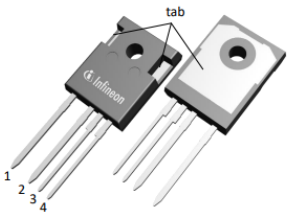
英飞凌MOSFET汽车功率器件

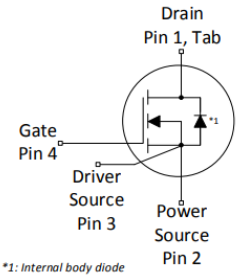
PG-TO247-4



英飞凌AIMZA75R008M1H CoolSiC™ 碳化硅汽车功率器件 750 V G1

750 V CoolSiC™ 基于英飞凌超过20年的碳化硅技术积累构建。750V CoolSiC™ MOSFET 利用宽带隙 SiC 材料的特性，提供了性能、可靠性和易用性的独特组合。它适用于高温和恶劣环境的操作，能够以简化且经济高效的方式实现行业领先的系统效率。

特性



- 高度稳健的 750V 技术，100% 经过雪崩测试
- 同类最佳的 $R_{DS(on)} \times Q_{fr}$
- 出色的 $R_{DS(on)} \times Q_{oss}$ 和 $R_{DS(on)} \times Q_G$
- 低 C_{rss}/C_{iss} 和高 $V_{GS(th)}$ 的独特组合
- 英飞凌专有芯片贴装技术
- 驱动器源引脚可用
- 同类最佳的 $R_{DS(on)}$

优点

- 增强了 500 V 以上总线电压的稳健性和可靠性
- 硬开关效率卓越
- 软开关拓扑中的开关频率更高
- 单极栅极驱动的抗寄生导通稳健性
- 通过改进栅极控制减少开关损耗

潜在应用

- 单向和双向车载充电器和 HV-LV DCDC 转换器（硬开关半桥和软开关拓扑）

产品验证

符合 AEC-Q101 标准

请注意：源和感测源引脚不可互换。它们的交换可能会导致故障。

表 1　　主要性能参数

Parameter	Value	Unit
V_{DSS} over full $T_{j,range}$	750	V
$R_{DS(on),typ}$	7.8	mΩ
$R_{DS(on),max}$	10.6	mΩ
$Q_{G,typ}$	178	nC
$I_{DM,max}$	708	A
$Q_{oss,typ}$ @ 500 V	352	nC
$E_{oss,typ}$ @ 500 V	63.1	µJ

Type/Ordering Code	Package	Marking	Related Links
AIMZA75R008M1H	PG-TO247-4	75A008M1	see Appendix A

目录

1 最大额定值

除非另有规定，T_j = 25 °C。

注意：为了获得最佳的使用寿命和可靠性，英飞凌建议运行条件不超过本数据手册中所述最大额定值的80%。

表 2 最大额定值

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Continuous DC drain current [1]	I_{DDC}	-	-	163 116	A	T_c = 25 °C T_c = 100 °C
Peak drain current [2]	I_{DM}	-	-	708	A	T_c = 25 °C, V_{GS} = 18 V
Avalanche energy, single pulse	E_{AS}	-	-	926	mJ	I_D = 34.7 A, V_{DD} = 50 V; see table 11
Avalanche current, single pulse	I_{AS}	-	-	34.7	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	200	V/ns	V_{DS}= 0…500 V
Gate source voltage (static)	V_{GS}	-5	-	23	V	-
Gate source voltage (transient)	V_{GS}	-10	-	25	V	t_p ≤ 500 ns, duty cycle ≤ 1 %
Power dissipation	P_{tot}	-	-	517	W	T_c = 25 °C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	175	°C	-
Mounting torque	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous reverse drain current [1]	I_{SDC}	-	-	163 98	A	V_{GS} = 18 V, T_c = 25 °C V_{GS} = 0 V, T_c = 25 °C
Peak reverse drain current [2]	I_{SM}	-	-	708 232	A	T_c = 25 °C, t_p ≤ 250 ns T_c = 25 °C
Insulation withstand voltage	V_{ISO}	-	-	n.a.	V	V_{rms}, T_c = 25 °C, t = 1 min

1) 受 $T_{j,max}$限制

2) 脉冲宽度 t_{pulse} 受 $T_{j,max}$ 限制。

2 热特性

表3 热特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{th(j-c)}$	-	-	0.29	°C/W	Not subject to production test. Parameter verified by design/characterization according to JESD51-14.
Soldering temperature, wave soldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

3 工作范围

表 4 工作范围

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate-source voltage operating range including undershoots [3)]	V_{GS}	-2	-	20	V	-
Recommended turn-on voltage	$V_{GS(on)}$	-	18	-	V	-
Recommended turn-off voltage	$V_{GS(off)}$	-	0	-	V	-

3)

重要提示：如果应用中器件的栅源电压超出工作范围（表 4），则器件的$R_{DS(on)}$和$V_{GS(th)}$可能会在器件使用寿命结束时超过数据手册中规定的最大值。为了确保器件在计划使用寿命内正常运行，必须考虑最大额定值（表 2）和应用说明 AN2018-09。

4 电气特性

除非另有规定， T_j = 25 °C

表 5 静态特性

对于施加阻断电压 > 525 V 的应用，要求客户在早期设计阶段评估宇宙辐射效应的影响，并联系英飞凌销售办事处获取必要的技术支持。

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source voltage [4]	V_{DSS}	750	-	-	V	V_{GS} = 0 V, I_D = 3.24 mA, T_j = -55 °C to 175 °C
Gate threshold voltage [5]	$V_{GS(th)}$	3.5	4.3	5.6	V	V_{DS} = V_{GS}, I_D = 32.4 mA, T_j = 25 °C
Zero gate voltage drain current	I_{DSS}	-	1 10	75 -	µA	V_{DS} = 750 V, V_{GS} = 0 V, T_j = 25 °C V_{DS} = 750 V, V_{GS} = 0 V, T_j = 175 °C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS} = 20V, V_{DS} = 0 V, T_j = 25 °C
Drain-source on-state resistance	$R_{DS(on)}$	-	9.6 7.8 7.2 14.0	- 10.6 - -	mΩ	V_{GS} = 15 V, I_D = 90.3 A, T_j = 25 °C V_{GS} = 18 V, I_D = 90.3 A, T_j = 25 °C V_{GS} = 20 V, I_D = 90.3 A, T_j = 25 °C V_{GS} = 18 V, I_D = 90.3 A, T_j =175 °C
Internal gate resistance	$R_{G,int}$	-	3.0	-	Ω	f = 1 MHz

[4] 在 T_j = 25 °C 下进行测试，最小 V_{DSS} 已通过设计在整个结温范围内验证。

[5] 在 V_{GS} = +20 V 时，1 ms 脉冲后进行测试。不建议使用“线性模式”操作。为了评估潜在的“线性模式”操作，请联系英飞凌销售办事处。

表 6 动态特性

外部寄生元件（PCB布局）对开关行为有显著影响。必须尽量减少杂散电感和耦合电容。如需布局建议，请使用提供的应用说明或联系英飞凌销售办事处。

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	6137	-	pF	V_{GS} = 0 V, V_{DS} = 500 V, f = 250 kHz
Reverse transfer capacitance	C_{rss}	-	37	-	pF	V_{GS} = 0 V, V_{DS} = 500 V, f = 250 kHz
Output capacitance [6]	C_{oss}	-	392	510	pF	V_{GS} = 0 V, V_{DS} = 500 V, f = 250 kHz
Output charge [6]	Q_{oss}	-	352	458	nC	calculation based on C_{oss}
Effective output capacitance, energy related [7]	$C_{o(er)}$	-	505	-	pF	V_{GS} = 0 V, V_{DS} = 0..500 V
Effective output capacitance, time related [8]	$C_{o(tr)}$	-	704	-	pF	I_D = constant, V_{GS} = 0 V, V_{DS} = 0…500 V
Turn-on delay time	$t_{d(on)}$	-	22	-	ns	V_{DD} = 500 V, V_{GS} = 0/18 V, I_D = 90.3 A, $R_{G,ext}$ = 1.8 Ω;see table 10

表 6　　动态特性

外部寄生元件（PCB布局）对开关行为有显著影响。必须尽量减少杂散电感和耦合电容。如需布局建议，请使用提供的应用说明或联系英飞凌销售办事处。

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Rise time	t_r	-	30	-	ns	V_{DD}= 500 V, V_{GS}= 0/18 V, I_D= 90.3 A, $R_{G,ext}$= 1.8 Ω;see table 10
Turn-off delay time	$t_{d(off)}$	-	50	-	ns	V_{DD}= 500 V, V_{GS}= 0/18 V, I_D= 90.3 A, $R_{G,ext}$= 1.8 Ω;see table 10
Fall time	t_f	-	16	-	ns	V_{DD}= 500 V, V_{GS}= 0/18 V, I_D= 90.3 A, $R_{G,ext}$= 1.8 Ω;see table 10

6) 最大规格由计算出的六西格玛置信上限定义。

7) $C_{o(er)}$是一个固定电容，当V_{DS}从0上升至500V时，其提供与C_{oss}相同的储存能量。

8) $C_{o(tr)}$是一个固定电容，当V_{DS}从0上升至500V时，其充电时间与C_{oss}相同。

表7　　栅极电荷特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Plateau gate to source charge	$Q_{GS(pl)}$	-	50	-	nC	V_{DD}= 500 V, I_D= 90.3 A, V_{GS}= 0 to 18 V
Gate to drain charge	Q_{GD}	-	45	-	nC	V_{DD}= 500 V, I_D= 90.3 A, V_{GS}= 0 to 18 V
Total gate charge	Q_G	-	178	-	nC	V_{DD}= 500 V, I_D= 90.3 A, V_{GS}= 0 to 18 V

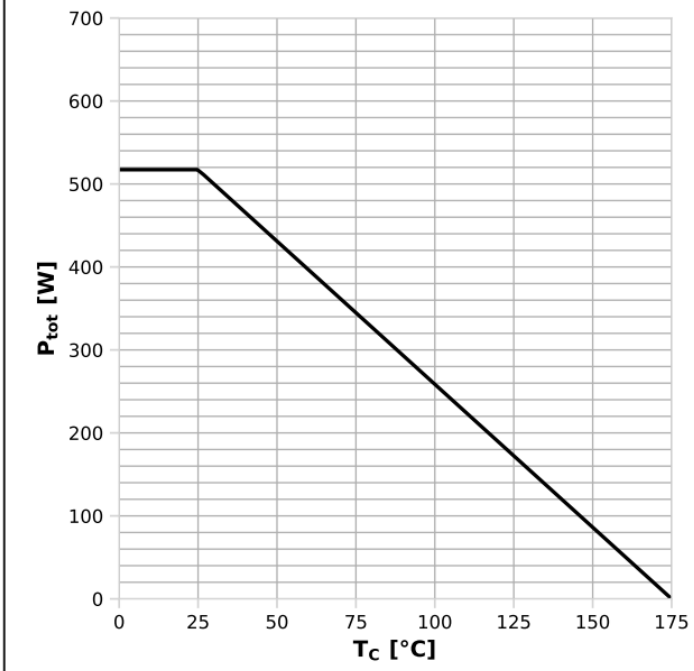
表8　　反向二极管特性

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source reverse voltage	V_{SD}	-	3.9	5.3	V	V_{GS}= 0 V, I_S= 90.3 A, T_j= 25 °C
MOSFET forward recovery time	t_{fr}	-	47 26	-	ns	V_{DD}= 500 V, I_S= 90.3 A, di_S/dt = 1000 A/µs; see table 9 V_{DD}= 500 V, I_S= 90.3 A, di_S/dt = 4000 A/µs; see table 9
MOSFET forward recovery charge 9)	Q_{fr}	-	418 677	-	nC	V_{DD}= 500 V, I_S= 90.3 A, di_S/dt = 1000 A/µs; see table 9 V_{DD}= 500 V, I_S= 90.3 A, di_S/dt = 4000 A/µs; see table 9
MOSFET peak forward recovery current	I_{frm}	-	18 52	-	A	V_{DD}= 500 V, I_S= 90.3 A, di_S/dt = 1000 A/µs; see table 9 V_{DD}= 500 V, I_S= 90.3 A, di_S/dt = 4000 A/µs; see table 9

9) Q_{fr}包括Q_{oss}

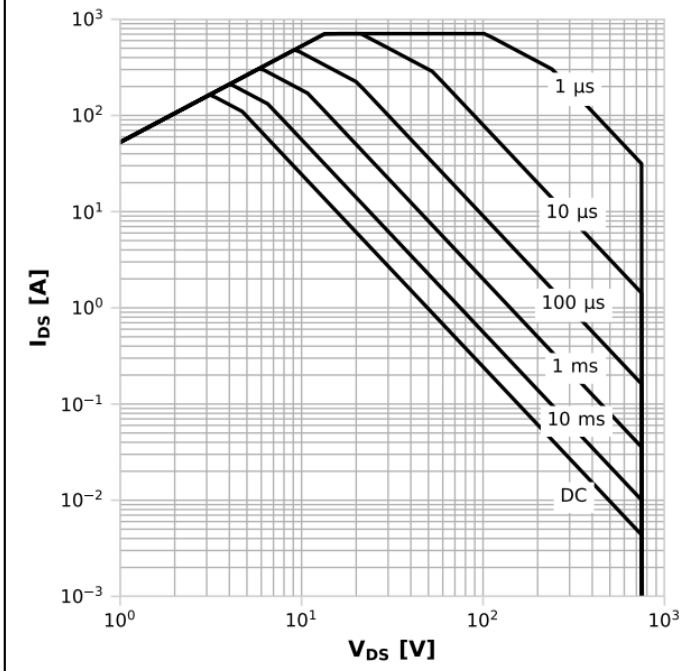
5 电气特性图

Diagram 1: Power dissipation



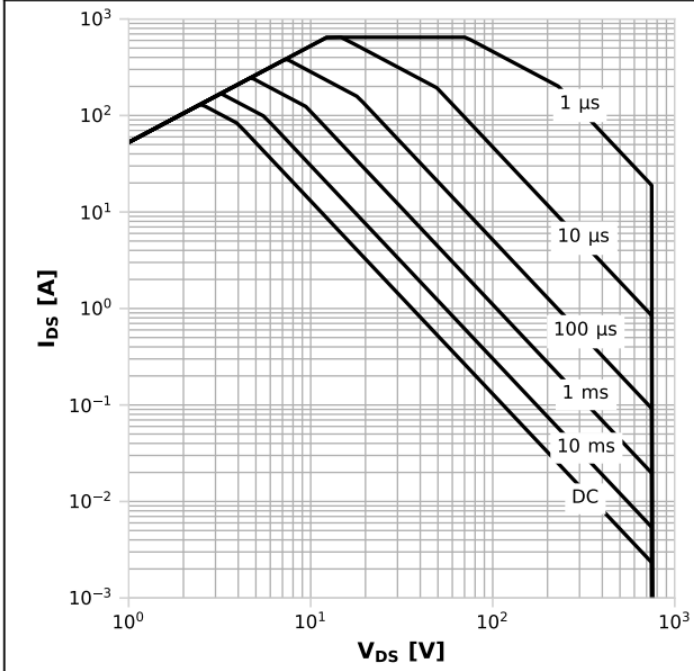
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



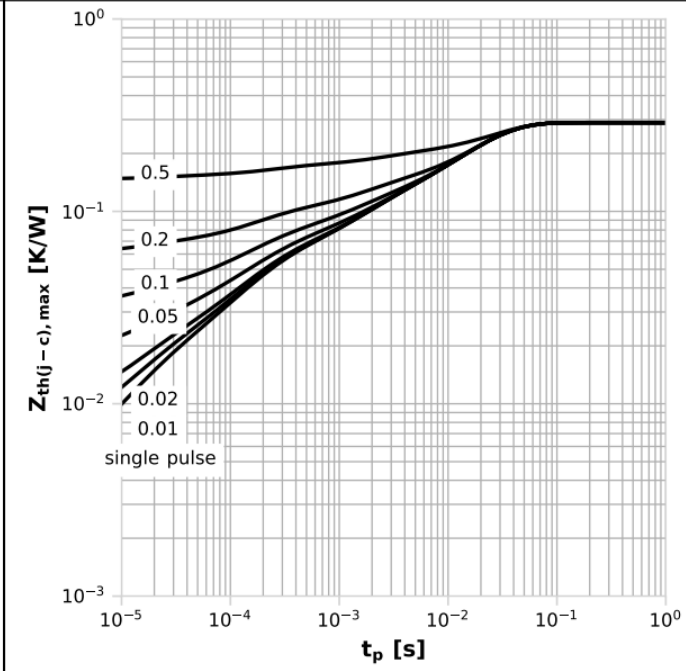
$I_{DS}=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



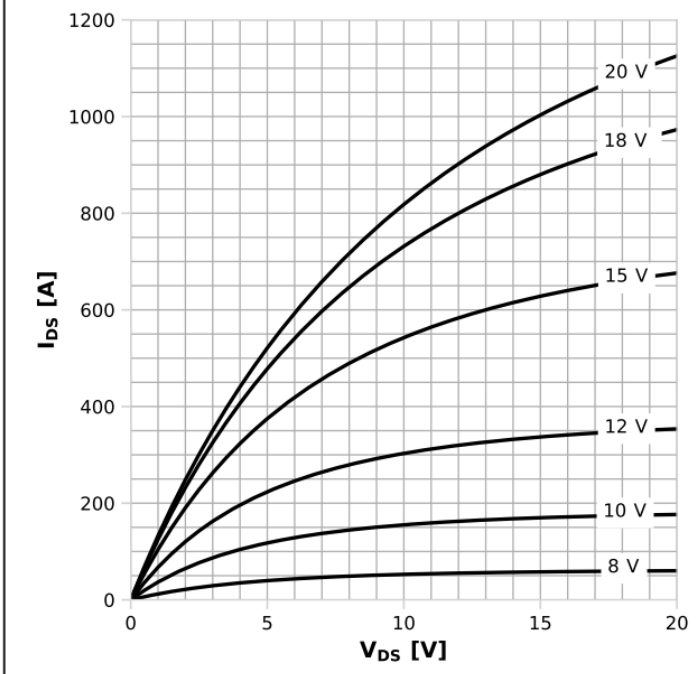
$I_{DS}=f(V_{DS})$; T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



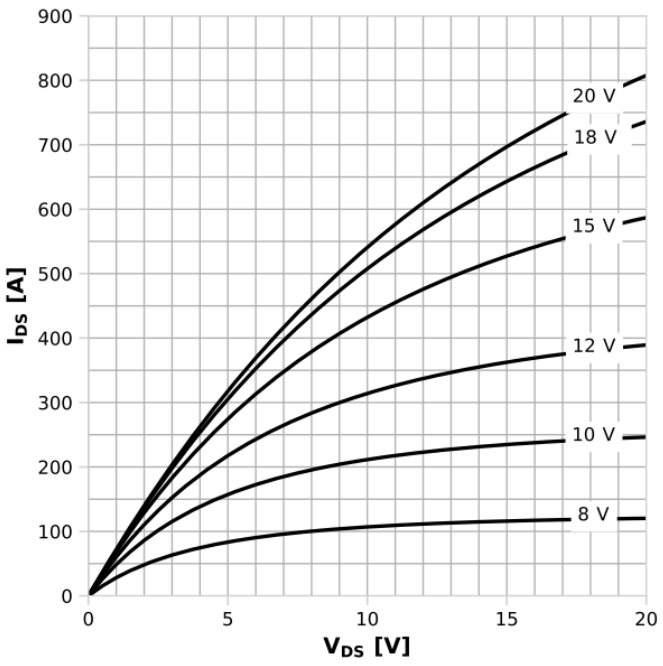
$Z_{th(j-c),max}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



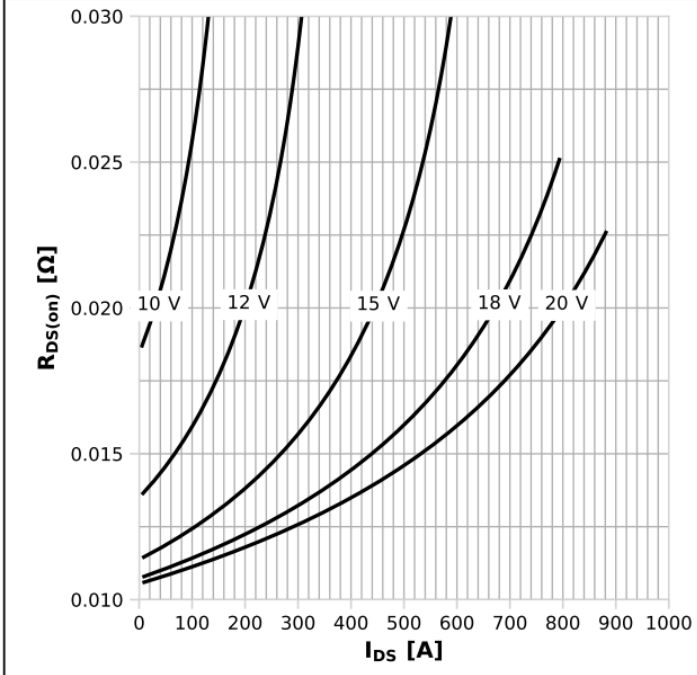
$I_{DS}=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



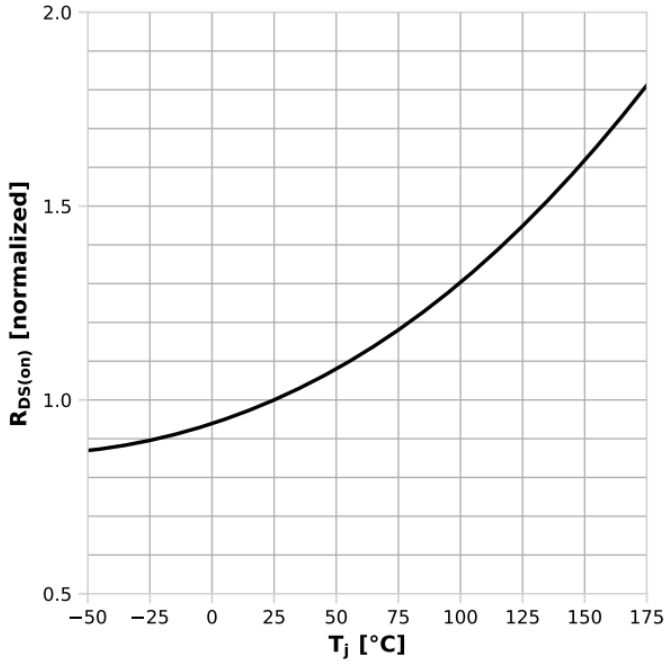
$I_{DS}=f(V_{DS})$; $T_j=175$ °C; parameter: V_{GS}

Diagram 7: Typ. drain-source on-state resistance



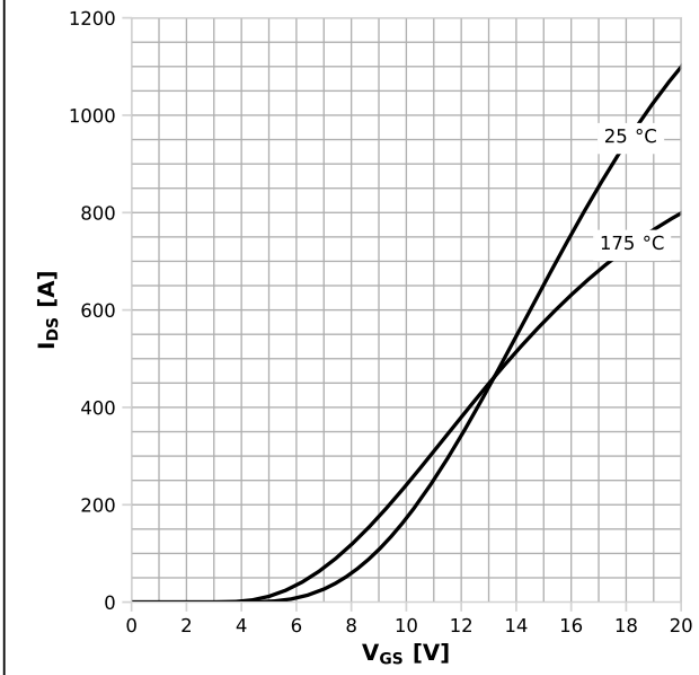
$R_{DS(on)}=f(I_{DS})$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



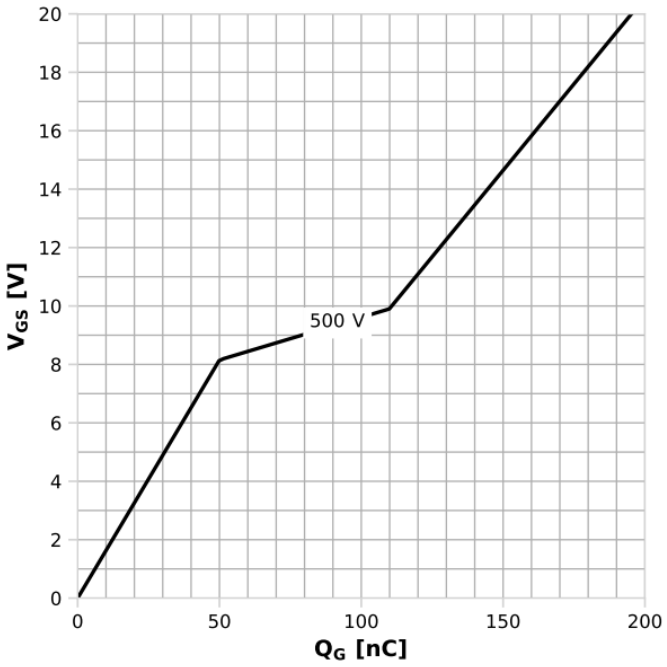
$R_{DS(on)}=f(T_j)$; $I_D=90.3$ A; $V_{GS}=18$ V

Diagram 9: Typ. transfer characteristics



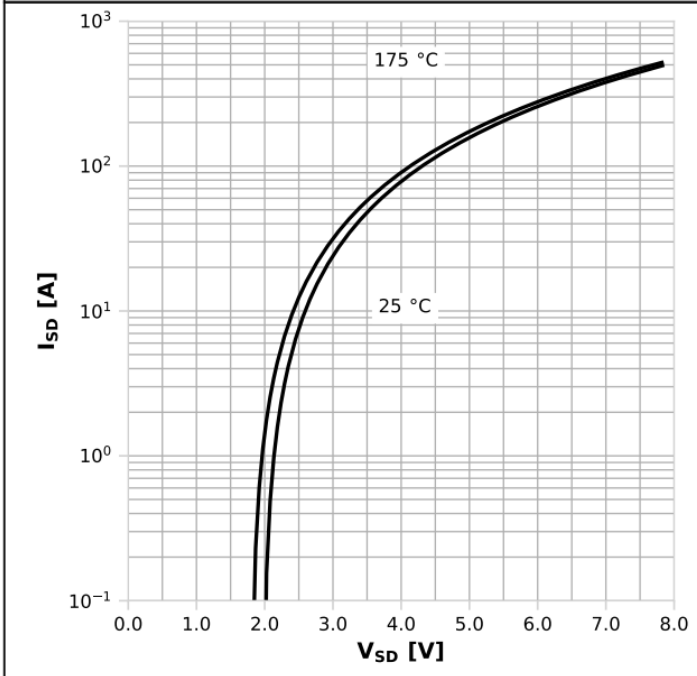
$I_{DS}=f(V_{GS})$; $V_{DS}=20$ V; parameter: T_j

Diagram 10: Typ. gate charge



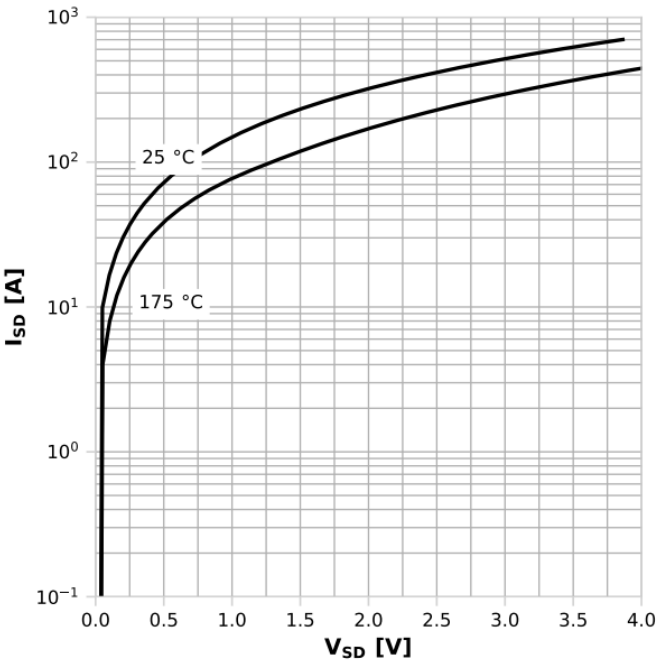
$V_{GS}=f(Q_G)$; $I_D=90.3$ A pulsed; parameter: V_{DD}

Diagram 11: Typ. reverse drain current characteristics



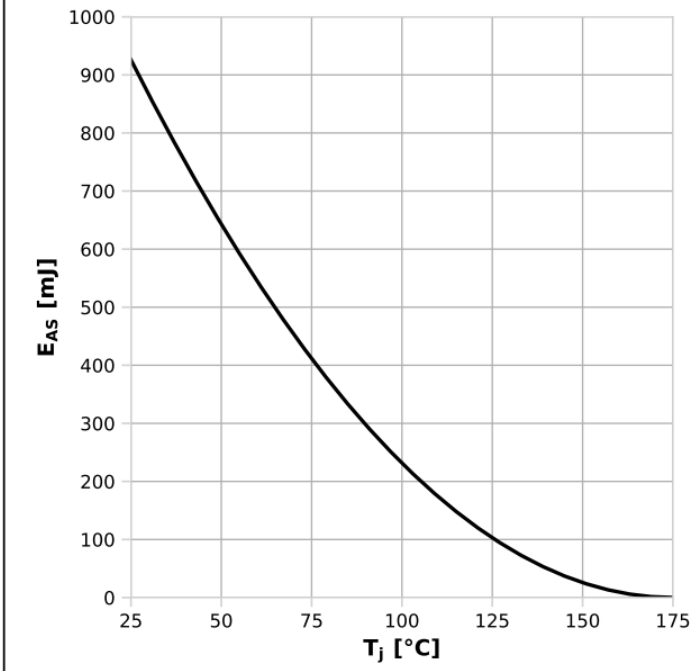
$I_{SD}=f(V_{SD})$; $V_{GS}=0$ V; parameter: T_j

Diagram 12: Typ. reverse drain current characteristics



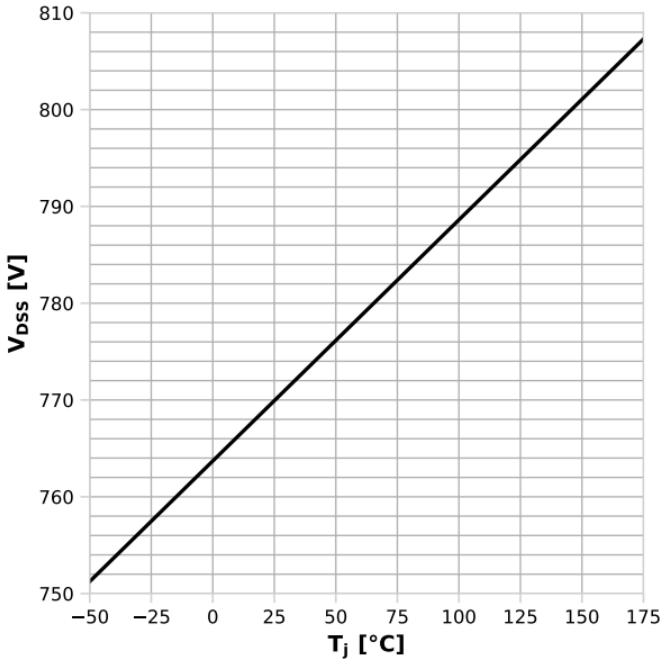
$I_{SD}=f(V_{SD})$; $V_{GS}=18$ V; parameter: T_j

Diagram 13: Avalanche energy



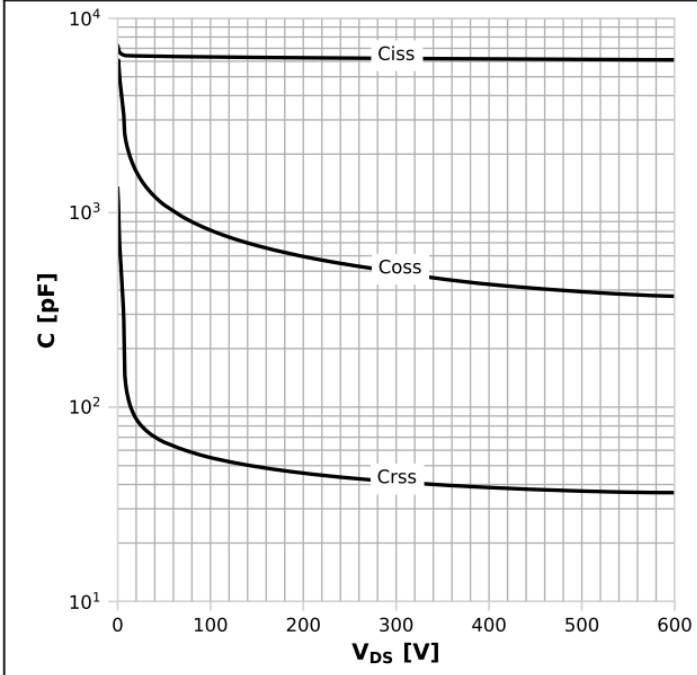
$E_{AS}=f(T_j)$; I_D=34.7 A; V_{DD}=50 V

Diagram 14: Drain-source breakdown voltage



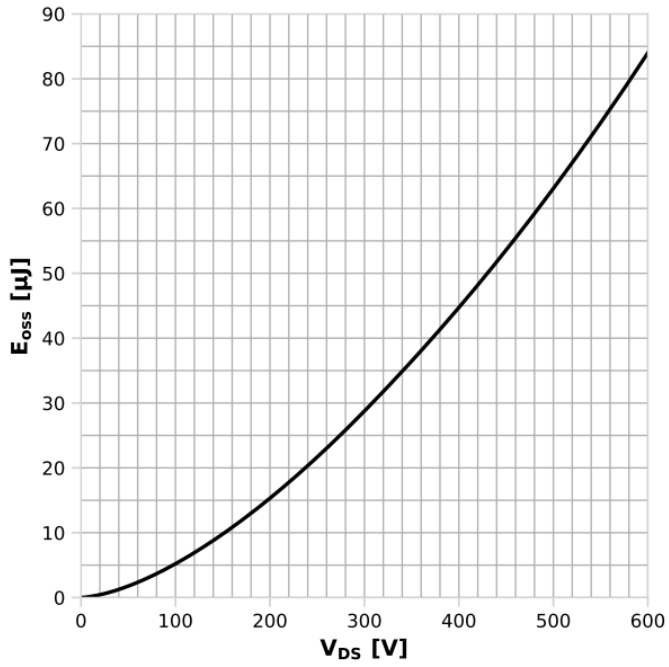
$V_{DSS}=f(T_j)$; I_D=3.24 mA

Diagram 15: Typ. capacitances



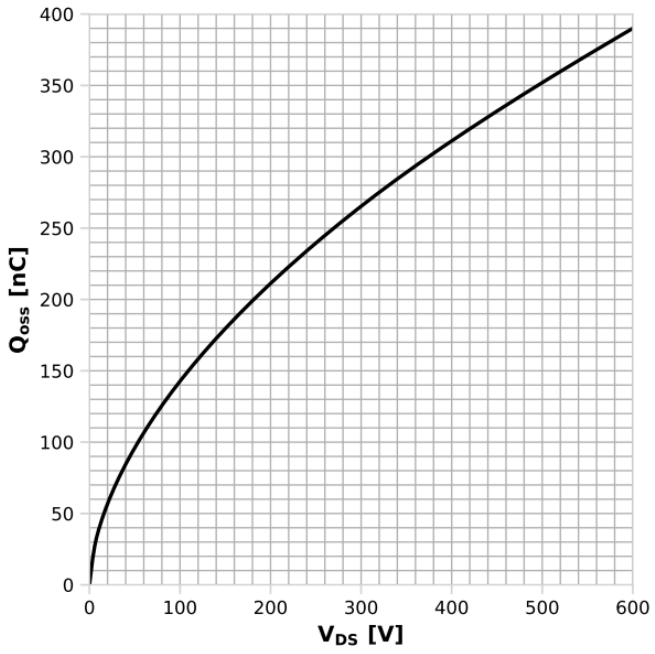
$C=f(V_{DS})$; V_{GS}=0 V; f=250 kHz

Diagram 16: Typ. Coss stored energy



$E_{oss}=f(V_{DS})$

Diagram 17: Typ. Qoss output charge



$Q_{oss}=f(V_{DS})$

6 测试电路

表 9 体二极管特性（CoolSiC）

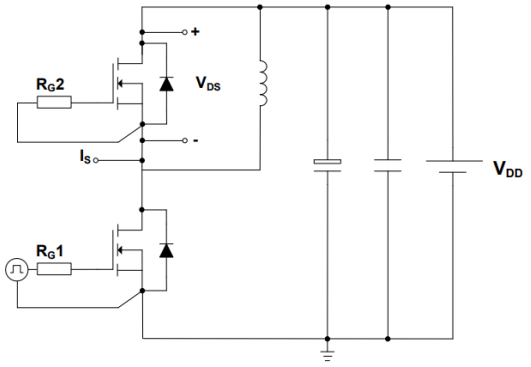
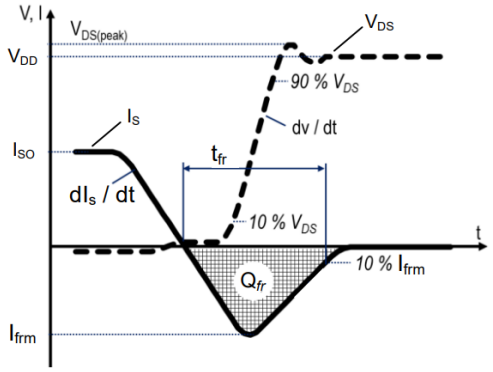
Test circuit for body diode characteristics	Body diode recovery waveform
	

表 10 开关时间 (CoolSiC)

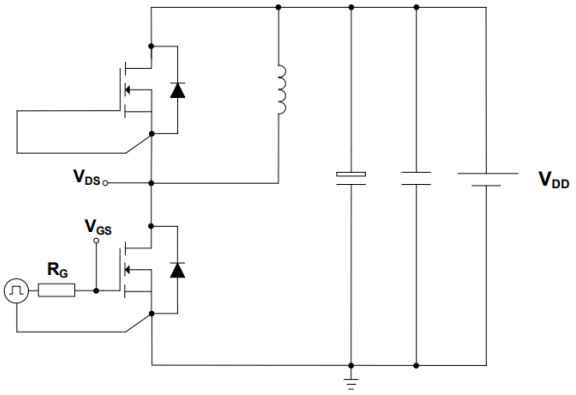
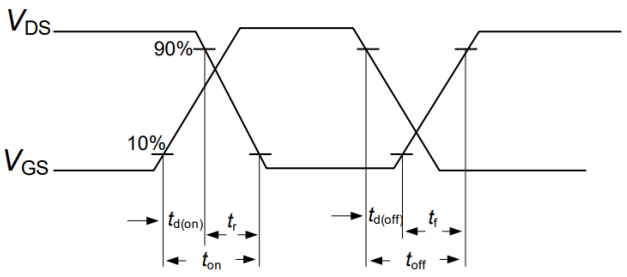
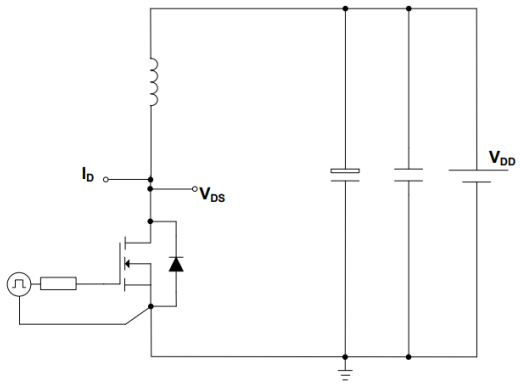
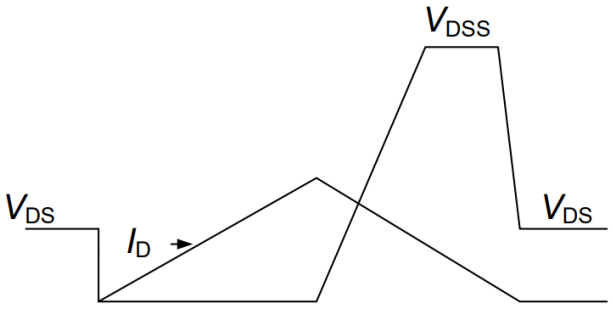
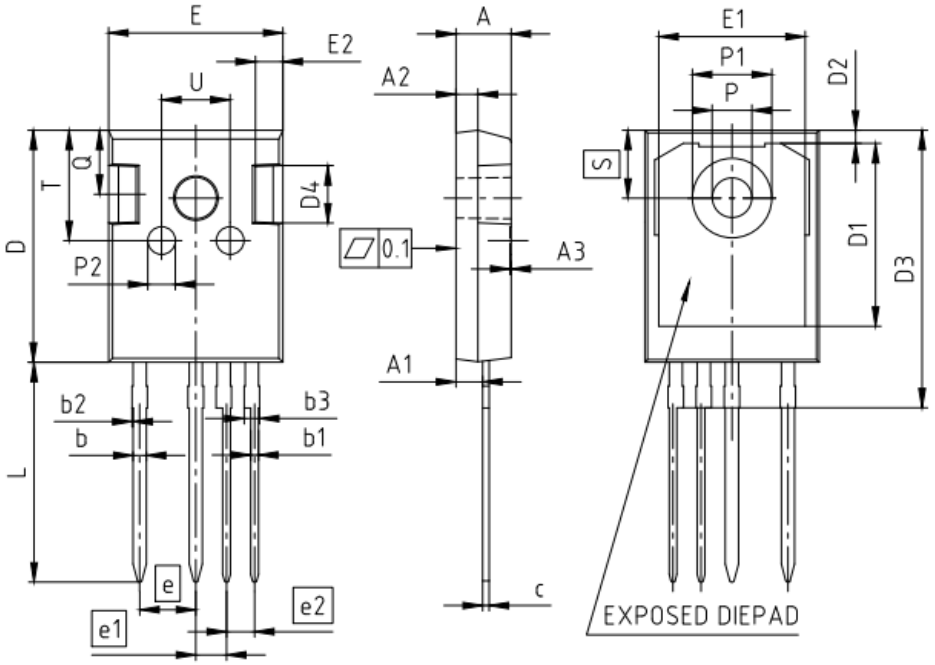
Switching times test circuit for inductive load	Switching times waveform
	

表 11 非钳位感性负载

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 封装外形



NOTES:
DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS

PACKAGE - GROUP NUMBER:	PG-TO247-4-U02				
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 PG-TO 247 - 4 外形图，尺寸单位为毫米

8 附录A

表 12 相关链接

- IFX CoolSiC CoolSiC™ 汽车功率器件 750 V G1 网页
- IFX CoolSiC CoolSiC™ 汽车功率器件 750 V G1 应用笔记
- IFX CoolSiC CoolSiC™ 汽车功率器件 750 V G1 仿真模型
- IFX 设计工具

修订记录

AIMZA75R008M1H

Revision 2024 - 07 - 29 , Rev. 2 . 0

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.0	2024-07-29	Release of final version

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