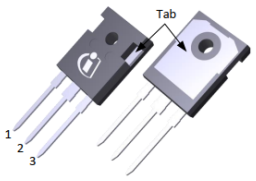
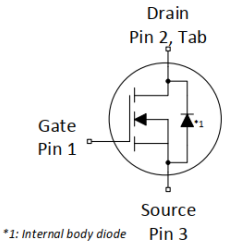
PG-TO247-3

英飞凌 CoolSiC™ M1

英飞凌 CoolSiC™ MOSFET 650V G1

650 V CoolSiC™基于英飞凌超过20年的碳化硅技术积累构建。650V 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

- 优化高电流下的开关行为
- 具有低 Qfr 值的快速体二极管确保换向的稳健性
- 卓越的栅极氧化物可靠性
- $T_{j,max}$ =175°C 和优异的热性能
- 较低 $R_{DS(on)}$ 和脉冲电流对温度的依赖性
- 增强雪崩能力
- 与标准驱动兼容
- 开尔文源可将开关损耗降低 4 倍

优点

- 高性能、高可靠性和易用性的独特组合
- 易于使用和集成
- 适用于连续硬换向拓扑
- 更高的稳健性和系统可靠性
- 提高效率
- 减小系统尺寸，提高功率密度

潜在应用

- SMPS
- UPS（不间断电源）
- 太阳能逆变器
- 电动汽车充电基础设施
- 储能和电池化成
- D 类放大器

产品验证

完全符合 JEDEC 工业应用标准

表 1　　主要性能参数

Parameter	Value	Unit
V_{DS} @ T_J = 25 °C	650	V
$R_{DS(on),typ}$	107	mΩ
$R_{DS(on),max}$	142	mΩ
$Q_{G,typ}$	15	nC
$I_{DM,max}$	48	A
Q_{oss} @ 400 V	35	nC
E_{oss} @ 400 V	5.3	µJ

Part number	Package	Marking	Related links
IMW65R107M1H	PG-TO247-3	65R107M1	see Appendix A

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 最大额定值

除非另有规定， T_j = 25 °C。

注：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}	-	-	21 15	A	T_c = 25 °C T_c = 100 °C
Peak drain current [2]	I_{DM}	-	-	48	A	T_c = 25 °C, V_{GS} = 18 V
Avalanche energy, single pulse	E_{AS}	-	-	76	mJ	I_D = 2.8 A, V_{DD} = 50 V; see table 11
Avalanche energy, repetitive	E_{AR}	-	-	0.38	mJ	
Avalanche current, single pulse	I_{AS}	-	-	2.8	A	-
MOSFET *dv/dt* ruggedness	*dv/dt*	-	-	200	V/ns	V_{DS}= 0...400 V
Gate source voltage (static) [3]	V_{GS}	-5	-	23	V	-
Gate source voltage (transient)	V_{GS}	-7	-	25	V	t_{pulse} ≤ 1% duty cycle/f_{sw}
Power dissipation	P_{tot}	-	-	94	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}	-	-	21 14	A	V_{GS} = 18 V, T_c = 25 °C V_{GS} = 0 V, T_c = 25 °C
Peak reverse drain current [2]	I_{SM}	-	-	48	A	T_c = 25 °C, t_p ≤ 250 ns
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。
3) 应用设计中的最大栅极源电压应符合 IPC-9592B 的规定。

2 热特性

表 3 热特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{th(j-c)}$	-	-	1.6	°C/W	-
Thermal resistance, junction - ambient	$R_{th(j-a)}$	-	-	62	°C/W	Leaded
Thermal resistance, junction - ambient, SMD version	$R_{th(j-a)}$	-	-	-	°C/W	n.a.
Soldering temperature, wavesoldering 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 [4]	V_{GS}	-2	-	20	V	-
Recommended turn-on voltage	$V_{GS(on)}$	-	18	-	V	
Recommended turn-off voltage	$V_{GS(off)}$	-	0	-	V	

4)

重要提示：如果应用中器件的栅极源电压超出工作范围（表 4），则器件 RDS,on 和 VGS(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的使用寿命内正常运行，必须考虑最大额定值（表 2）和 CoolSiC TM MOSFET 650V M1 沟槽功率器件应用说明 AN_1907_PL52_1911_144109。

4 电气特性

除非另有规定， T_j = 25 °C

表 5 静态特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Drain-source voltage	V_{DSS}	650	-	-	V	V_{GS} = 0 V, I_D = 0.3 mA
Gate threshold voltage [5]	$V_{GS(th)}$	3.5	4.5	5.7	V	V_{DS} = V_{GS}, I_D = 3 mA
Zero gate voltage drain current	I_{DSS}	-	1 3	100 -	µA	V_{DS} = 650 V, V_{GS} = 0 V, T_j = 25 °C V_{DS} = 650 V, V_{GS} = 0 V, T_j = 175 °C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS} = 20 V, V_{DS} = 0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	107 150	142 -	mΩ	V_{GS} = 18 V, I_D = 8.9 A, T_j = 25 °C V_{GS} = 18 V, I_D = 8.9 A, T_j =175 °C
Internal gate resistance	$R_{G,int}$	-	12.0	-	Ω	f = 1 MHz

[5] 在 V_{GS}= +20 V 时 1 ms 脉冲之后进行测试

表 6 动态特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	496	-	pF	V_{GS} = 0 V, V_{DS} = 400 V, f = 250 kHz
Reverse transfer capacitance	C_{rss}	-	7	-	pF	
Output capacitance [6]	C_{oss}	-	58	75	pF	
Output charge [6]	Q_{oss}	-	35	46	nC	calculation based on C_{oss}
Effective output capacitance, energy related [7]	$C_{o(er)}$	-	66	-	pF	V_{GS} = 0 V, V_{DS} = 0...400 V
Effective output capacitance, time related [8]	$C_{o(tr)}$	-	87	-	pF	I_D = constant, V_{GS} = 0 V, V_{DS} = 0... 400 V
Turn-on delay time	$t_{d(on)}$	-	9.2	-	ns	V_{DD} = 400 V, V_{GS} = 0/18 V, I_D = 8.9 A, $R_{G,ext}$ = 1.8 Ω; see table 10
Rise time	t_r	-	11.4	-	ns	
Turn-off delay time	$t_{d(off)}$	-	12.6	-	ns	
Fall time	t_f	-	6.2	-	ns	

[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 400 V 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 400 V 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	$Q_{GS(pl)}$	-	4	-	nC	V_{DD} = 400 V, I_D = 8.9 A, V_{GS} = 0 to 18 V
Gate to drain charge	Q_{GD}	-	4	-	nC	
Total gate charge	Q_G	-	15	-	nC	

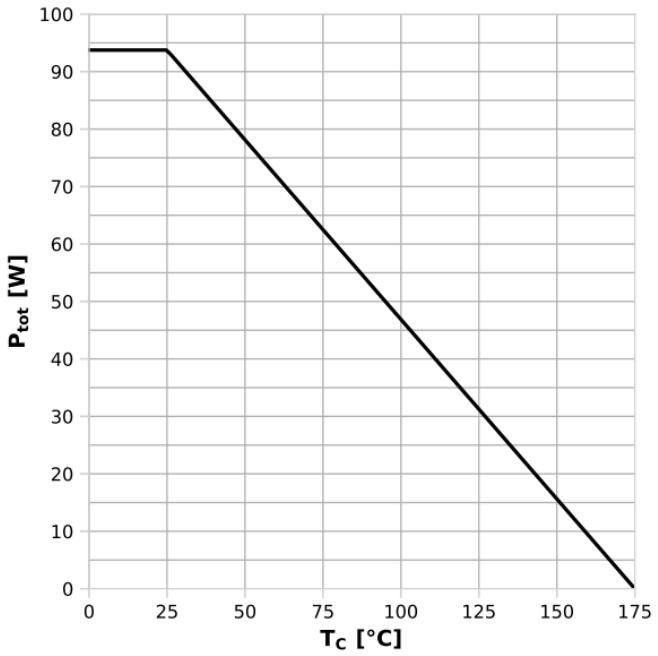
表8　　反向二极管特性

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Drain-source reverse voltage	V_{SD}	-	4.0	-	V	V_{GS} = 0 V, I_S = 8.9 A, T_j = 25 °C
MOSFET forward recovery time	t_{fr}	-	55	-	ns	V_{DD} = 400 V, I_S = 8.9 A, di_S/dt = 1000 A/µs; see table 9
MOSFET forward recovery charge [9)]	Q_{fr}	-	76	-	nC	
MOSFET peak forward recovery current	I_{frm}	-	6.8	-	A	

9)　Q_{fr}包括 Q_{oss}

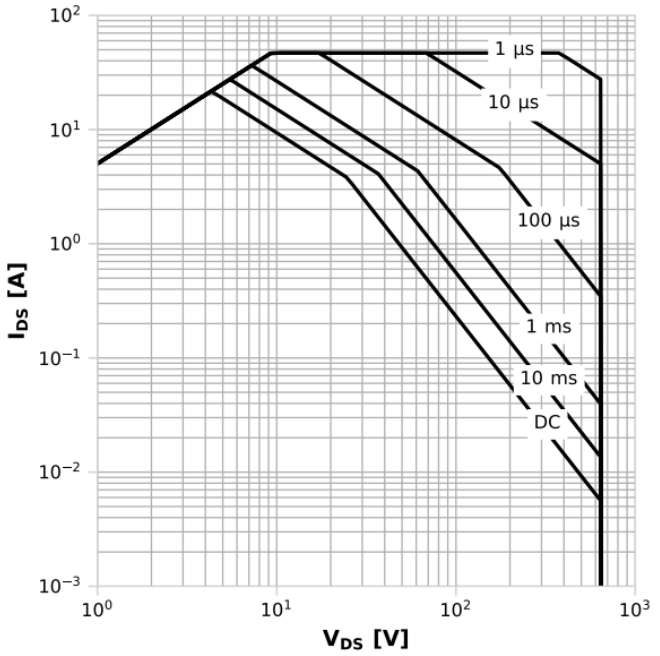
5 电气特性图

Diagram 1: Power dissipation



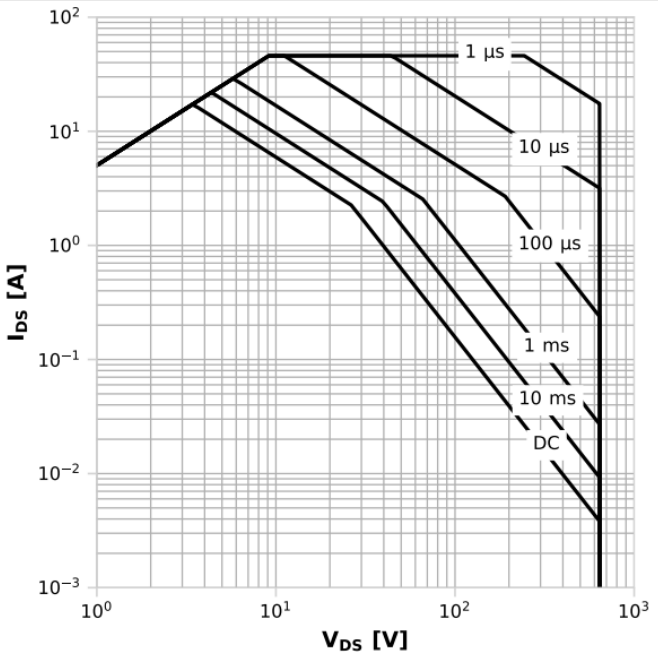
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



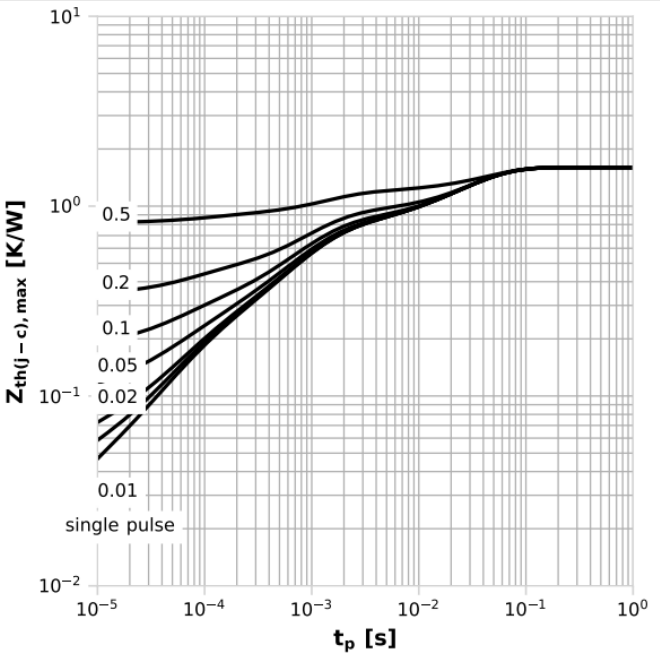
$I_{DS}=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

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: $D=t_p/T$

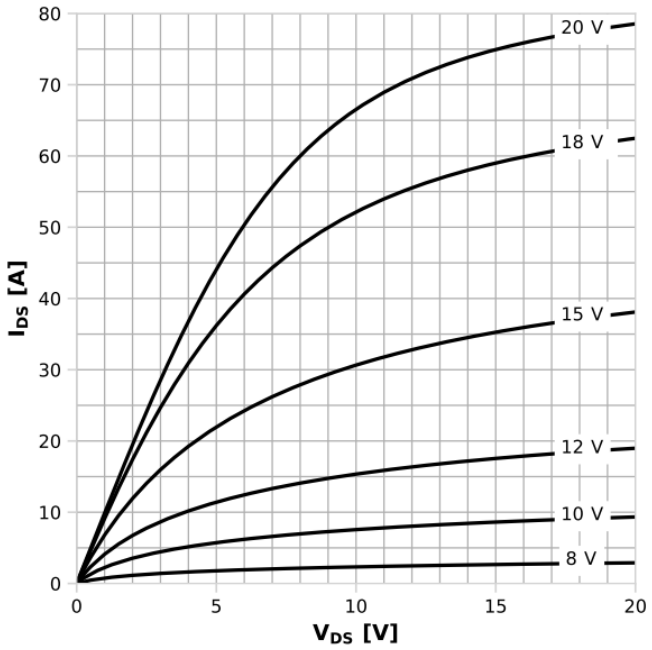
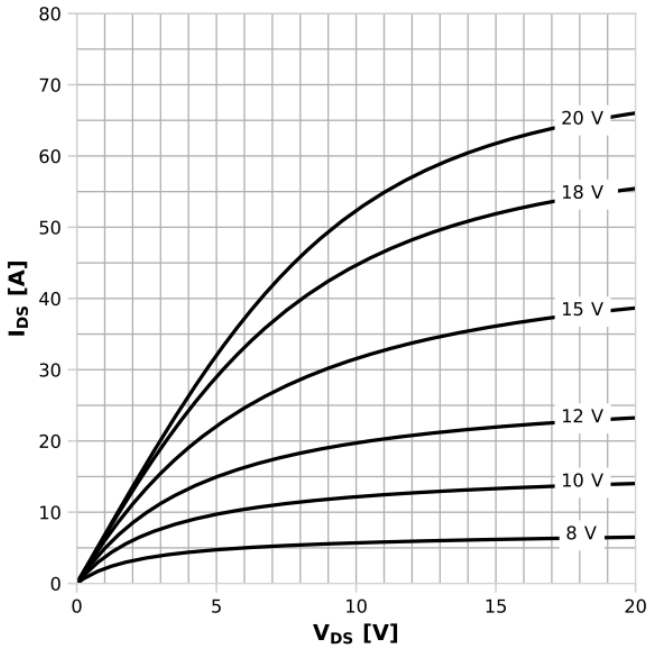
Diagram 5: Typ. output characteristics	Diagram 6: Typ. output characteristics
	
$I_{DS}=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}	$I_{DS}=f(V_{DS})$; $T_j=175$ °C; parameter: V_{GS}

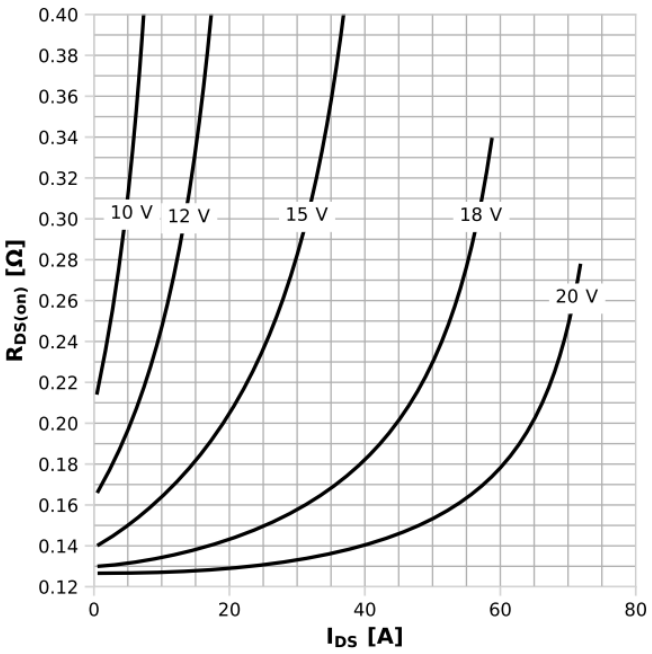
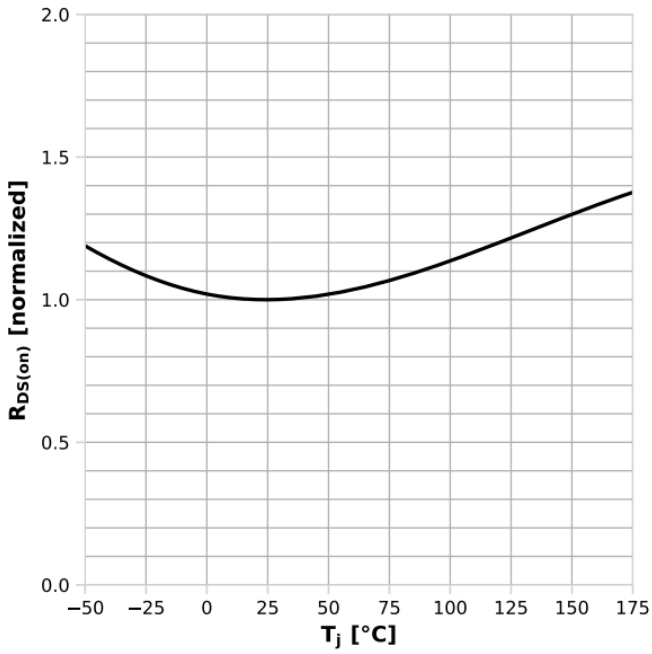
Diagram 7: Typ. drain-source on-state resistance	Diagram 8: Drain-source on-state resistance
	
$R_{DS(on)}=f(I_{DS})$; $T_j=125$ °C; parameter: V_{GS}	$R_{DS(on)}=f(T_j)$; $I_D=8.9$ A; $V_{GS}=18$ V

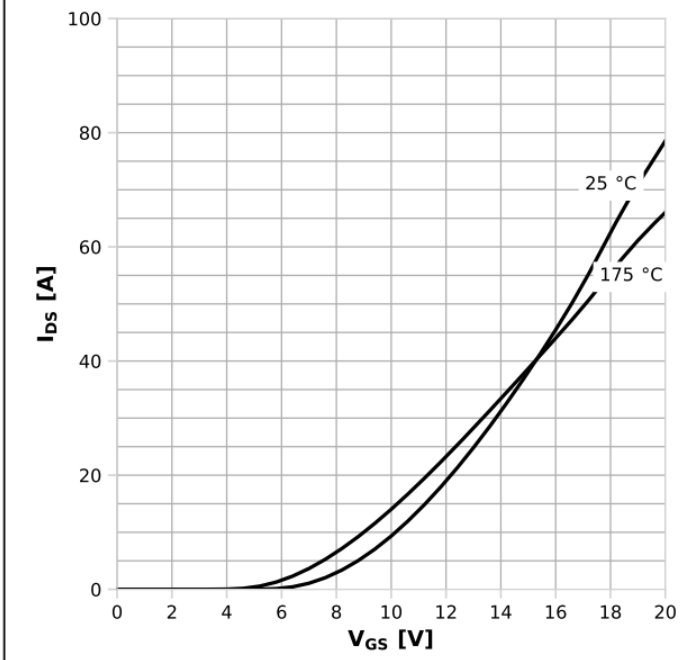
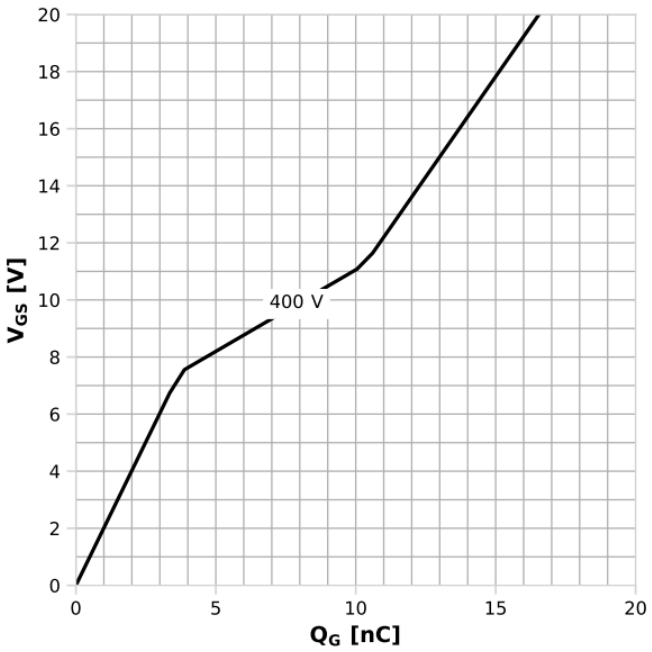
Diagram 9: Typ. transfer characteristics	Diagram 10: Typ. gate charge
	
$I_{DS}=f(V_{GS})$; V_{DS}=20V; parameter: T_j	$V_{GS}=f(Q_G)$; I_D=8.9 A pulsed; parameter: V_{DD}

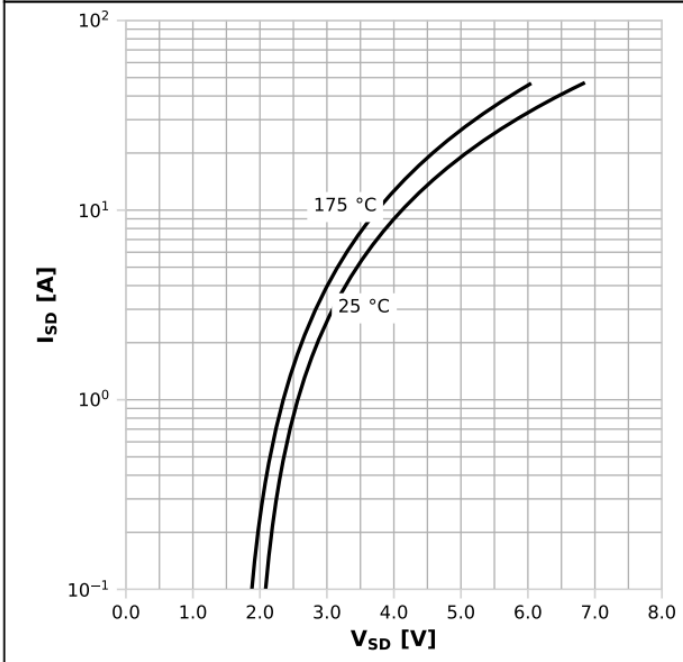
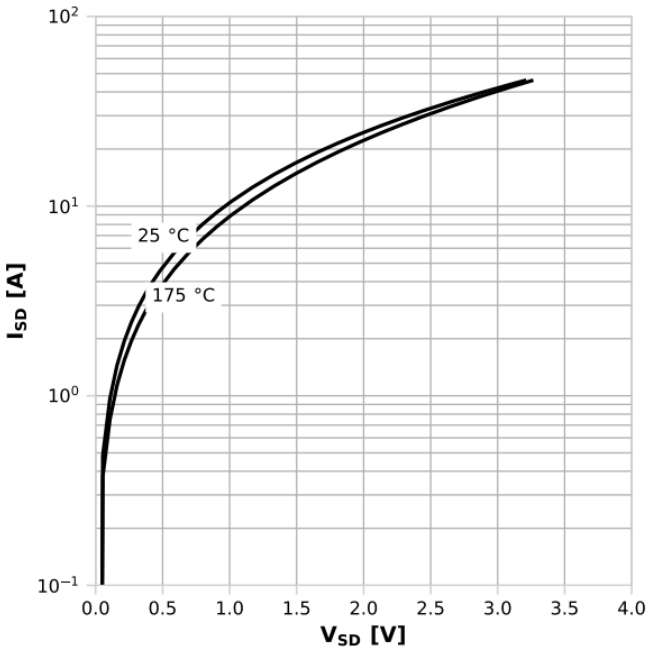
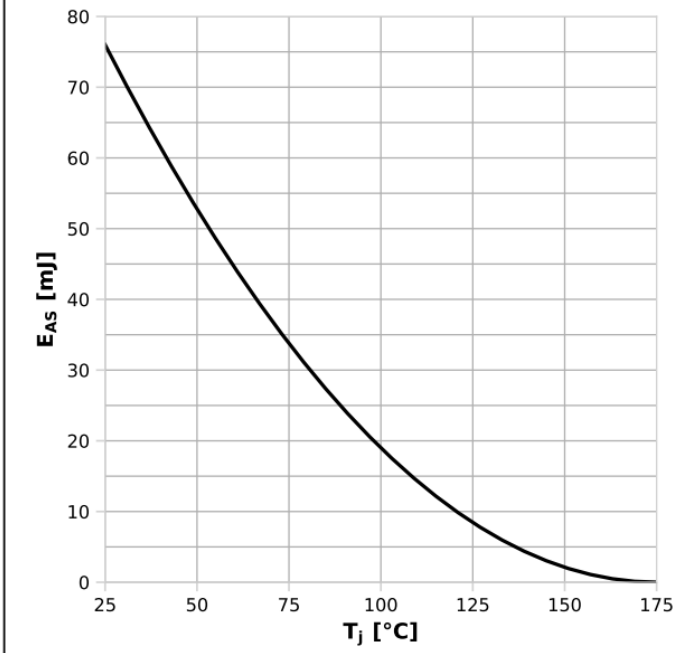
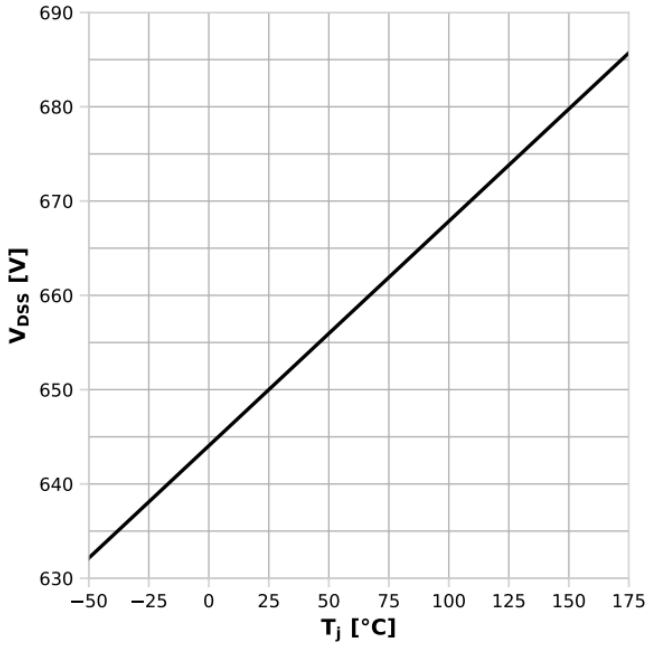
Diagram 11: Typ. reverse drain current characteristics	Diagram 12: Typ. reverse drain current characteristics
	
$I_{SD}=f(V_{SD})$; V_{GS}=0 V; parameter: T_j	$I_{SD}=f(V_{SD})$; V_{GS}=18 V; parameter: T_j

Diagram 13: Avalanche energy



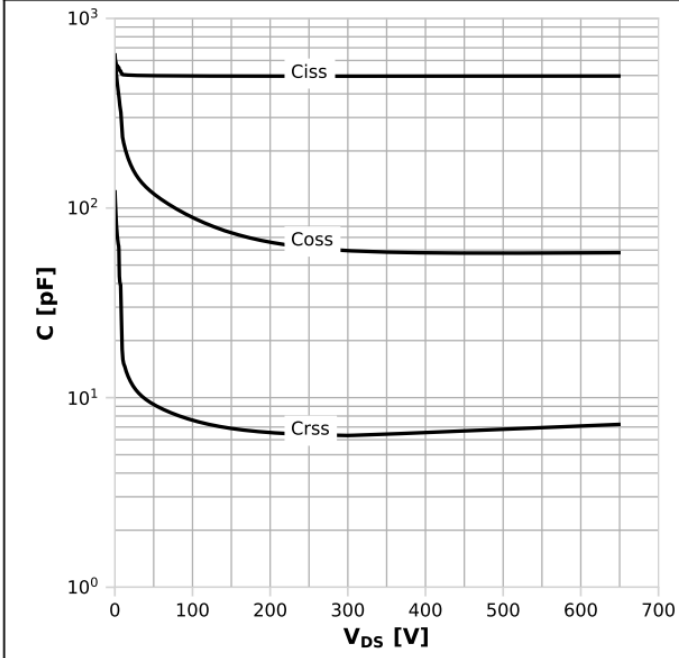
$E_{AS}=f(T_j)$; I_D=2.8 A; V_{DD}=50 V

Diagram 14: Drain-source breakdown voltage



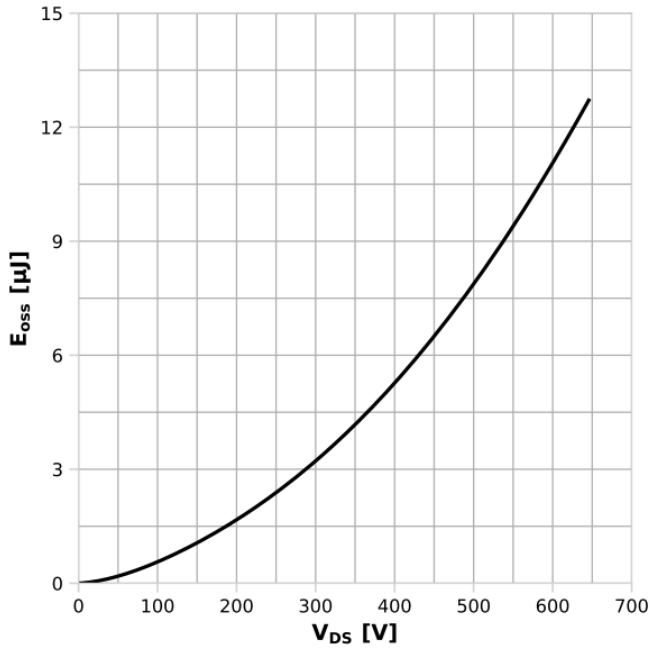
$V_{DSS}=f(T_j)$; I_D=0.3 mA

Diagram 15: Typ. capacitances



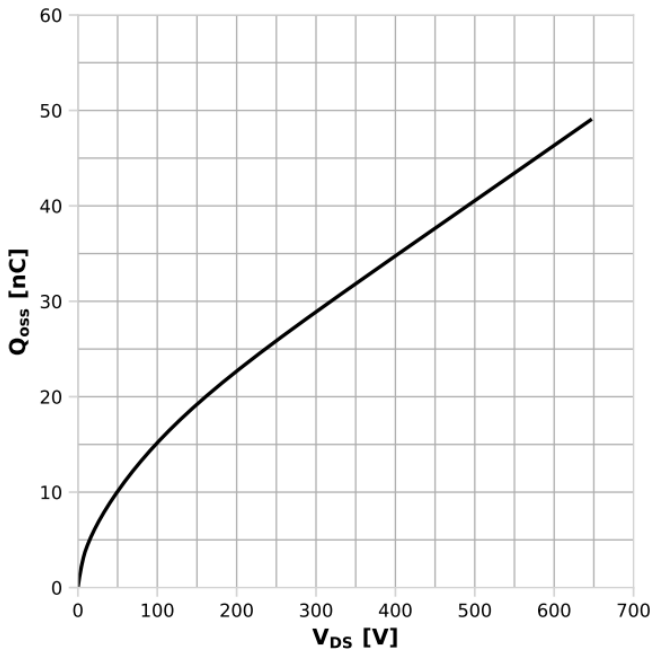
$C=f(V_{DS})$; V_{GS}=0 V; f=250 kHz

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

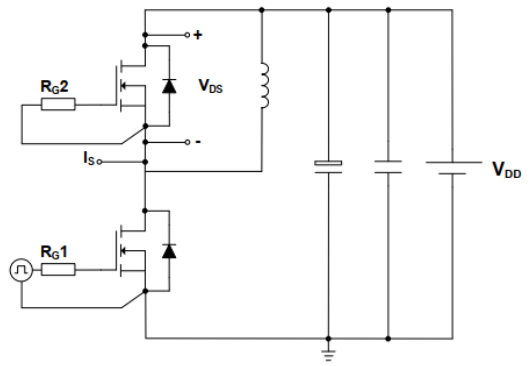
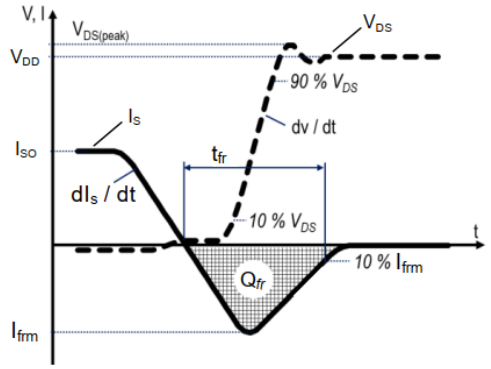
Test circuit for body diode characteristics	Body diode recovery waveform
	

表 10　　开关时间

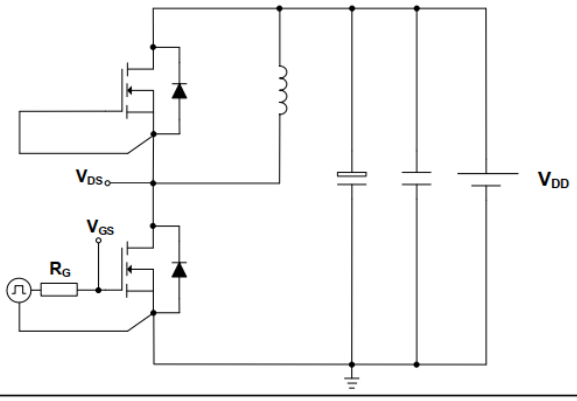
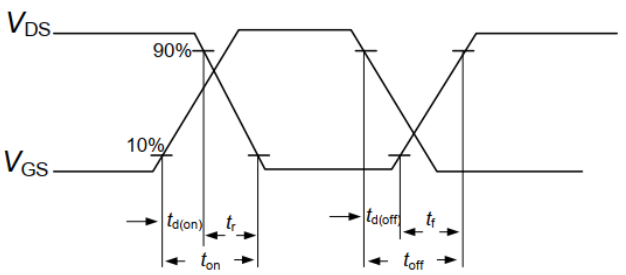
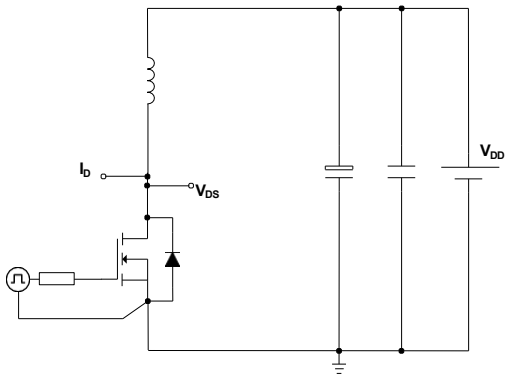
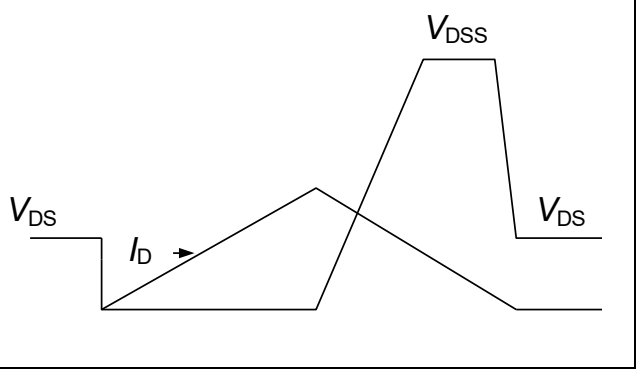
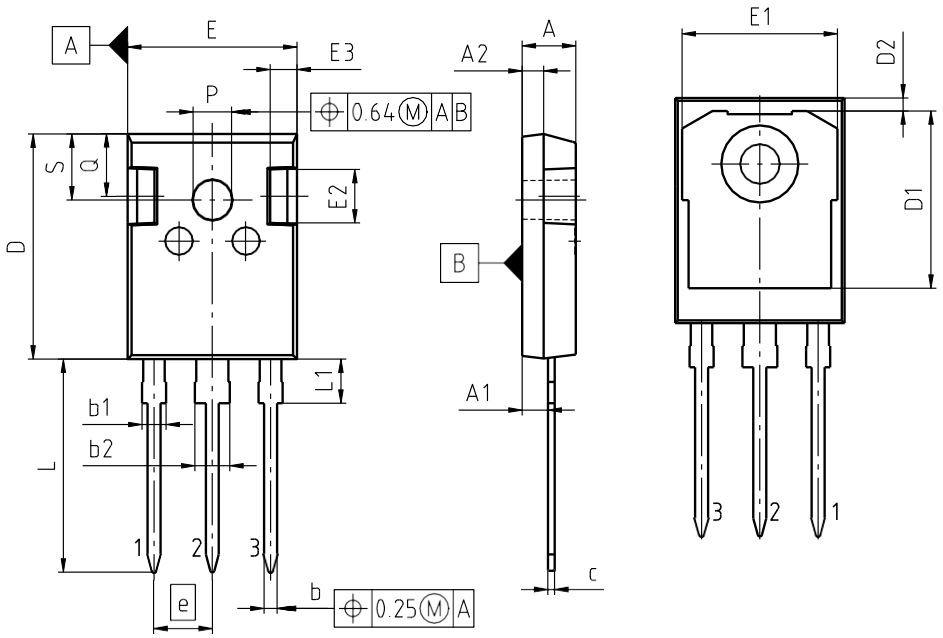
Switching times test circuit for inductive load	Switching times waveform
	

表 11　　非钳位感性负载

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 封装外形



PACKAGE - GROUP NUMBER:	PG-TO247-3	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
N	3	
L	19.80	20.40
L1	3.85	4.50
øP	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

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

图 1　　PG-TO247-3外形图，尺寸单位为毫米

8 附录A

表 12 相关链接

- 英飞凌 CoolSiC CoolSiC™ MOSFET 650 V G1 网页
- 英飞凌 CoolSiC CoolSiC™ MOSFET 650 V G1 应用笔记
- 英飞凌 CoolSiC CoolSiC™ MOSFET 650 V G1 仿真模型
- IFX 设计 工具

修订记录

IMW65R107M1H

Revision 2025 - 01 - 20 , Rev. 2 . 2

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.0	2019-12-16	Release of final version
2.1	2024-08-26	V_{GS} specs update ,$T_{j,max}$ update , I_{DSS} update, nomenclature update, datasheet layout update.
2.2	2025-01-20	Corrected Is value in test condition of parameter Vsd.

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版本 **2026-04-20**

Infineon Technologies AG 出版，
德国 **Neubiberg 85579**

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