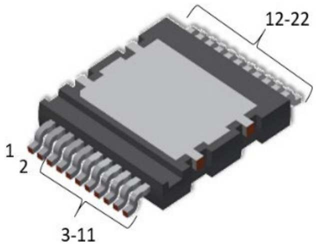
英飞凌 IMCQ120R017M2H

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

特性

- V_{DSS} = 1200 V 时 T_{vj} = 25°C
- I_{DDC} = 84 A 时 T_{C} = 100°C
- $R_{DS(on)}$ = 17.1mΩ V_{GS} = 18V、 T_{vj} = 25°C 时
- 开关损耗非常低
- 过载运行最高结温可达 T_{vj} = 200°C
- 短路耐受时间 2 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
- .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



Halogen-free

Green

Lead-free

RoHS

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

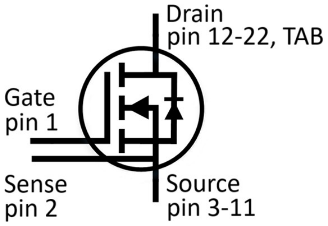
- 符合JEDEC47/20/22相关测试的工业应用要求

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
IMCQ120R017M2H	PG-HDSOP-22-U03	12M2H017

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}	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	$R_{th(j-c)}$			0.2	0.26	K/W
Comparative Tracking Index	*CTI*	IEC 60112 (material group 1 according to IEC 60664-1)	600			V

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	118	A
			$T_c = 100$ °C	84	
Peak drain current, t_p limited by $T_{vj(max)}$ 1)	I_{DM}	$V_{GS} = 18$ V		420	A
Gate-source voltage, max. transient voltage 2)	V_{GS}	$t_p \leq 0.5$ µs, $D < 0.01$		-10...25	V
Gate-source voltage, max. static voltage	V_{GS}			-7...23	V
Avalanche energy, single pulse	E_{AS}	$I_D = 40$ A, $V_{DD} = 50$ V, $L = 0.6$ mH		508	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 40$ A, $V_{DD} = 50$ V, $L = 3.1$ µH		2.54	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		2	µs
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25$ °C	580	W
			$T_c = 100$ °C	290	

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	$R_{DS(on)}$	$I_D = 40$ A	$T_{vj} = 25$ °C, $V_{GS(on)} = 18$ V		17.1		mΩ
			$T_{vj} = 150$ °C, $V_{GS(on)} = 18$ V		35	45	
			$T_{vj} = 175$ °C, $V_{GS(on)} = 18$ V		40.6		
			$T_{vj} = 25$ °C, $V_{GS(on)} = 15$ V		21.4		
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 12.7$ mA, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20$ V)	$T_{vj} = 25$ °C	3.5	4.2	5.1	V
			$T_{vj} = 175$ °C		3.2		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C			350	µA
			$T_{vj} = 175$ °C		6		
Gate leakage current	I_{GSS}	$V_{DS} = 0$ V	$V_{GS} = 23$ V			120	nA
			$V_{GS} = -10$ V			-120	
Forward transconductance	g_{fs}	$I_D = 40$ A, $V_{DS} = 20$ V			13.6		S
Internal gate resistance	$R_{G,int}$	$f = 1$ MHz, $V_{AC} = 25$ mV			2.9		Ω
Input capacitance	C_{iss}	$V_{DS} = 800$ V, $V_{GS} = 0$ V, $f = 100$ kHz, $V_{AC} = 25$ mV			3.73		nF
Output capacitance	C_{oss}	$V_{DS} = 800$ V, $V_{GS} = 0$ V, $f = 100$ kHz, $V_{AC} = 25$ mV			126		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}	Calculated based on $C_{oss} = f(V_{DD})$			53		µJ
Output charge	Q_{oss}	Calculated based on $C_{oss} = f(V_{DD})$			196		nC
Effective output capacitance, energy related	$C_{o(er)}$	$V_{DS} = 0...800$ V, $V_{GS} = 0$ V, Calculated based on E_{oss}			166		pF
Effective output capacitance, time related	$C_{o(tr)}$	$I_D =$ constant, $V_{DS} = 0...800$ V, $V_{GS} = 0$ V, Calculated based on Q_{oss}			245		pF
Total gate charge	Q_G	$V_{DD} = 800$ V, $I_D = 40$ A, $V_{GS} = -2/18$ V, turn-on pulse			91.1		nC

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表 4　　（续） 特征值

Parameter	**Symbol**	**Note or test condition**		**Values**			**Unit**
				Min.	**Typ.**	**Max.**	
Plateau gate charge	$Q_{GS(pl)}$	V_{DD} = 800 V, I_D = 40 A, V_{GS} = -2/18 V, turn-on pulse			22.4		nC
Gate-drain charge	Q_{GD}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = -2/18 V, turn-on pulse			20.6		nC
Turn-on delay time	$t_{d(on)}$	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		10		ns
			T_{vj} = 175 °C		7.4		
Rise time	t_r	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		6		ns
			T_{vj} = 175 °C		5.3		
Turn-off delay time	$t_{d(off)}$	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		20.8		ns
			T_{vj} = 175 °C		24.4		
Fall time	t_f	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		8.9		ns
			T_{vj} = 175 °C		10.5		
Turn-on energy	E_{on}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		330		µJ
			T_{vj} = 175 °C		590		
Turn-off energy	E_{off}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		110		µJ
			T_{vj} = 175 °C		180		
Total switching energy1)	E_{tot}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = 0/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		580		µJ
			T_{vj} = 175 °C		1170		

（表格续下页……）

表 4 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy at -5 V	E_{on}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = -5/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -5 V	T_{vj} = 25 °C		308		µJ
			T_{vj} = 175 °C		602		
Turn-off energy at -5 V	E_{off}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = -5/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -5 V	T_{vj} = 25 °C		80		µJ
			T_{vj} = 175 °C		88		
Total switching energy at -5 V[1]	E_{tot}	V_{DD} = 800 V, I_D = 40 A, V_{GS} = -5/18 V, $R_{G,ext}$ = 2.3 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = -5 V	T_{vj} = 25 °C		585		µJ
			T_{vj} = 175 °C		1373		
Virtual junction temperature	T_{vj}			-55		175	°C
Virtual junction temperature	$T_{vj(over)}$	overload, cumulative max. 100 h[2]				200	°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°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} ≥ 25 °C		1200	V
Continuous reverse drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{SDC}	V_{GS} = 0 V	T_c = 25 °C	99	A
			T_c = 100 °C	56.6	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	V_{GS} = 0 V		252	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} = 40 A, V_{GS} = 0 V	T_{vj} = 25 °C		4.2	5.5	V
			T_{vj} = 100 °C		4.1		
			T_{vj} = 175 °C		4		
MOSFET forward recovery charge	Q_{fr}	V_{DD} = 800 V, I_{SD} = 40 A, V_{GS} = 0 V, $R_{G,ext}$ = 2.3 Ω, Q_{fr} includes also Q_C	T_{vj} = 25 °C		0.33		µC
			T_{vj} = 175 °C		0.99		
MOSFET peak forward recovery current	I_{frm}	V_{DD} = 800 V, I_{SD} = 40 A, V_{GS} = 0 V, $R_{G,ext}$ = 2.3 Ω, Q_{fr} includes also Q_C	T_{vj} = 25 °C		44		A
			T_{vj} = 175 °C		81		
MOSFET forward recovery energy	E_{fr}	V_{DD} = 800 V, I_{SD} = 40 A, V_{GS} = 0 V, $R_{G,ext}$ = 2.3 Ω, Q_{fr} includes also Q_C	T_{vj} = 25 °C		140		µJ
			T_{vj} = 175 °C		400		
MOSFET forward recovery energy at -5 V	E_{fr}	V_{DD} = 800 V, I_{SD} = 40 A, V_{GS} = -5 V, $R_{G,ext}$ = 2.3 Ω, Q_{fr} includes also Q_C	T_{vj} = 25 °C		197		µJ
			T_{vj} = 175 °C		683		
Virtual junction temperature	T_{vj}			-55		175	°C
Virtual junction temperature	$T_{vj(over)}$	overload, cumulative max. 100 h(1)				200	°C

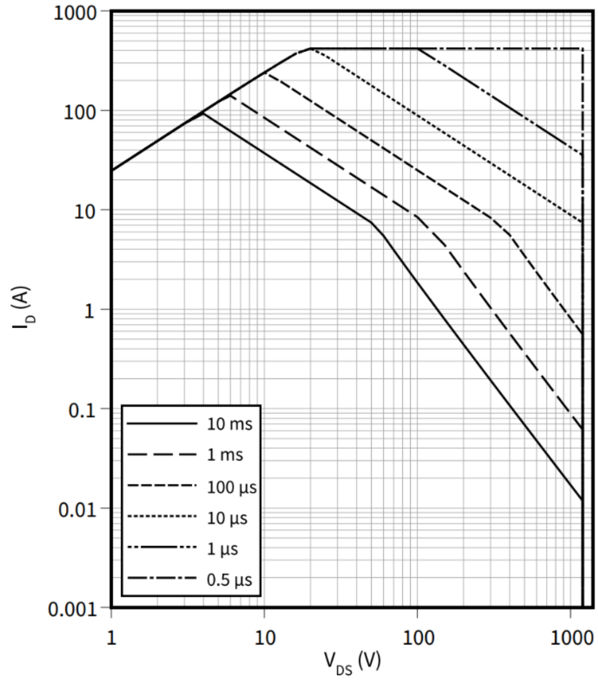
1) 最多 5000 次循环。最大Δ T 限制为 100 K。

4 特性图

Safe operating area (SOA)

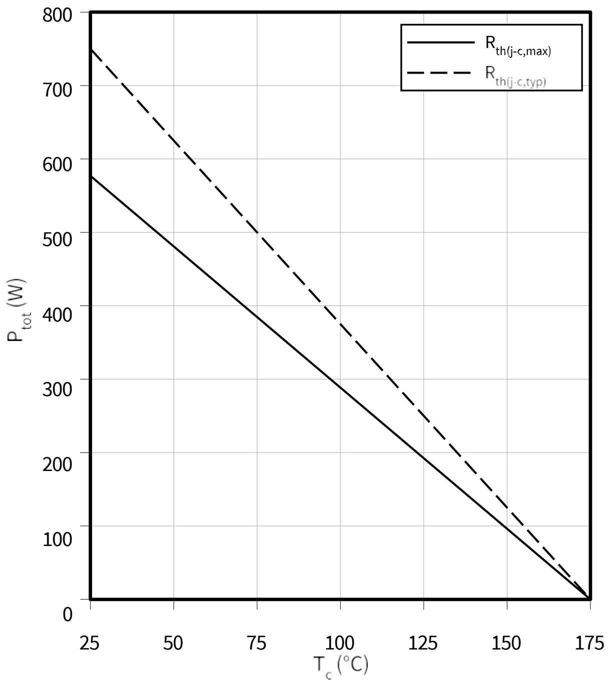
$I_D = f(V_{DS})$

$T_{vj} \leq 175$ °C, $T_c = 25$ °C



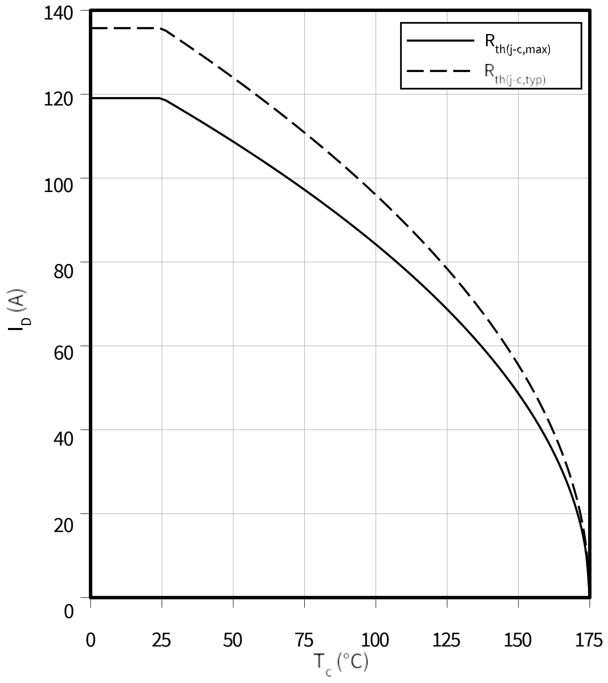
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



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

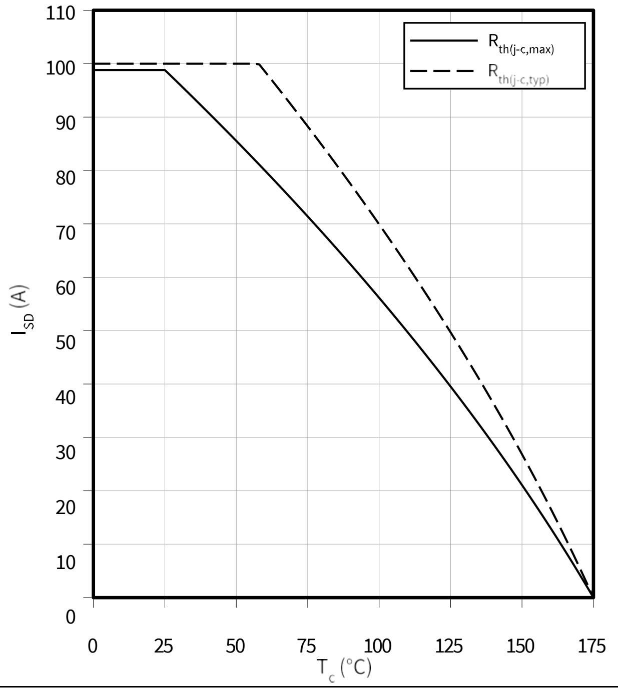
$I_D = f(T_c)$



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

$I_{SD} = f(T_c)$

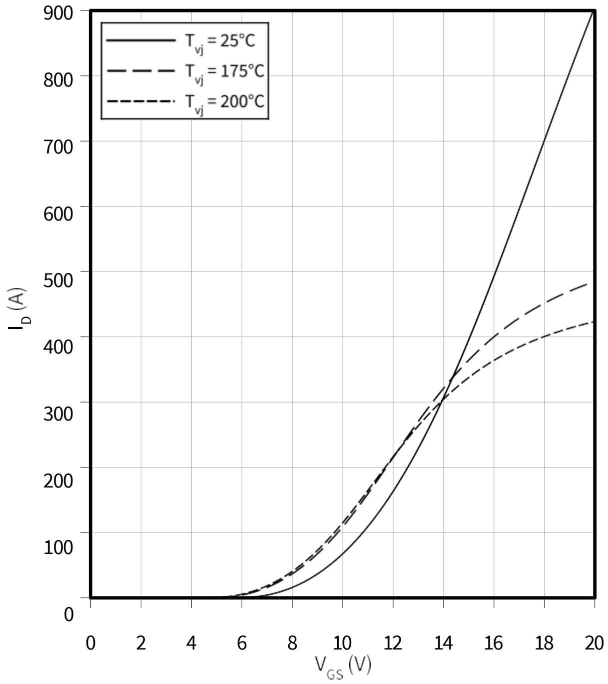
$V_{GS} = 0$ V



Typical transfer characteristic

$I_D = f(V_{GS})$

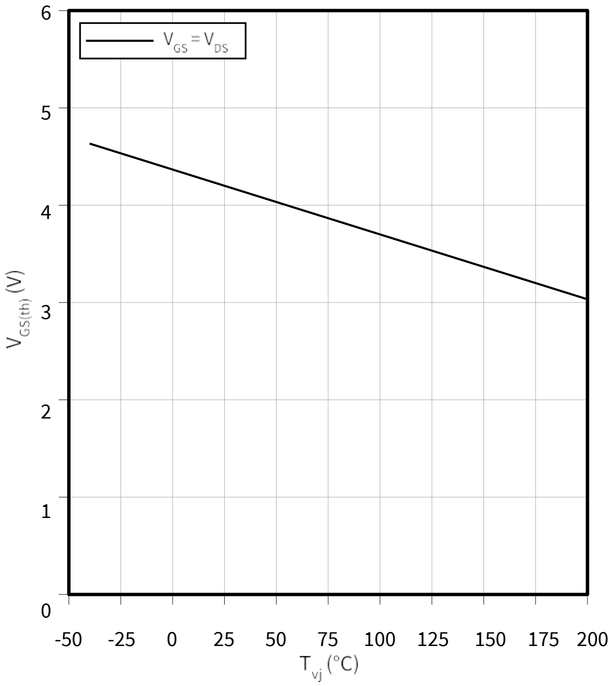
$V_{DS} = 20$ V, $t_p = 20$ µs



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

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

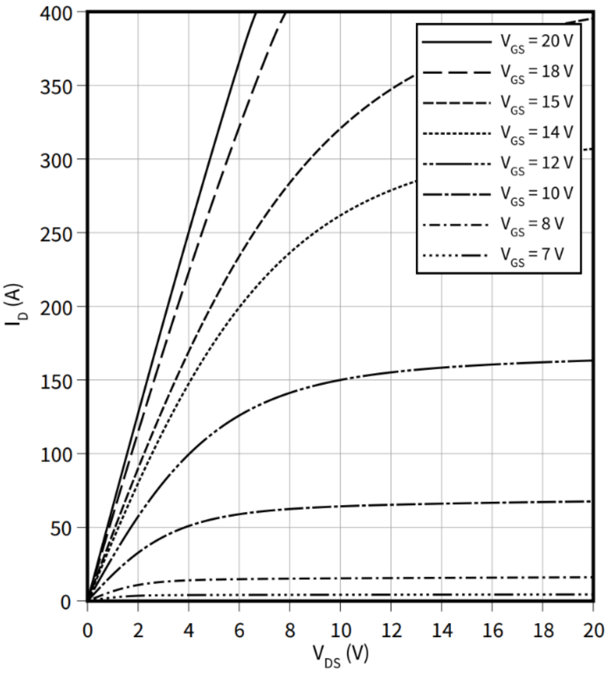
$I_D = 12.7$ mA



Typical output characteristic, V_{GS} as a parameter

$I_D = f(V_{DS})$

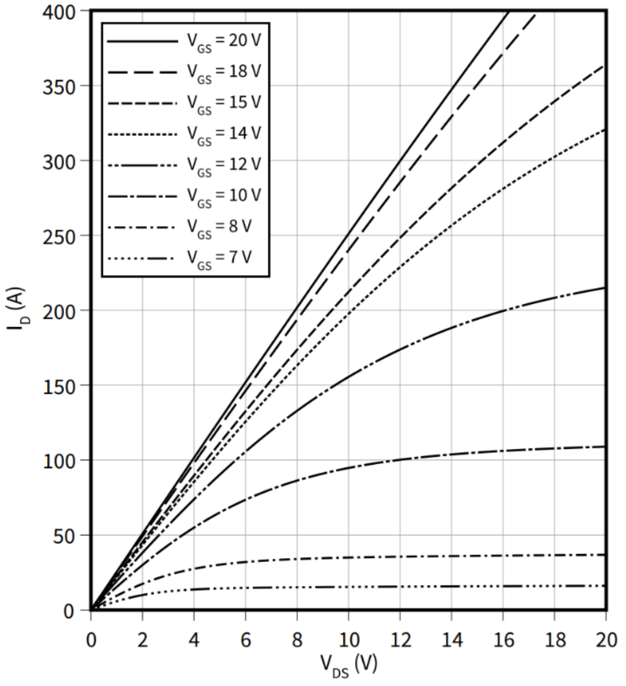
$T_{vj} = 25$ °C, $t_p = 20$ µs



Typical output characteristic, V_{GS} as a parameter

$I_D = f(V_{DS})$

$T_{vj} = 175$ °C, $t_p = 20$ µs

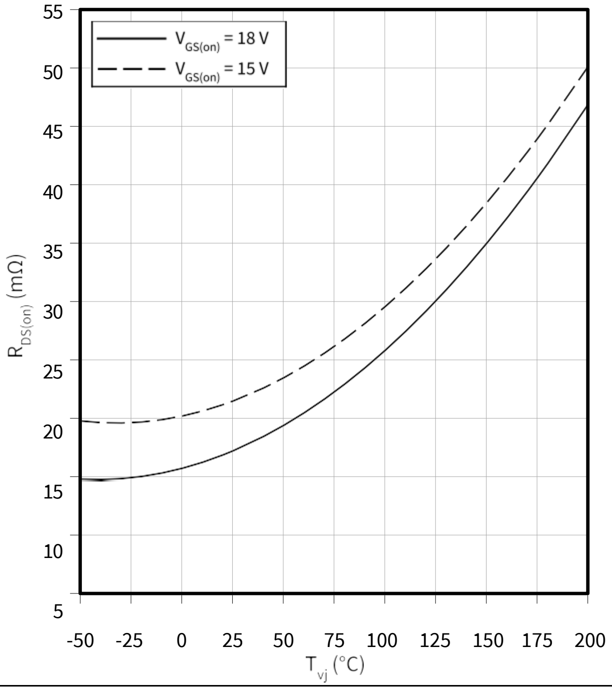


4 特性图

Typical on-state resistance as a function of junction temperature

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

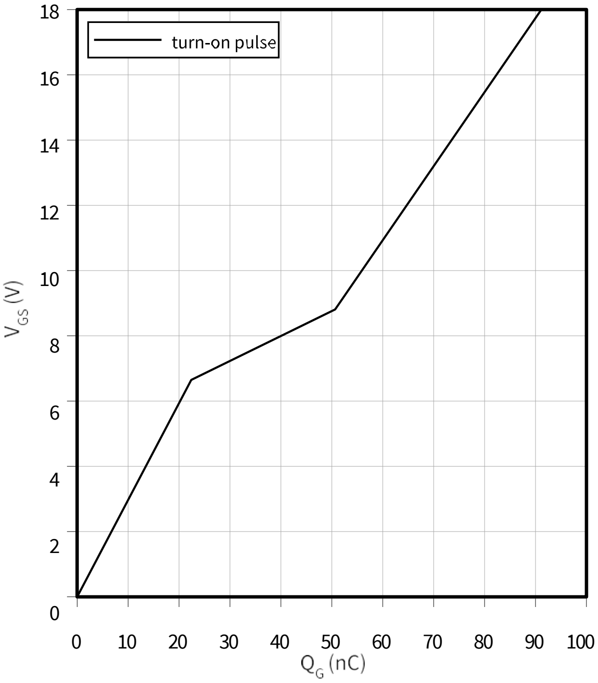
$I_D = 40$ A



Typical gate charge

$V_{GS} = f(Q_G)$

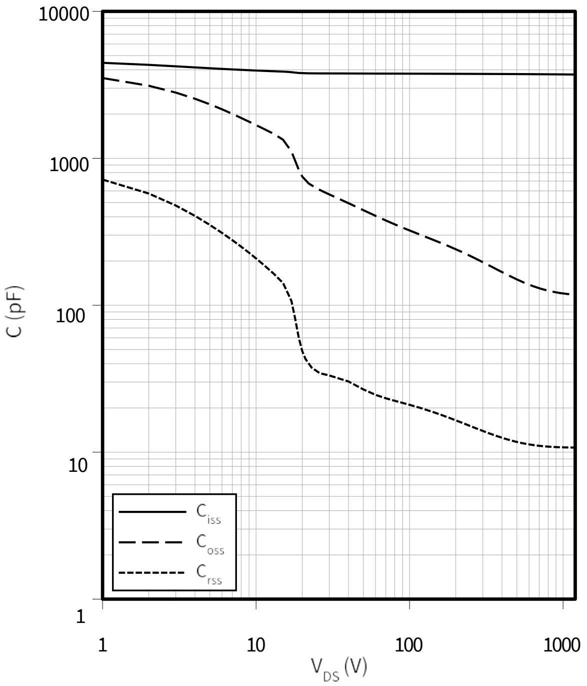
$I_D = 40$ A, $V_{DS} = 800$ V



Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$

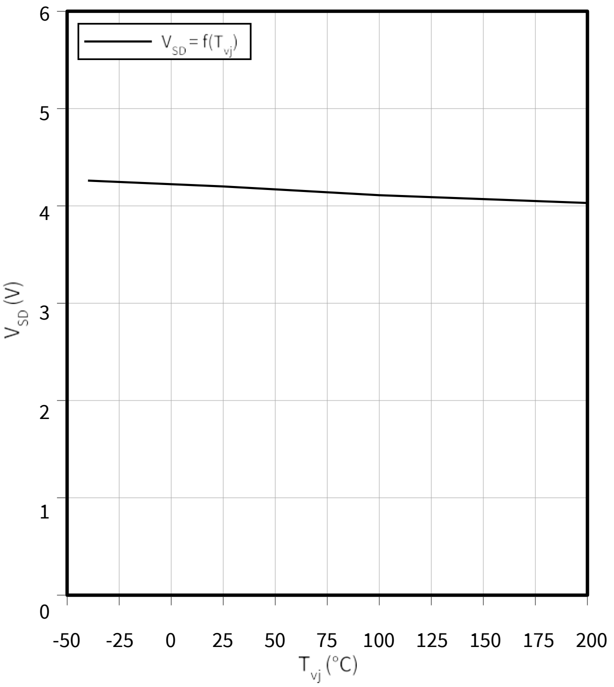
f = 100 kHz, $V_{GS} = 0$ V



Typical reverse drain voltage as a function of junction temperature

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

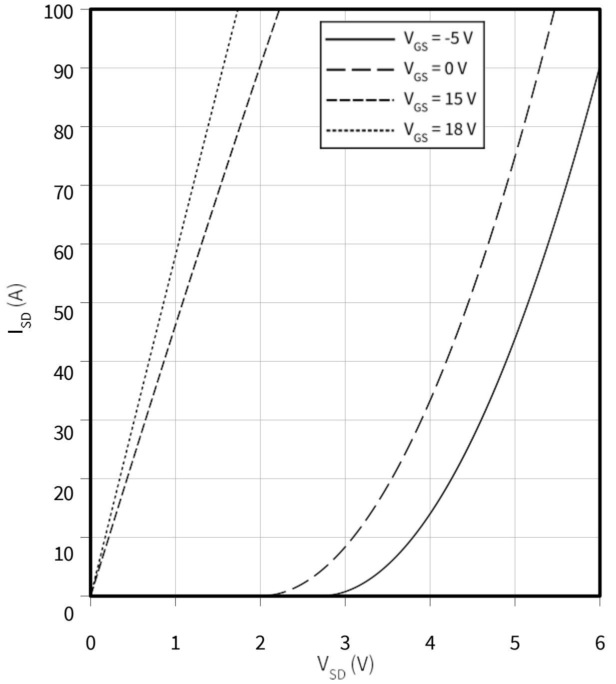
$I_{SD} = 40$ A, $V_{GS} = 0$ V



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

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

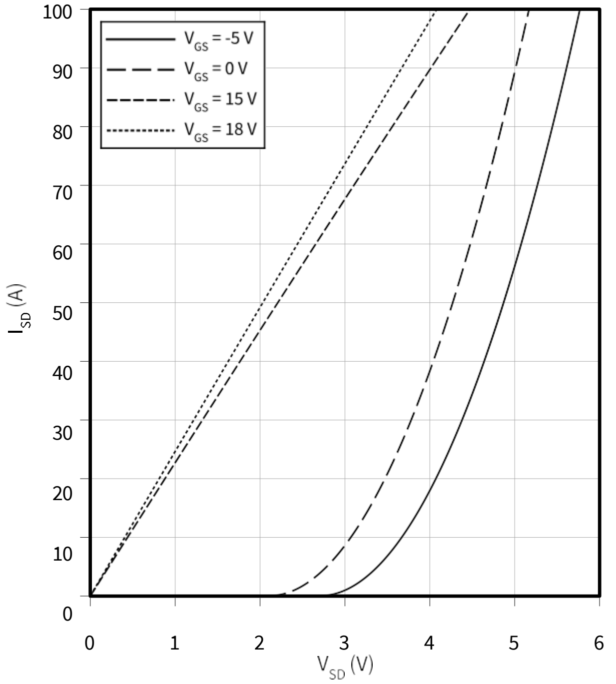
$T_{vj} = 25$ °C, $t_p = 20$ µs



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

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

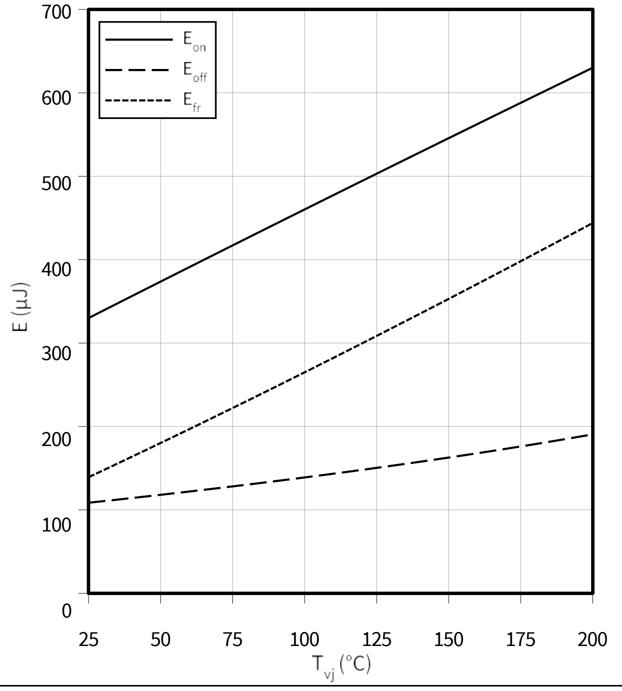
$T_{vj} = 175$ °C, $t_p = 20$ µs



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

$E = f(T_{vj})$

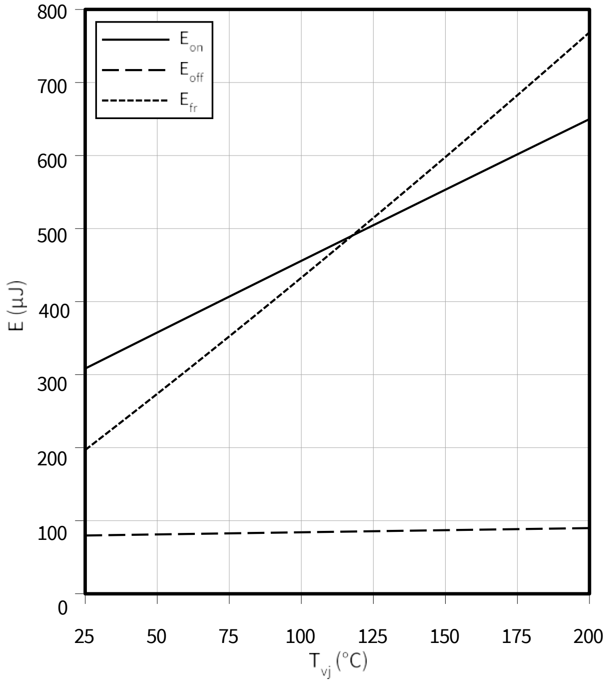
$V_{GS} = 0/18$ V, $I_D = 40$ A, $R_{G,ext} = 2.3$ Ω, $V_{DD} = 800$ V



Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -5 V

$E = f(T_{vj})$

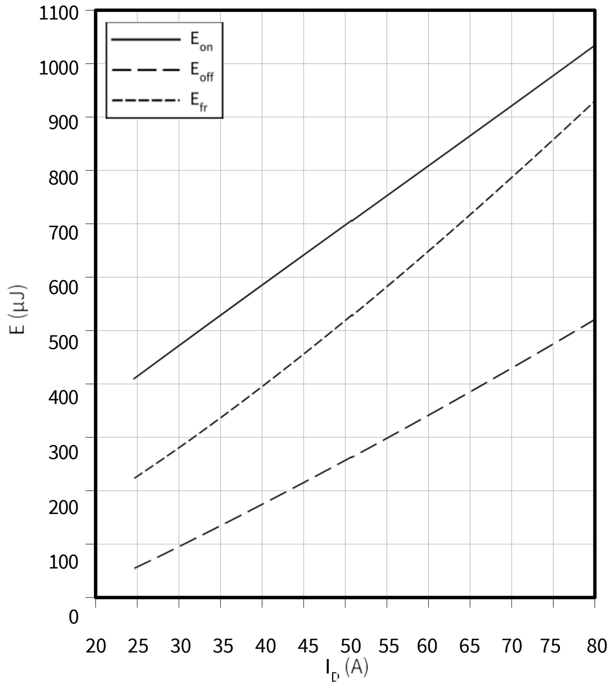
$V_{GS} = -5/18$ V, $I_D = 40$ A, $R_{G,ext} = 2.3$ Ω, $V_{DD} = 800$ V



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(I_D)

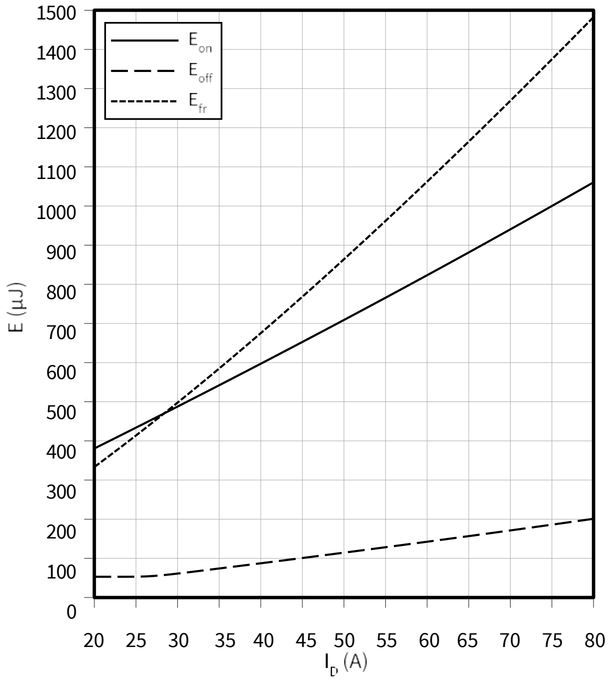
V_{GS} = 0/18 V, T_{vj} = 175 °C, $R_{G,ext}$ = 2.3 Ω, V_{DD} = 800 V



Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -5 V

E = f(I_D)

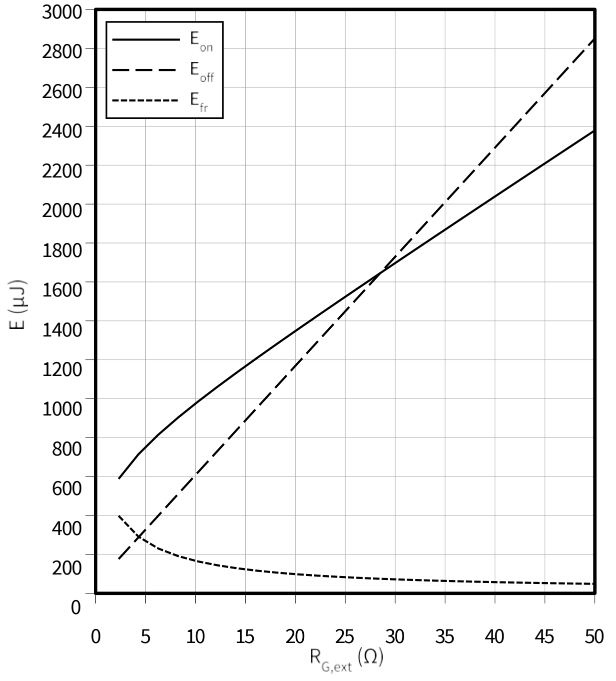
V_{GS} = -5/18 V, T_{vj} = 175 °C, $R_{G,ext}$ = 2.3 Ω, V_{DD} = 800 V



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

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

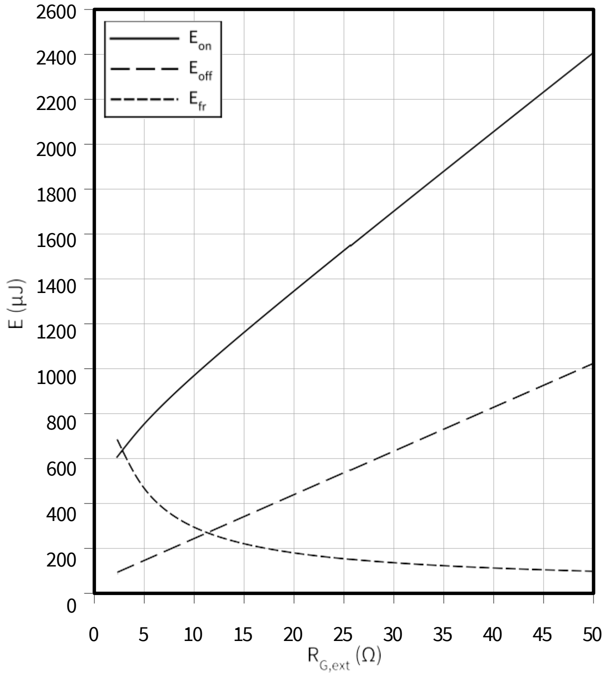
V_{GS} = 0/18 V, I_D = 40 A, T_{vj} = 175 °C, V_{DD} = 800 V



Typical switching energy as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -5 V

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

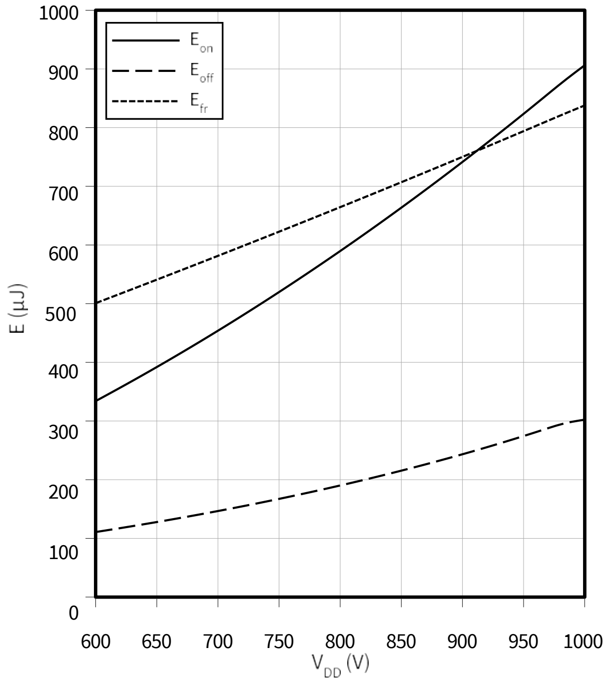
V_{GS} = -5/18 V, I_D = 40 A, T_{vj} = 175 °C, V_{DD} = 800 V



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

$E = f(V_{DD})$

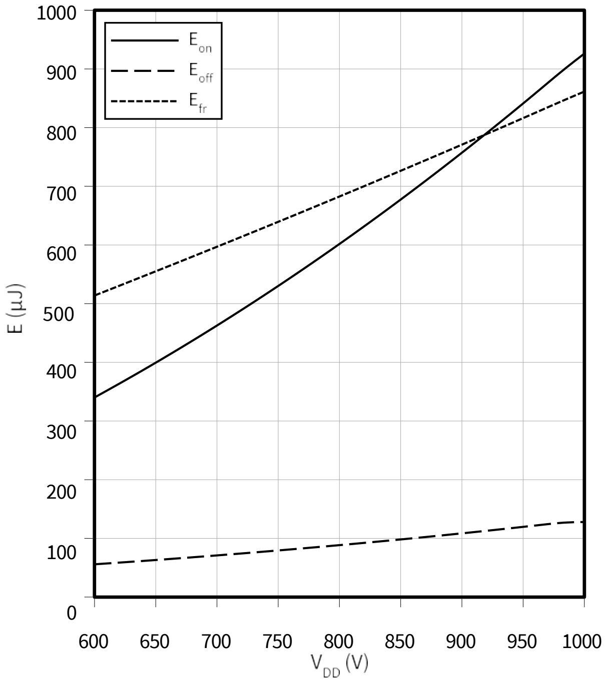
I_D = 40 A, T_{vj} = 175 °C, $R_{G,ext}$ = 2.3 Ω, V_{GS} = 0/18 V



Typical switching energy as a function of DC link voltage, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -5 V

$E = f(V_{DD})$

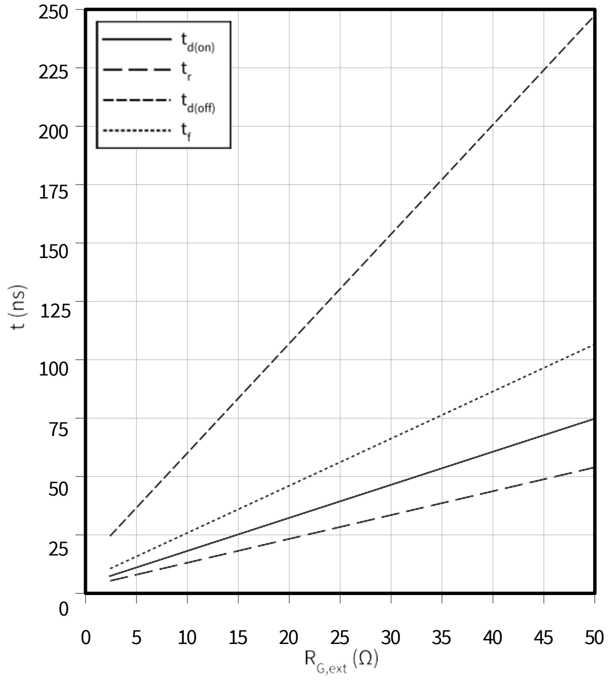
V_{GS} = -5/18 V, I_D = 40 A, T_{vj} = 175 °C, $R_{G,ext}$ = 2.3 Ω



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

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

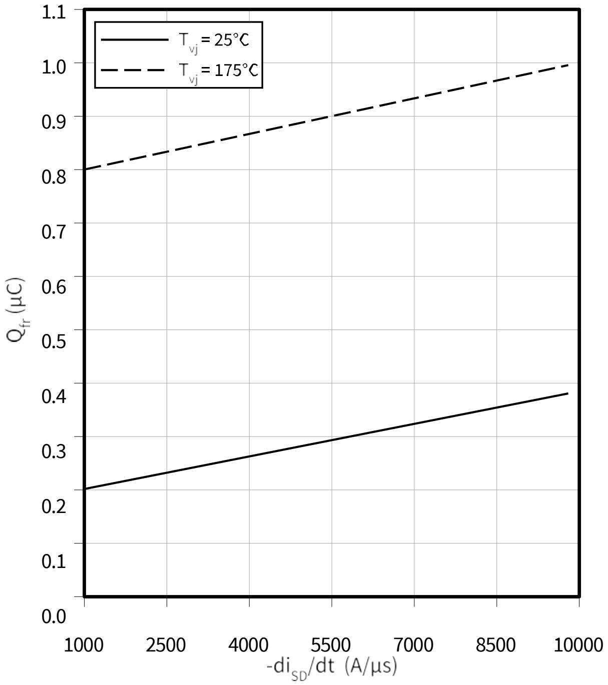
V_{GS} = 0/18 V, I_D = 40 A, T_{vj} = 175 °C, V_{DD} = 800 V



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

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

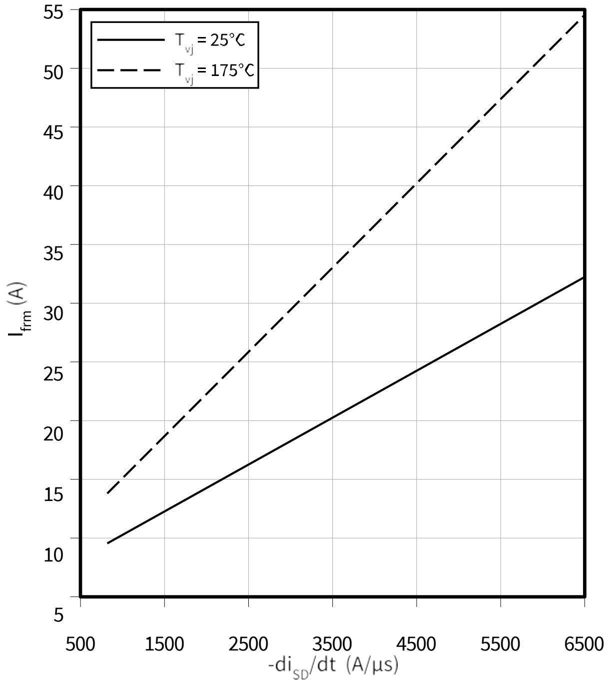
V_{GS} = 0/18 V, I_{SD} = 40 A, V_{DD} = 800 V



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

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

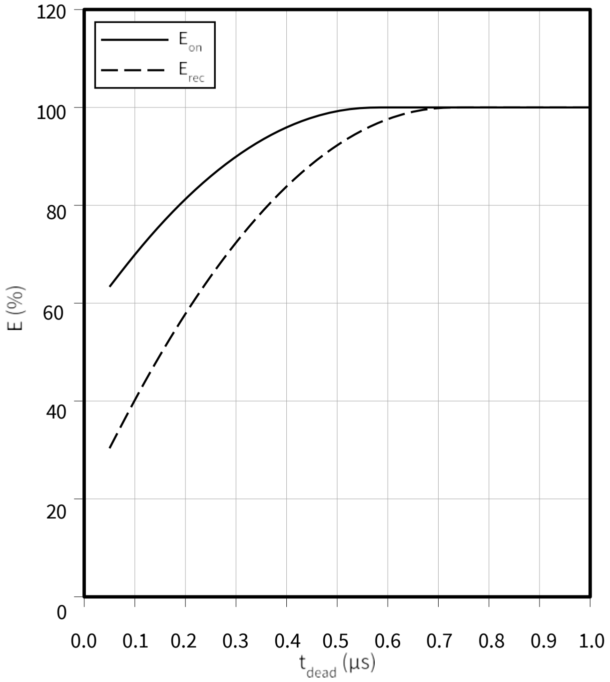
V_{GS} = 0/18 V, I_{SD} = 40 A, V_{DD} = 800 V



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

$E = f(t_{dead})$

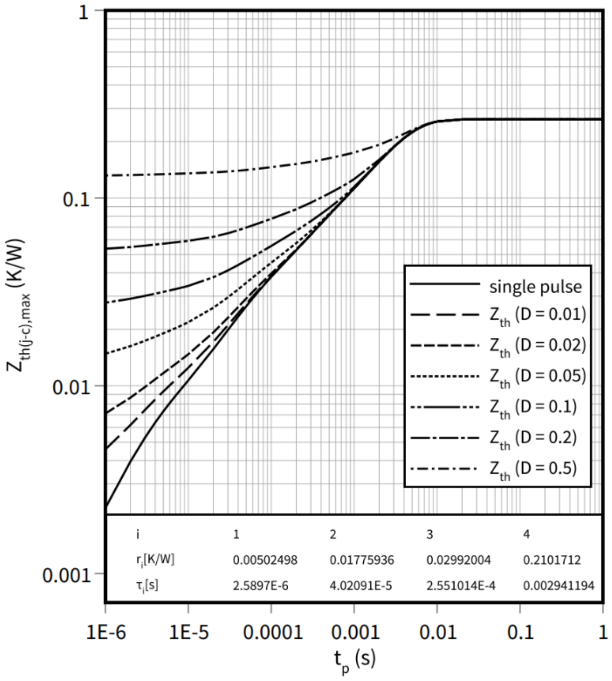
V_{GS} = 0/18 V, I_D = 40 A, T_{vj} = 175 °C, $R_{G,ext}$ = 2.3 Ω V_{DD} = 800 V



Max. transient thermal impedance (MOSFET/diode)

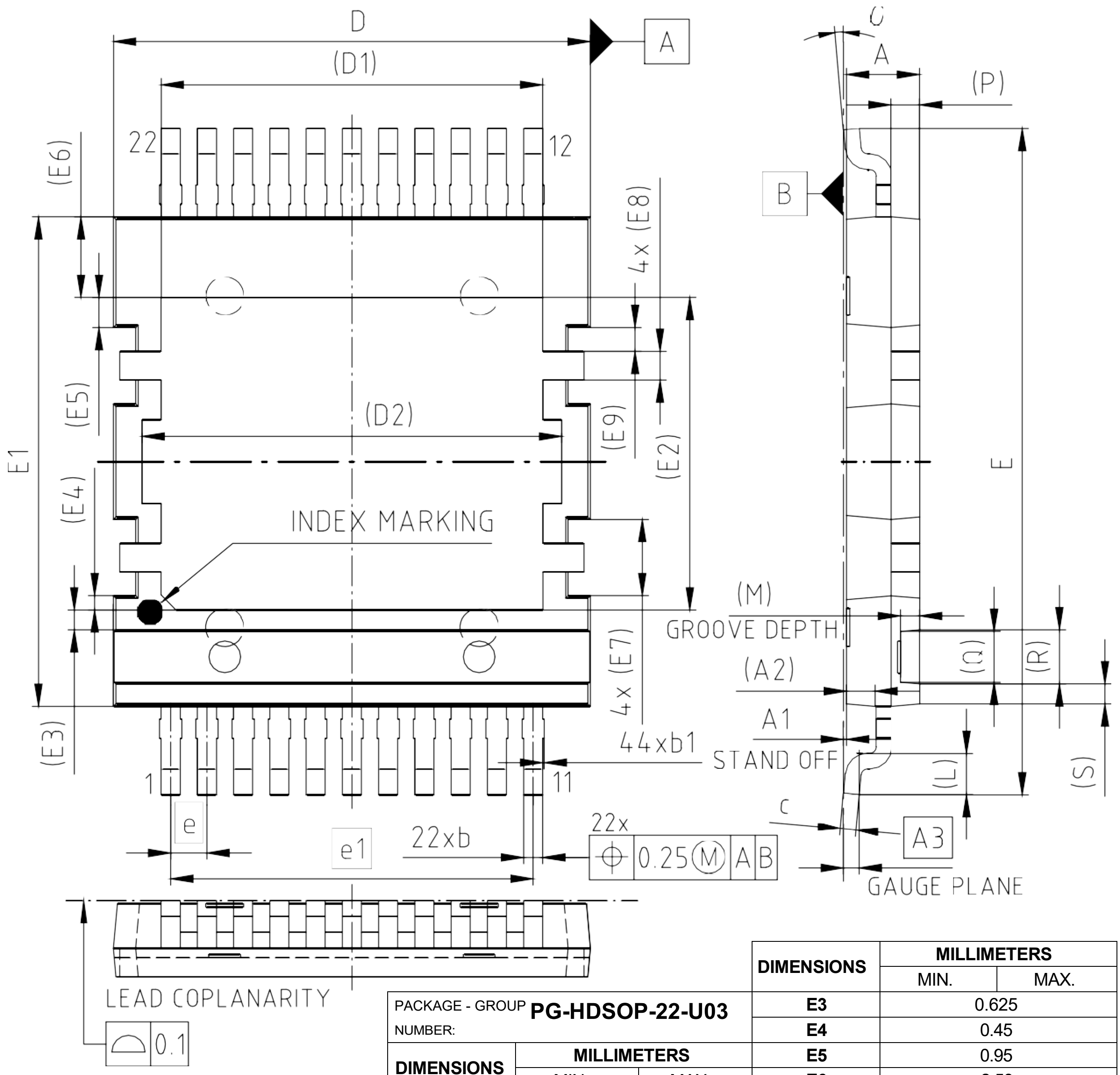
$Z_{th(j-c),max} = f(t_p)$

$D = t_p/T$



i	1	2	3	4
r_i[K/W]	0.00502498	0.01775936	0.02992004	0.2101712
$τ_i$[s]	2.5897E-6	4.02091E-5	2.551014E-4	0.002941194

5 封装外形



NOTES:

ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT

DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS

PACKAGE - GROUP NUMBER: **PG-HDSOP-22-U03**

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	2.25	2.35
A1	0.00	0.15
A2	0.90	
A3	0.50	
b	0.50	0.70
b1	---	0.15
c	0.46	0.58
D	14.90	15.10
D1	12.00	
D2	13.20	
E	20.81	21.11
E1	15.30	15.50
E2	9.83	

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
E3	0.625	
E4	0.45	
E5	0.95	
E6	2.53	
E7	2.40	
E8	0.90	
E9	0.75	
e	1.14	
e1	11.4	
L	1.30	
M	0.60	
N	22	
O	0°	8°
P	0.90	
Q	1.60	
R	1.70	
S	0.631	

图 1

6 测试条件

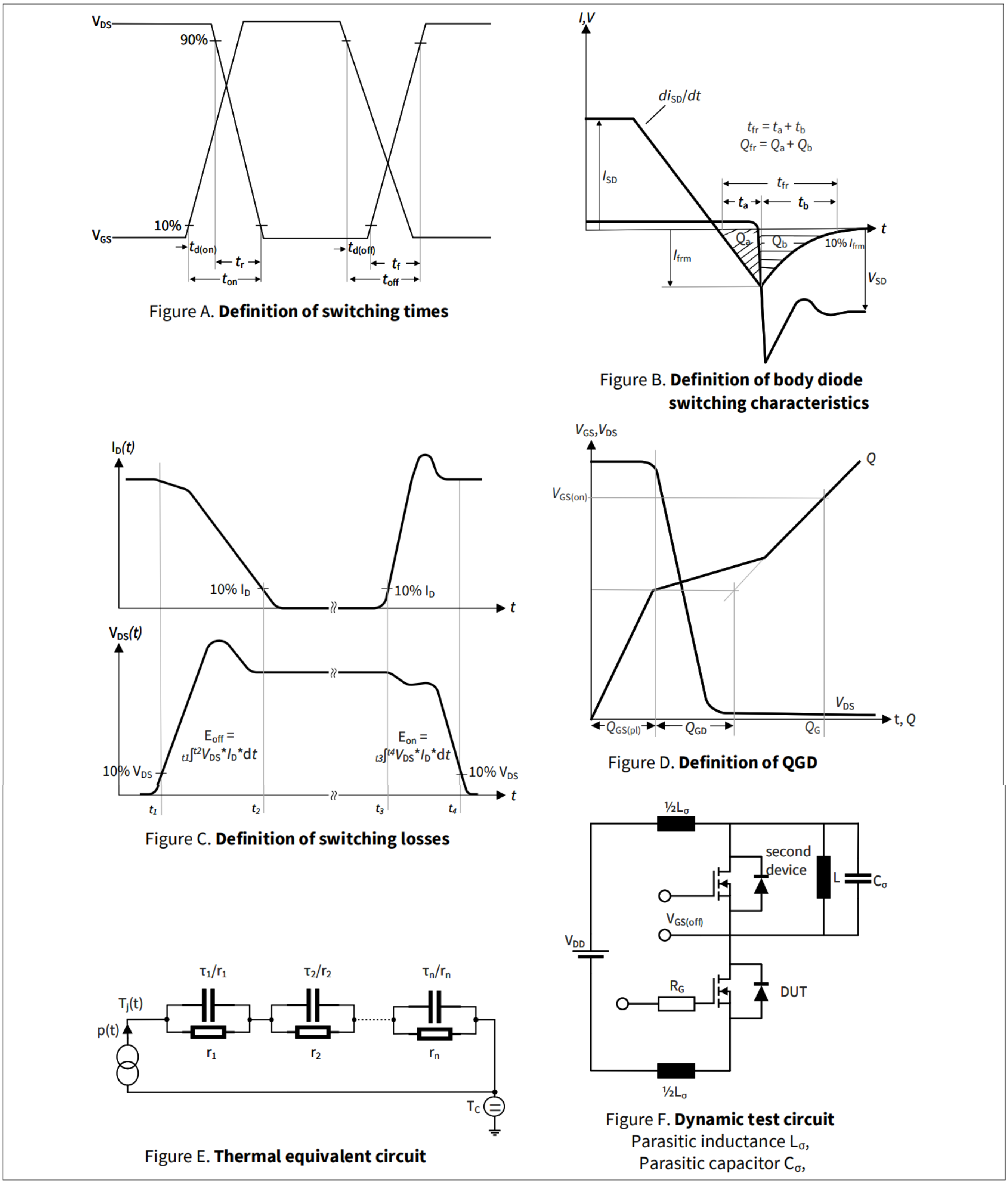


Figure A. **Definition of switching times**

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,

图 2

修订记录

Document revision	Date of release	Description of changes
0.10	2024-03-22	Target datasheet
0.20	2024-06-05	Added diagrams
0.30	2024-11-20	Preliminary datasheet
1.00	2024-12-12	Final datasheet
1.10	2025-10-13	Added CTI in Table 1 Increased I_{DM} in Table 2 Added switching information for V_{GS} = -5/18 V in Table 4 and 6 and corresponding diagrams Corrected E_{off} in Table 4 Added I_{SDC} in Table 5 Corrected test conditions and adapt values of the body diode in Table 6 Added SOA diagram on page 8 Added diagram E = f(V_{DD}) @ V_{GS} = 0/18 V Added diagram E = f(V_{DD}) @ V_{GS} = -5/18 V Editorial changes

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