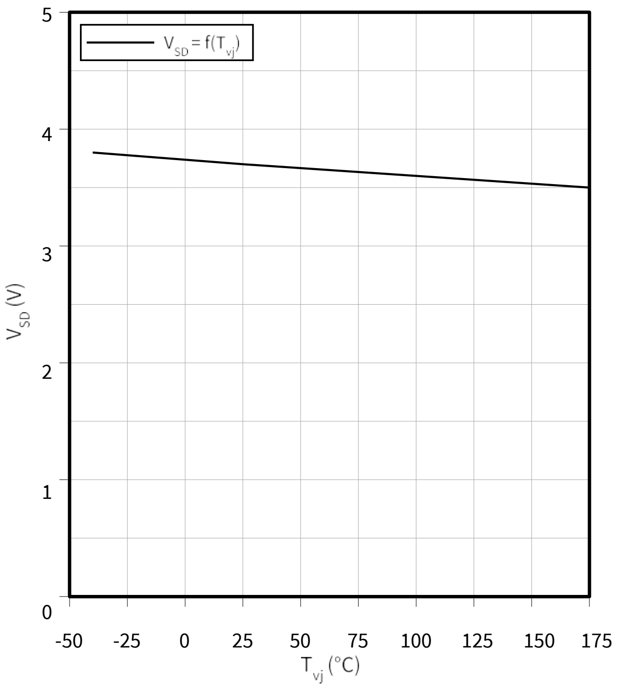
Typical on-state resistance as a function of junction temperature $R_{DS(on)} = f(T_{vj})$ $I_D = 20$ A	**Typical gate charge** $V_{GS} = f(Q_G)$ $I_D = 20$ A, $V_{DS} = 1200$ V





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** $V_{SD} = f(T_{vj})$ $I_{SD} = 20$ A, $V_{GS} = 0$ V

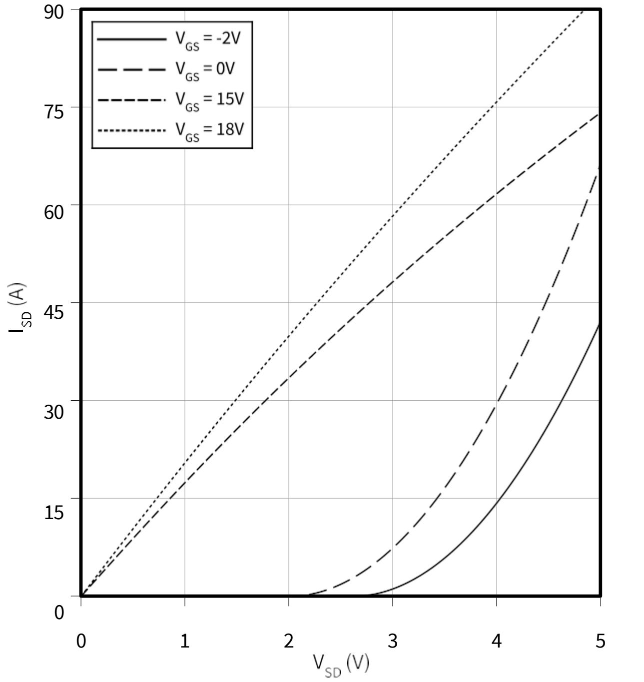




Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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

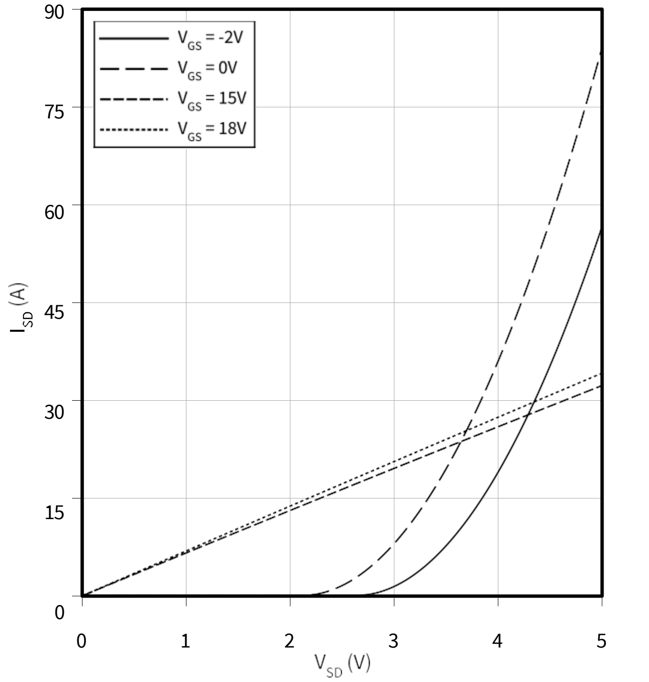
$T_{vj} = 25\ °C$, $t_p = 20\ µs$



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

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

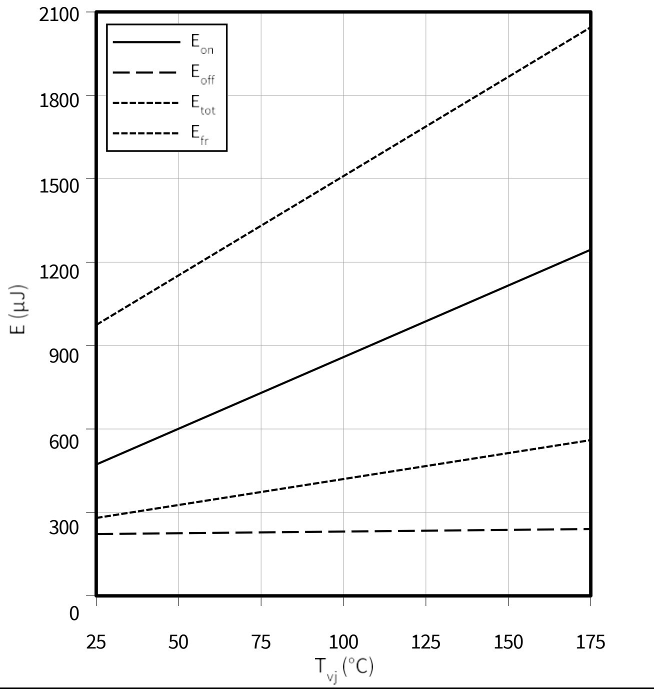
$T_{vj} = 175\ °C$, $t_p = 20\ µs$



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

$E = f(T_{vj})$

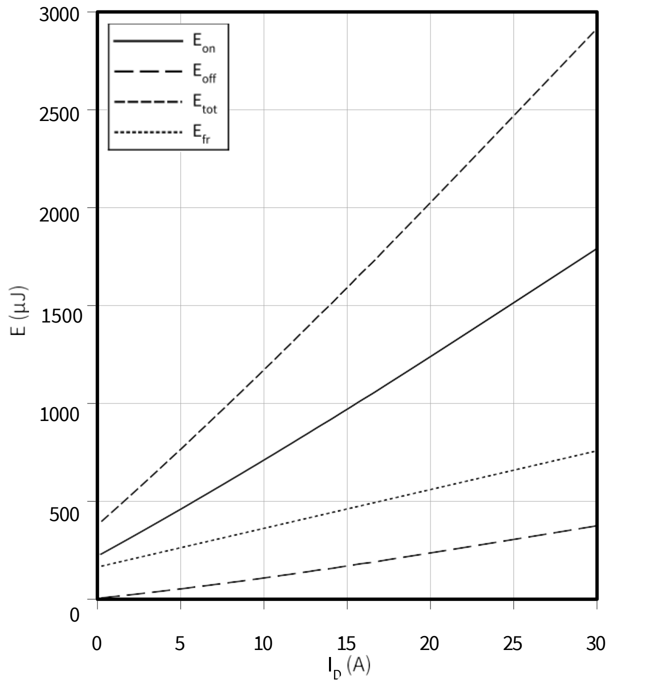
$V_{GS} = -2/18\ V$, $I_D = 20\ A$, $R_{G,ext} = 2\ Ω$, $V_{DD} = 1200\ V$

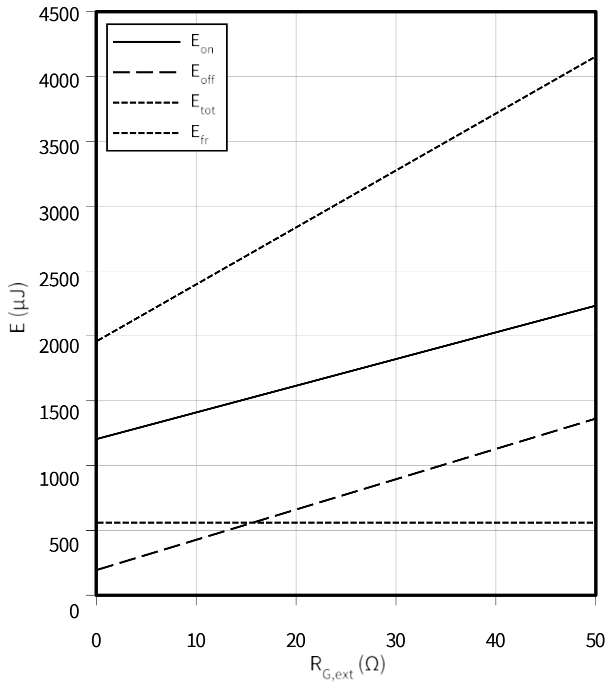
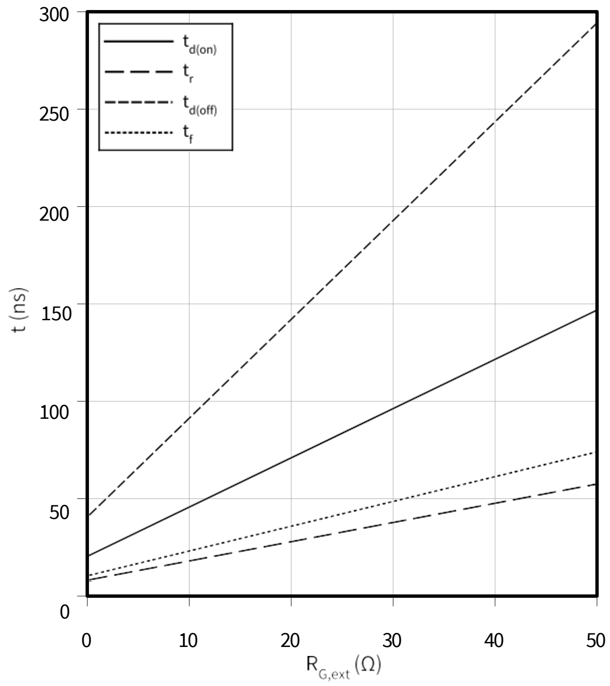
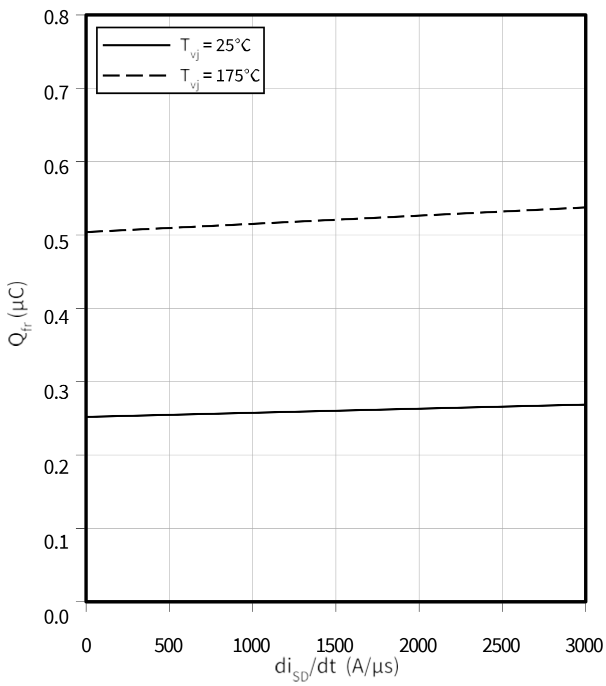
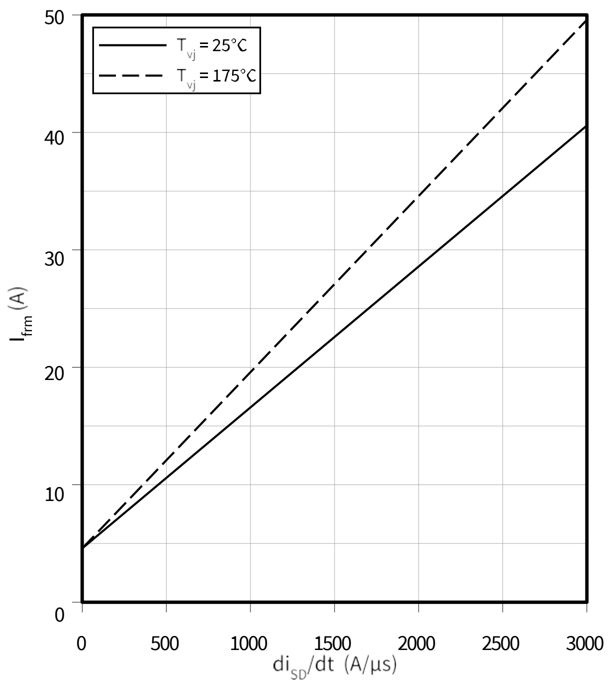


Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -2 V

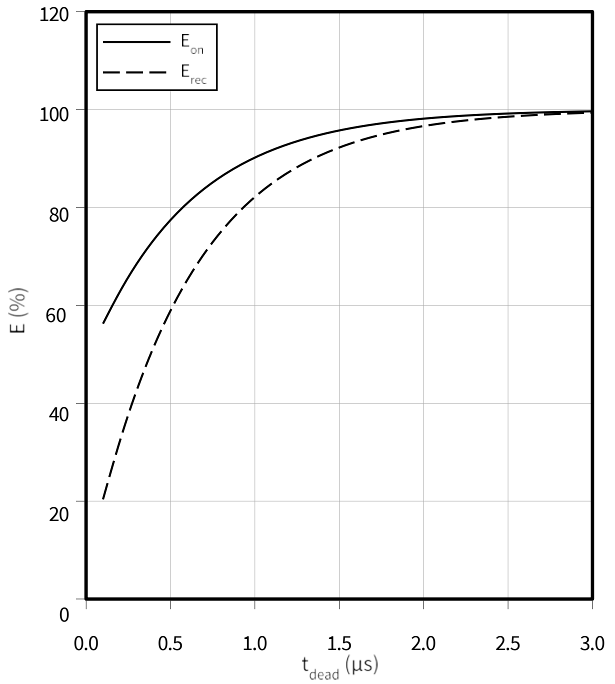
$E = f(I_D)$

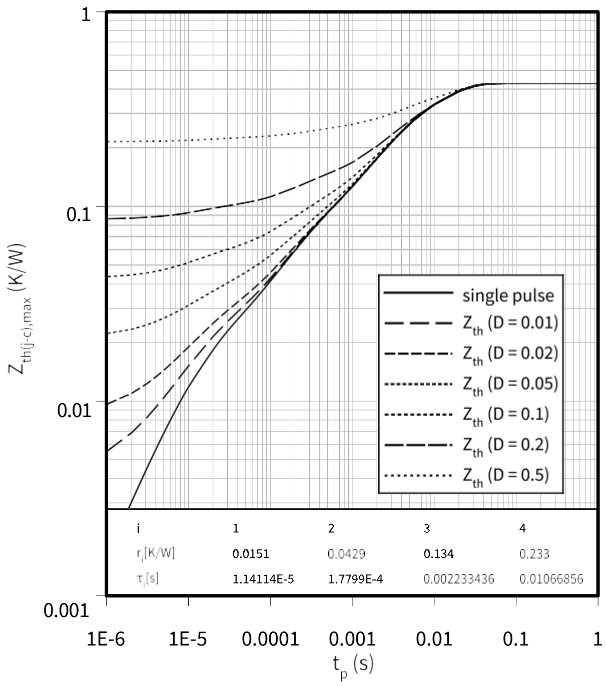
$V_{GS} = -2/18\ V$, $T_{vj} = 175\ °C$, $R_{G,ext} = 2\ Ω$, $V_{DD} = 1200\ V$



Typical switching energy losses as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -2 V	**Typical switching times as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -2 V**
$E = f(R_{G,ext})$	$t = f(R_{G,ext})$
V_{GS} = -2/18 V, I_D = 20 A, T_{vj} = 175 °C, V_{DD} = 1200 V	I_D = 20 A, T_{vj} = 175 °C, V_{DD} = 1200 V, V_{GS} = -2/18 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} = -2 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} = -2 V**
$Q_{fr} = f(di_{SD}/dt)$	$I_{frm} = f(di_{SD}/dt)$
V_{GS} = -2/18 V, I_{SD} = 20 A, V_{DD} = 1200 V	V_{GS} = -2/18 V, I_{SD} = 20 A, V_{DD} = 1200 V
	

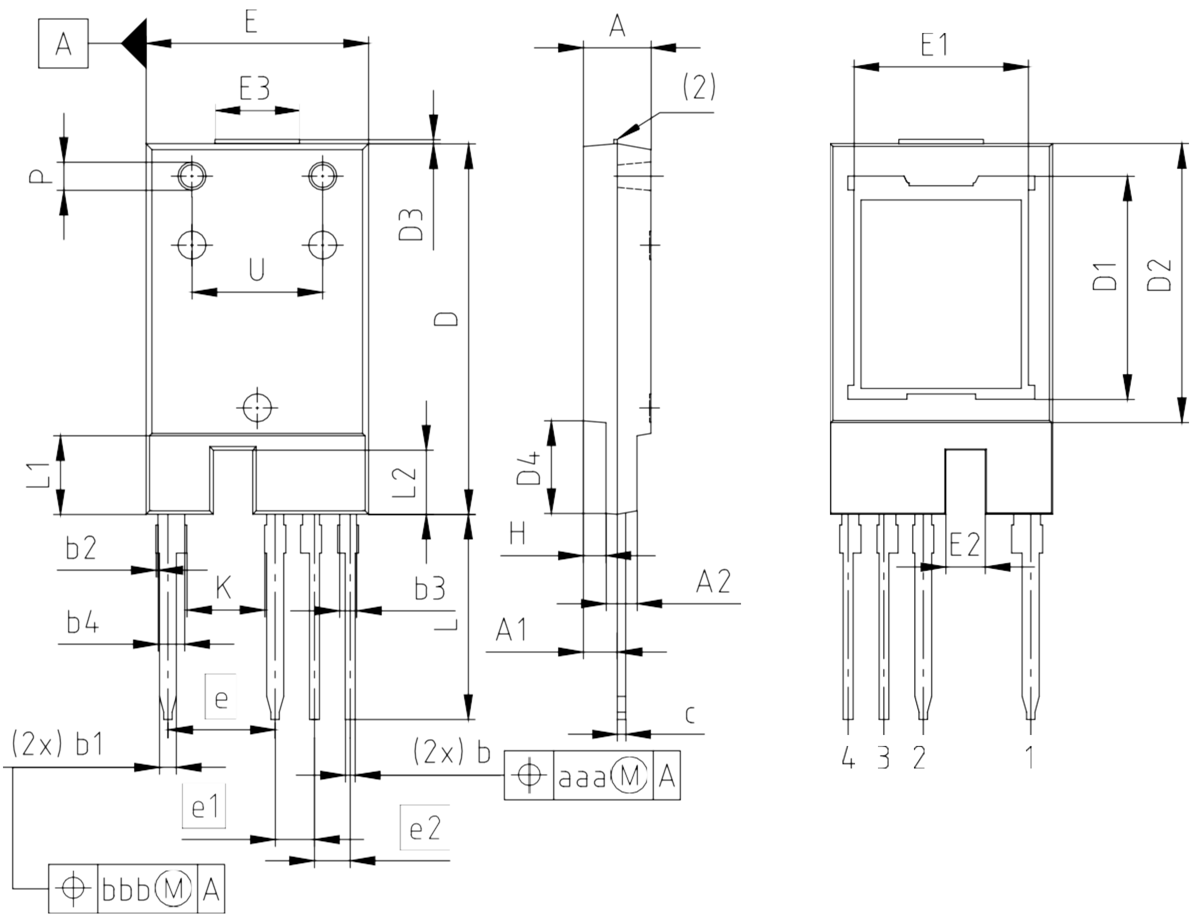
Typical switching energy losses as a function of dead time / blanking time, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -5 V $E = f(t_{dead})$ I_D = 20 A, T_{vj} = 175 °C, $R_{G,ext}$ = 2 Ω, V_{DD} = 1200 V	**Max. transient thermal impedance (MOSFET/diode)** $Z_{th(j\text{-}c),max} = f(t_p)$ $D = t_p/T$





5 封装外形

PG-TO247-4-PLUS-NT14



NOTES:
(1) ALL METAL SURFACES TIN PLATED EXPECT AREA OF CUT
(2) MOLD GATE PROTRUSION AFTER DEGATING

PACKAGE - GROUP NUMBER:	PG-TO247-4-U04				
DIMENSIONS	MILLIMETERS		DIMENSIONS	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	4.65	4.95	E1	12.00	12.80
A1	2.16	2.66	E2	2.60	3.00
A2	2.00	2.40	E3	5.00	7.00
b	0.60	0.80	e	7.62	
b1	1.10	1.30	e1	2.79	
b2	---	0.15	e2	2.54	
b3	1.10	1.30	H	1.51	1.71
b4	1.70	2.10	K	5.50	---
c	0.50	0.70	N	4	
D	26.00	26.70	L	14.30	14.90
D1	15.50	16.30	L1	5.40	5.70
D2	19.40	20.20	L2	5.40	5.70
D3	---	0.50	ØP	1.75	2.25
D4	6.35	6.65	U	9.00	9.50
E	15.60	16.00	aaa	0.25	
			bbb	0.25	

图 1

6 测试条件

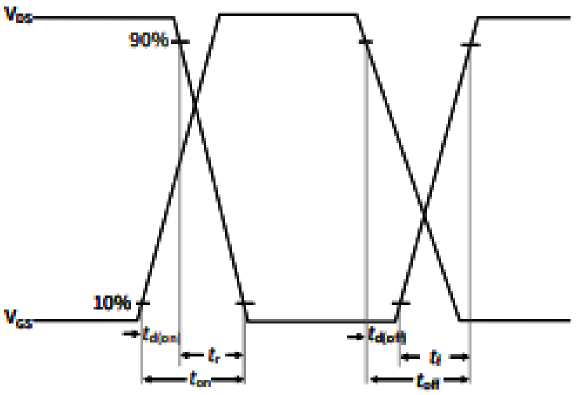


Figure A. **Definition of switching times**

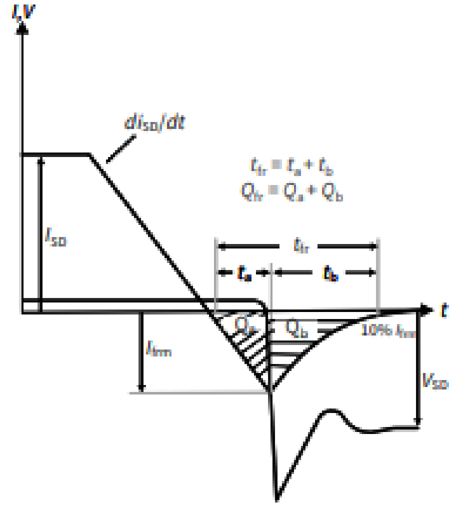


Figure B. **Definition of body diode switching characteristics**

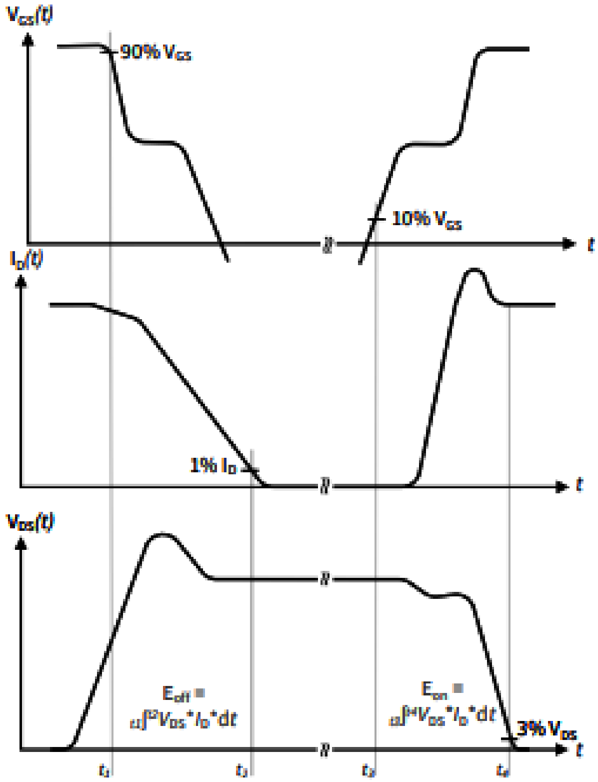


Figure C. **Definition of switching losses**

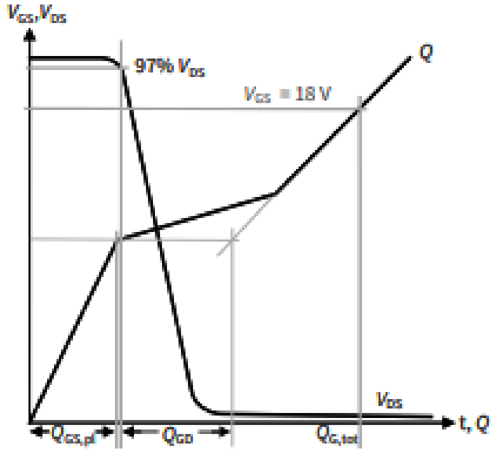


Figure D. **Definition of QGD**

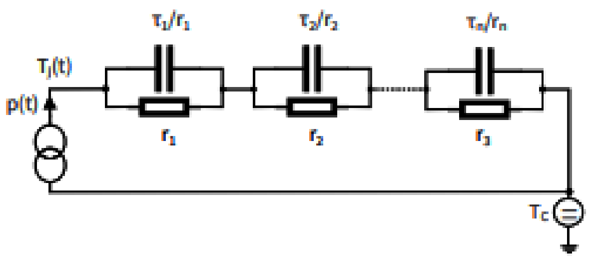


Figure E. **Thermal equivalent circuit**

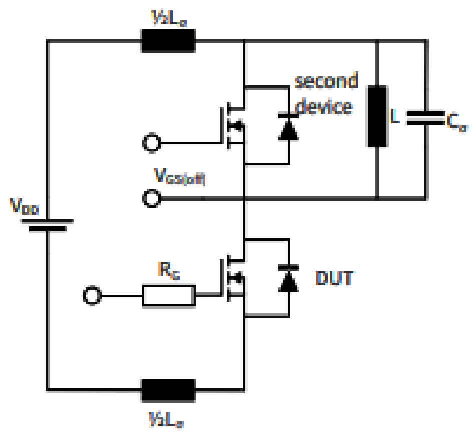


Figure F. **Dynamic test circuit**
Parasitic inductance Lσ,
Parasitic capacitor Cσ,

修订记录

Document revision	Date of release	Description of changes
0.10	2022-03-08	Preliminary datasheet
1.00	2022-10-04	Final datasheet
1.01	2022-10-06	Editorial changes
1.10	2023-01-16	Change of picture on page 1 Change of product outline drawing on page 13 Editorial changes

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