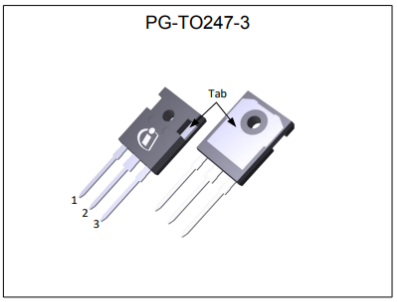
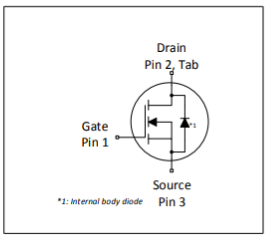
英飞凌MOSFET功率器件



英飞凌950V CoolMOS™ PFD7 SJ 功率器件IPW95R060PFD7

最新的 950V CoolMOS™ PFD7 系列为超结 (SJ) 技术树立了新的标杆。该技术旨在通过结合一流的性能和最先进的易用性来解决照明和工业 SMPS 应用问题。与 CoolMOS™ P7 系列相比，PFD7 提供集成的超快速体二极管，可在谐振拓扑中使用，具有市场最低的反向恢复电荷 (Qrr)。



特性

- 集成超快速体二极管
- 同类最佳的反向恢复电荷Q_{rr}
- 同类最佳的 FOM $R_{DS(on)}$ * E_{oss}, 减少 Q_g, C_{iss}, and C_{oss}
- 同类最佳 $V_{(GS)th}$3V和最小$V_{(GS)th}$±0.5V 的变化
- 集成快速体二极管
- 同类最佳的 CoolMOS™质量和可靠性
- 全面优化的产品组合
- THD 和 SMD 封装中具有同类最佳的 $R_{DS(on)}$
- ESD 保护最小值2 级 (HBM)

优点

- 出色的硬换向稳健性，可用于谐振拓扑
- 为增加总线电压的设计提供额外的安全裕度
- 实现更高功率密度的解决方案
- 提高工业 SMPS 应用的满载效率
- 与之前的 CoolMOS ™系列相比，价格更具竞争力
- 通过减少与ESD相关的故障，提高生产产量

潜在应用

- 适用于硬开关和软开关拓扑
- 针对 LLC 和 ZVS 拓扑结构进行了优化
- 照明和工业 SMPS 中的 PFC 和 LLC 应用

产品验证

完全符合 JEDEC 工业应用标准

请注意：对于MOSFET 并联，通常建议在栅极上使用铁氧体磁珠或单独的图腾柱。

表 1　　主要性能参数

Parameter	Value	Unit
V_{DS} @ T_j = 25 °C	950	V
$R_{DS(on),max}$	60	mΩ
$Q_{g,typ}$	315	nC
I_D	74.7	A
E_{oss} @ 500V	20.8	µJ
Body diode di_F/dt	1300	A/µs
Q_{oss} @ 500V	0.74	µC

Type / Ordering Code	Package	Marking	Related Links
IPW95R060PFD7	PG-TO247-3	95R060D7	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）。

目录

1 最大额定值

除非另有规定， T_j = 25 °C

表 2 最大额定值

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	- -	- -	74.7 47.3	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	342	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	228	mJ	I_D=5.7A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	1.75	mJ	I_D=5.7A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	5.7	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	120	V/ns	V_{DS}=0...400V
Gate source voltage (static)	V_{GS}	-20	-	20	V	static;
Gate source voltage (dynamic)	V_{GS}	-30	-	30	V	AC (f>1 Hz)
Power dissipation	P_{tot}	-	-	446	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	150	°C	-
Mounting torque	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	53	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	342	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	70	V/ns	V_{DS}=0...400V, I_{SD}<=53A, T_j=25°C see table 8
Maximum diode commutation speed	di_F/dt	-	-	1300	A/µs	V_{DS}=0...400V, I_{SD}<=53A, T_j=25°C see table 8
Insulation withstand voltage	V_{ISO}	-	-	n.a.	V	V_{rms}, T_C=25°C, t=1min

[1] 受$T_{j,max}$限制。最大占空比D = 0.50
[2] 脉冲宽度t_p受$T_{j,max}$限制
[3] 相同的低侧和高侧开关，具有相同的R_G

2 热特性

表3 热特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.28	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	-	°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 电气特性

除非另有规定， T_j = 25 °C

表4 静态特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	950	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.5	3	3.5	V	V_{DS}=V_{GS}, I_D=2.85mA
Zero gate voltage drain current	I_{DSS}	- -	- 200	1 -	µA	V_{DS}=950V, V_{GS}=0V, T_j=25°C V_{DS}=950V, V_{GS}=0V, T_j=150°C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.04 0.12	0.06 -	Ω	V_{GS}=10V, I_D=57.0A, T_j=25°C V_{GS}=10V, I_D=57.0A, T_j=150°C
Gate resistance	R_G	-	0.5	-	Ω	f=250kHz, open drain

表 5 动态特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	9378	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	117	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	194	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	1969	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	48	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=57.0A, R_G=5.3Ω; see table 9
Rise time	t_r	-	25	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=57.0A, R_G=5.3Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	248	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=57.0A, R_G=5.3Ω; see table 9
Fall time	t_f	-	7.1	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=57.0A, R_G=5.3Ω; see table 9

表6 栅极电荷特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	43	-	nC	V_{DD}=760V, I_D=57.0A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	94	-	nC	V_{DD}=760V, I_D=57.0A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	315	-	nC	V_{DD}=760V, I_D=57.0A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	4.5	-	V	V_{DD}=760V, I_D=57.0A, V_{GS}=0 to 10V

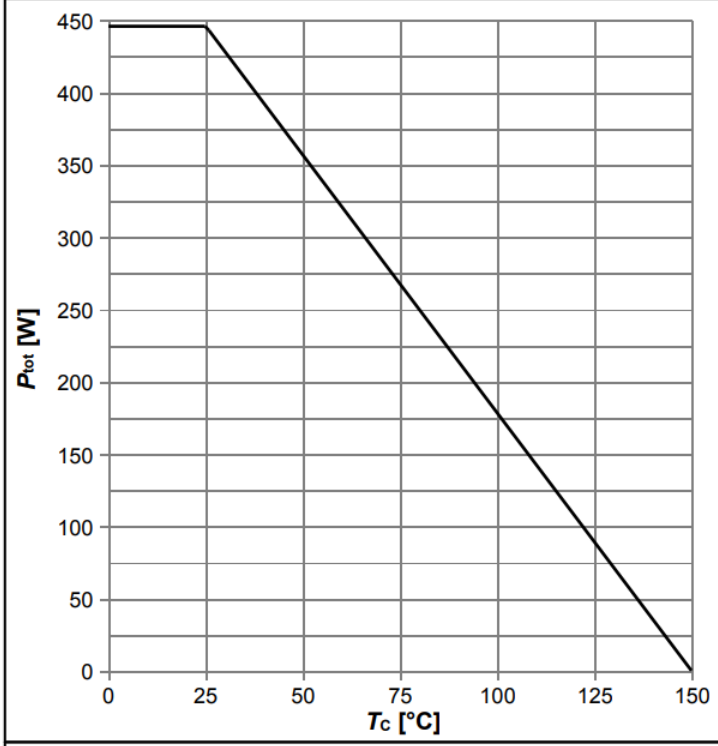
[1)] $C_{o(er)}$ 是一个固定电容， 当 V_{DS} 从 0 上升到 400V 时， 其存储的能量与 C_{oss} 相同
[2)] $C_{o(tr)}$ 为固定电容， 当 V_{DS} 从 0 上升至 400V 时， 其充电时间与 C_{oss} 相同

表7 反向二极管特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1.1	-	V	V_{GS}=0V, I_F=57.0A, T_j=25°C
Reverse recovery time	t_{rr}	-	213	-	ns	V_R=400V, I_F=57.0A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	1.84	-	µC	V_R=400V, I_F=57.0A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	16.3	-	A	V_R=400V, I_F=57.0A, di_F/dt=100A/µs; see table 8

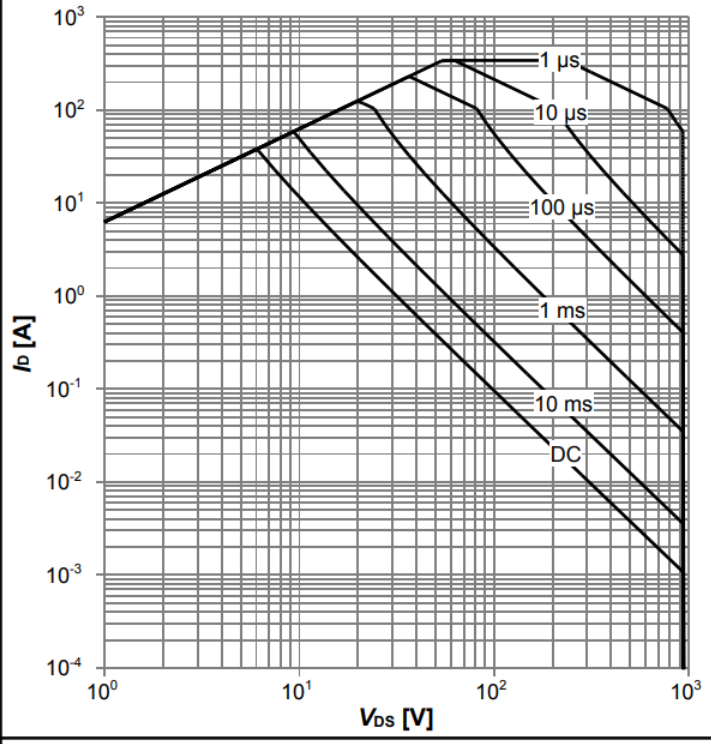
4 电气特性图

Diagram 1: Power dissipation



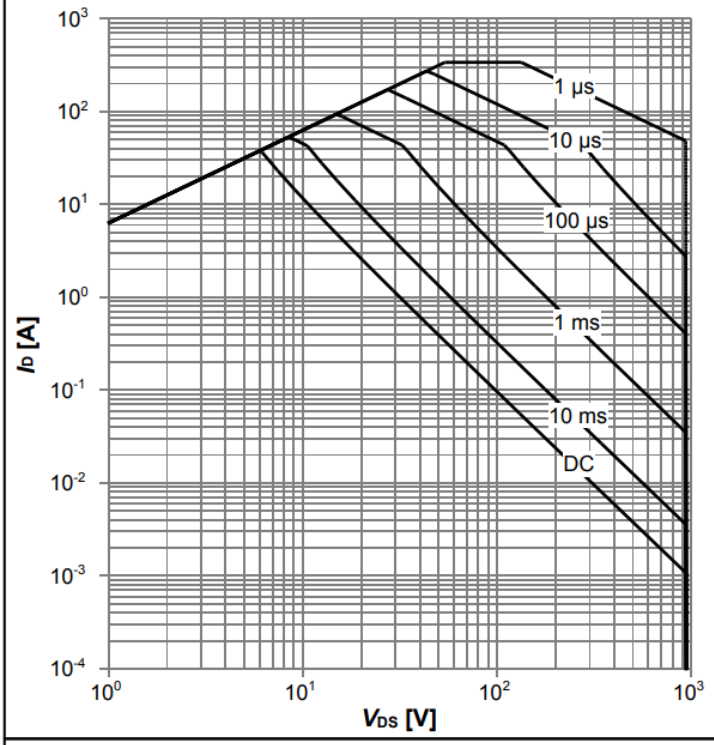
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



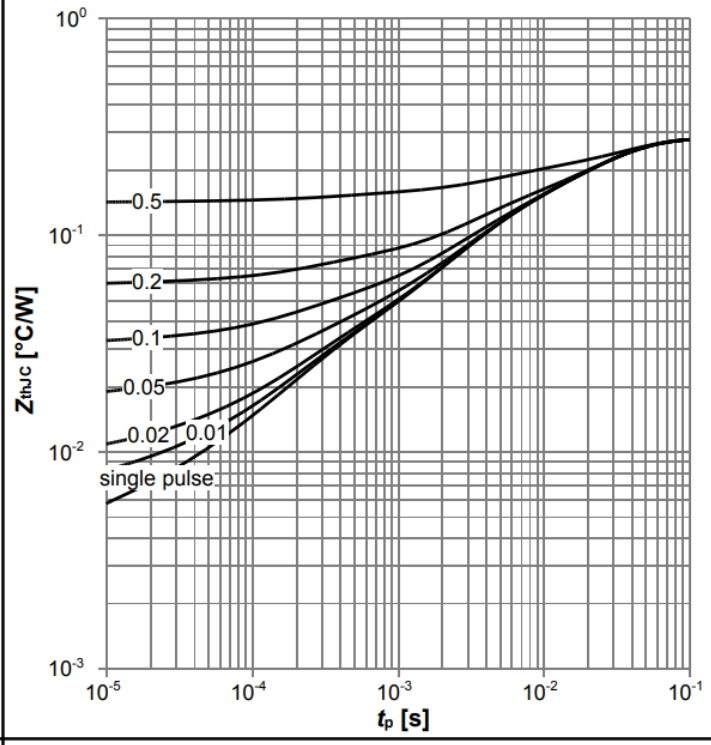
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Diagram 3: Safe operating area



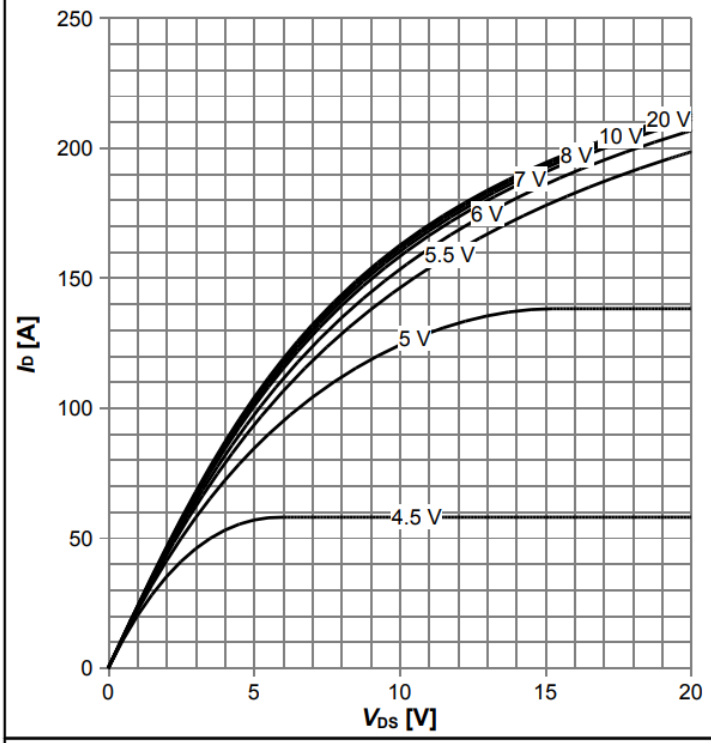
$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: t_p

Diagram 4: Max. transient thermal impedance



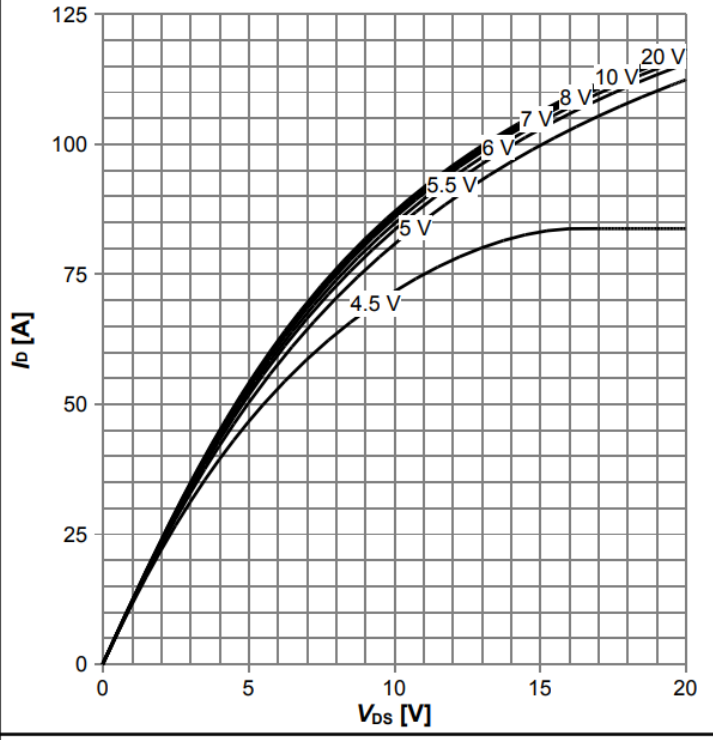
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



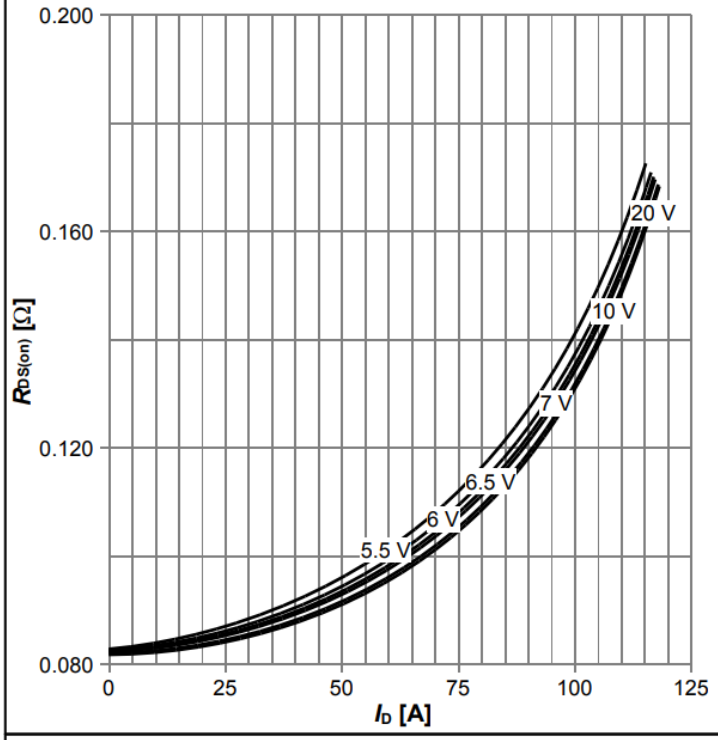
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



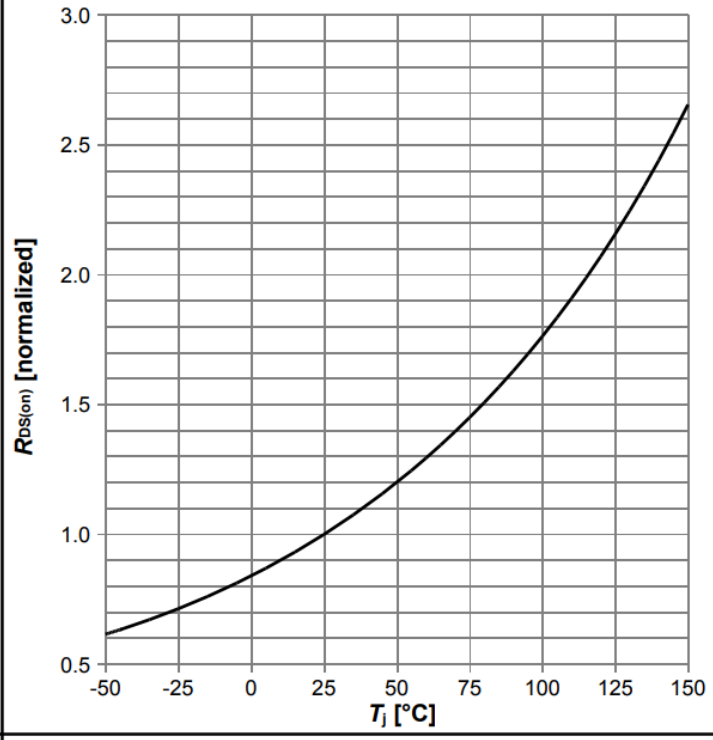
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



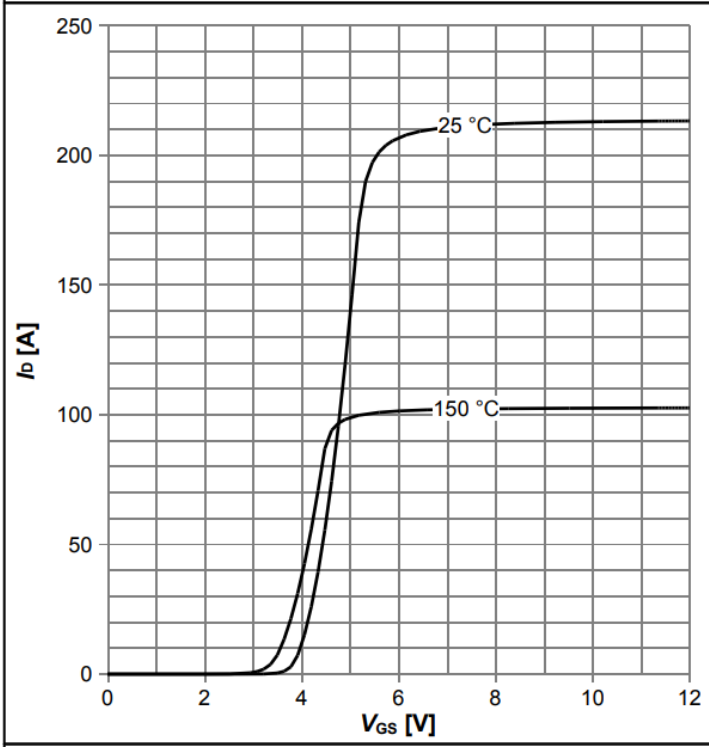
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



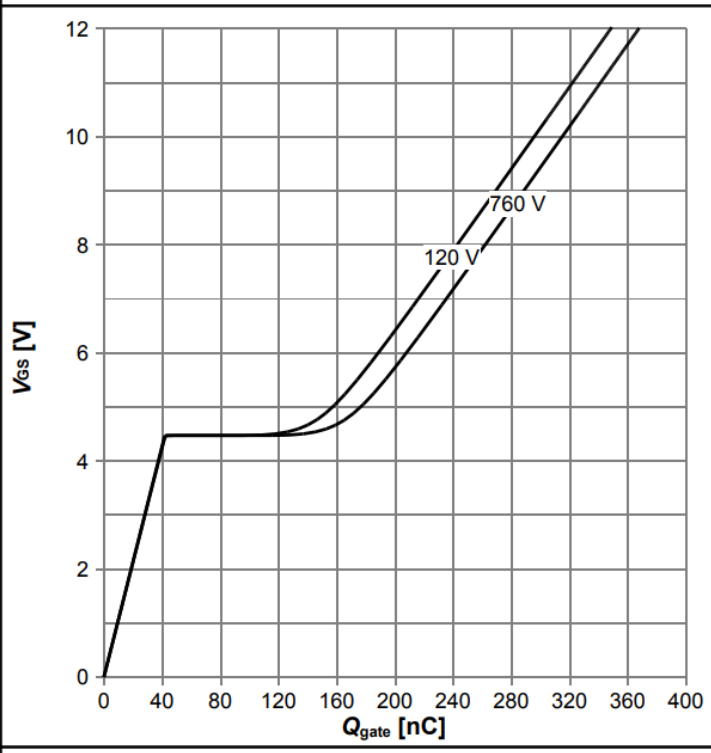
$R_{DS(on)}=f(T_j)$; $I_D=57.0$ A; $V_{GS}=10$ V

Diagram 9: Typ. transfer characteristics



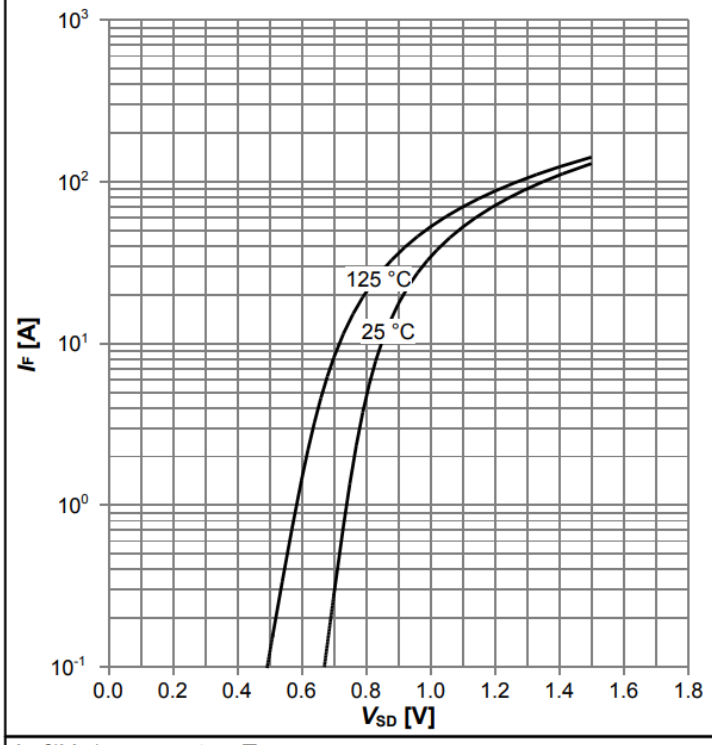
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



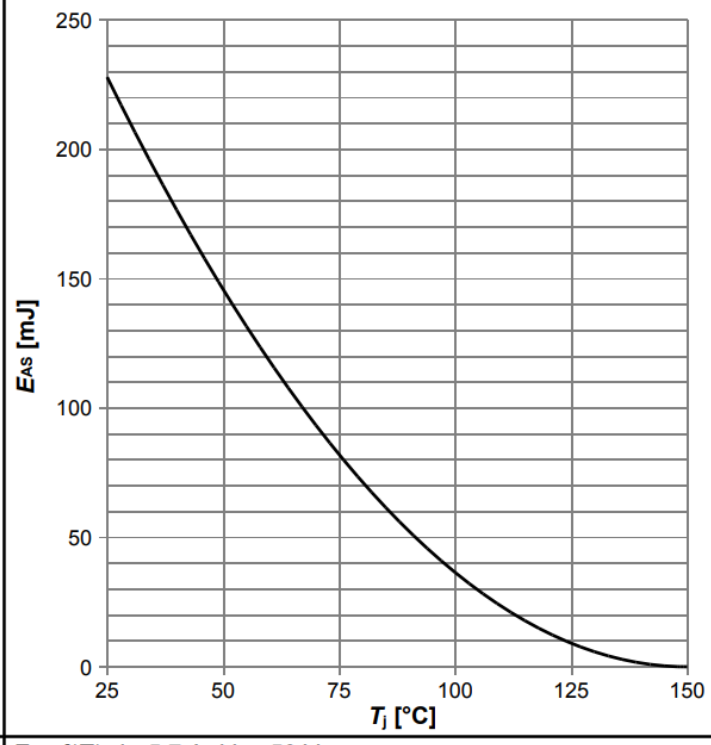
V_{GS}=f(Q_{gate}); I_D=57.0 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



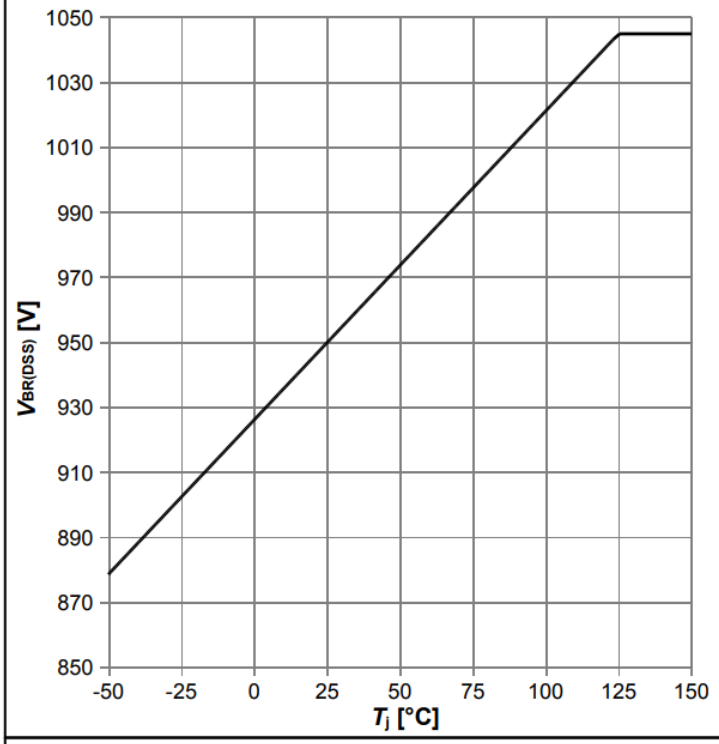
I_F=f(V_{SD}); parameter: T_j

Diagram 12: Avalanche energy



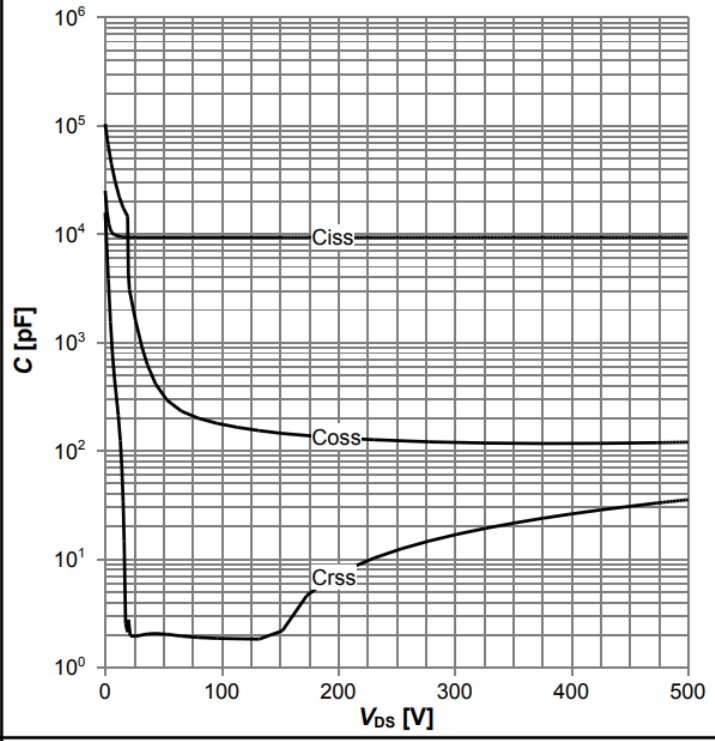
E_{AS}=f(T_j); I_D=5.7 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



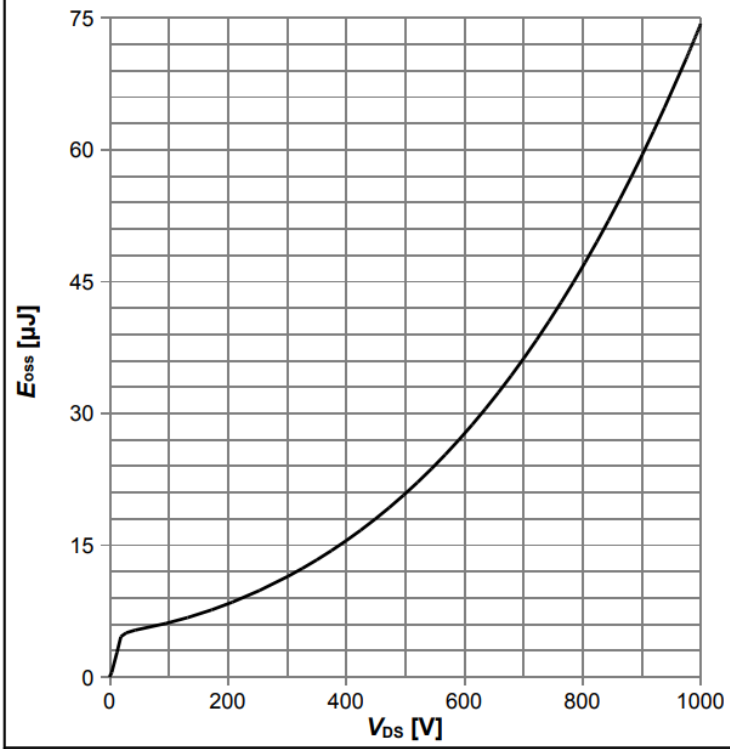
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Diagram 14: Typ. capacitances



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

Diagram 15: Typ. Coss stored energy



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

5 测试电路

表8 反向二极管特性

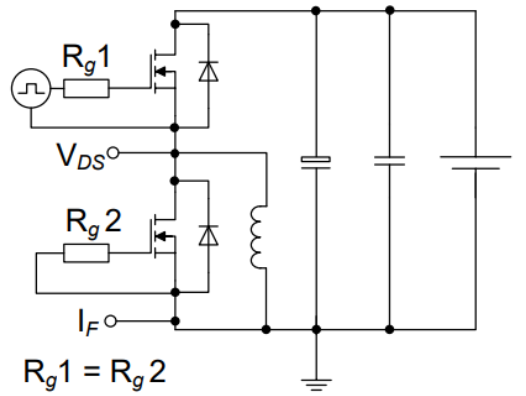
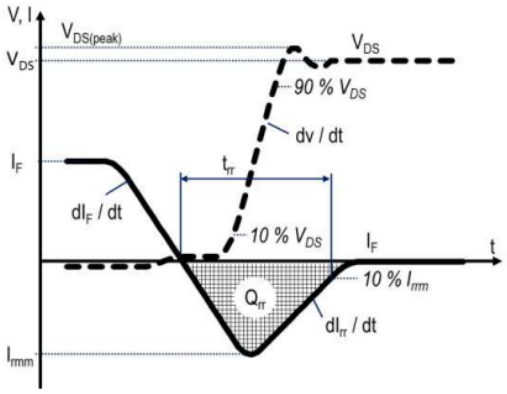
Test circuit for diode characteristics	Diode recovery waveform
	

表 9 切换时间

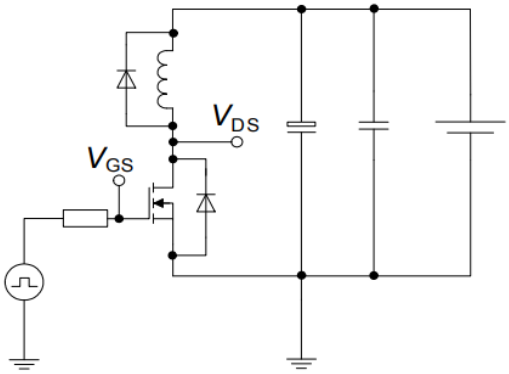
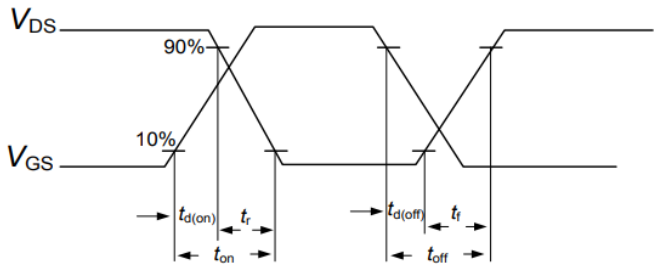
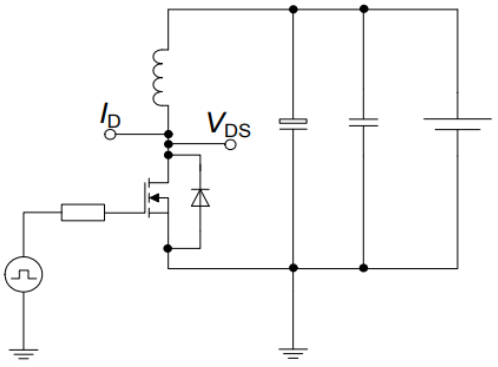
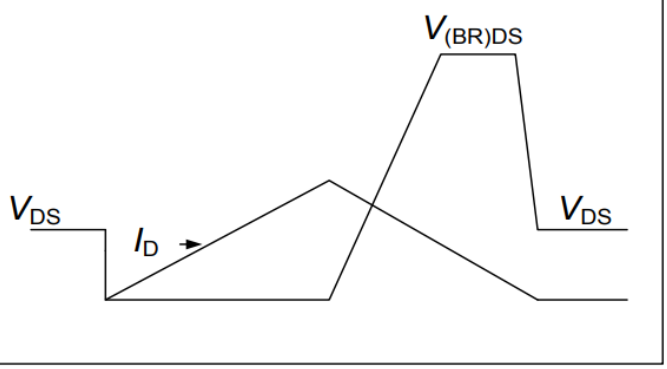
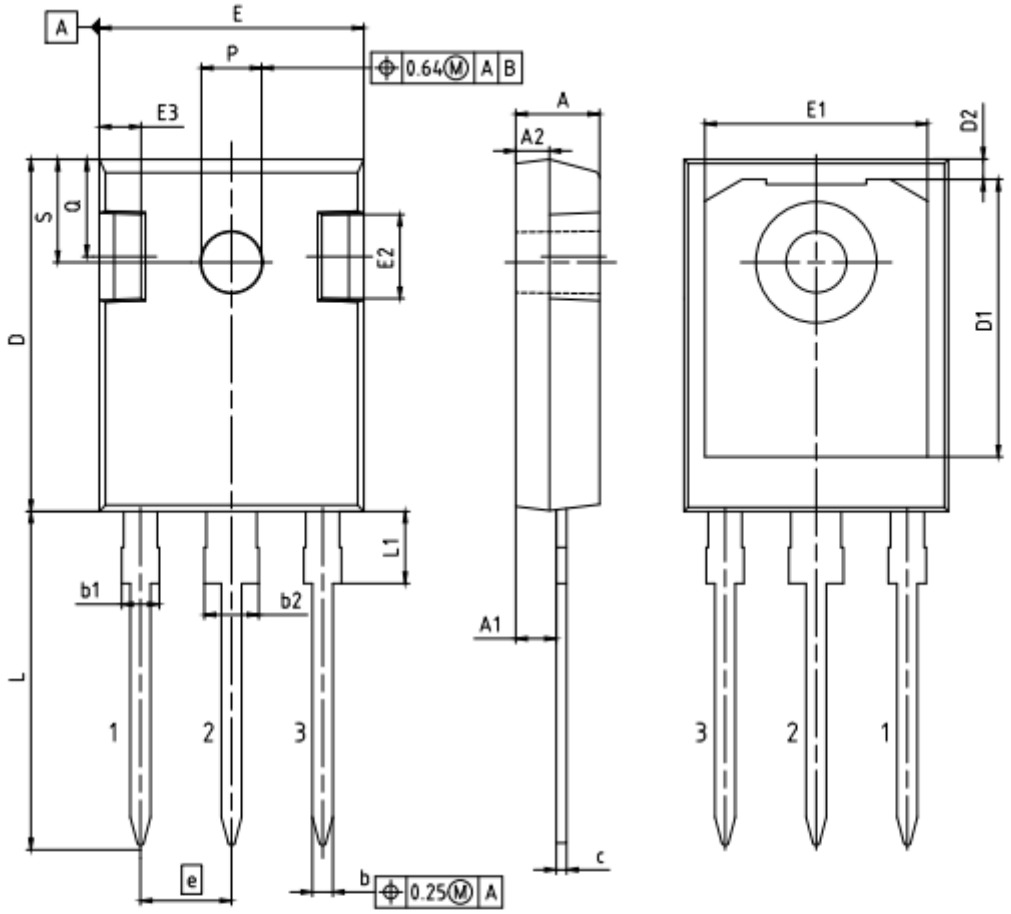
Switching times test circuit for inductive load	Switching times waveform
	

表 10 非钳位感性负载

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 封装外形



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	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

DOCUMENT NO.
Z8B00003327

REVISION
06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
25.07.2018

图 1 PG-TO247-3 外形图，尺寸单位为毫米

7 附录 A

表 11 相关链接

- **IFX CoolMOS PFD7 950V 网页：** www.infineon.com
- **IFX CoolMOS PFD7 950V 应用说明：** www.infineon.com
- **IFX CoolMOS PFD7 950V 仿真模型：** www.infineon.com
- **IFX 设计工具：** www.infineon.com

修订记录

IPW95R060PFD7

Revision: 2022-04-22, Rev. 2.1

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.0	2022-03-18	Release of final version
2.1	2022-04-22	Modified features

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