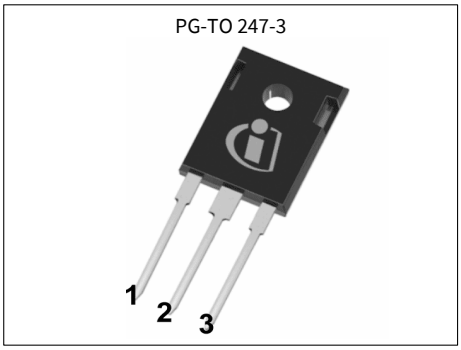
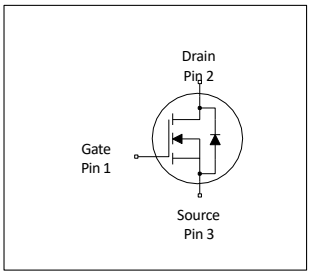
英飞凌MOSFET

600V CoolMOS™ CFD7 功率管





CoolMOS™ 是一种革命性的高压功率 MOSFET 技术，根据超级结 (SJ) 原理设计，由英飞凌科技公司首创。最新的 CoolMOS™ CFD7 是 CoolMOS™ CFD2 系列的后继产品，是专为相移全桥 (ZVS) 和 LLC 等软开关应用而定制的优化平台。由于降低了栅极电荷 (Q_g)、一流的反向恢复电荷 (Q_{rr}) 和改进的关断行为，CoolMOS™ CFD7 在谐振拓扑结构中提供了最高的效率。作为英飞凌快速体二极管产品组合的一部分，这一新产品系列融合了快速开关技术的所有优势和卓越的硬换向稳健性，同时又不影响设计过程中的轻松实施。CoolMOS™ CFD7 技术符合最高的效率和可靠性标准，并支持高功率密度解决方案。总之，CoolMOS™ CFD7 使谐振开关拓扑结构更高效、更可靠、更轻便、更低温。

特性

- 超快体二极管
- 低栅极电荷
- 同类最佳的反向恢复电荷(Q_{rr})
- 改进的 MOSFET 反向二极管 dv/dt 和di_F/dt 强度
- 最低 FOM $R_{DS(on)}$*Q_g和 $R_{DS(on)}$*E_{oss}
- 行业领先的 $R_{DS(on)}$，适配 THD 和 SMD 封装

优点

- 出色的硬换向稳健性
- 谐振拓扑的最高可靠性
- 最高效率杰出的易用性/性能平衡
- 实现更高功率密度的解决方案

潜在应用

适用于软开关拓扑

针对相移全桥 (ZVS)、LLC 应用进行了优化—服务器、电信、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

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} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	70	mΩ
$Q_{g,typ}$	67	nC
$I_{D,pulse}$	129	A
E_{oss} @ 400V	7.7	µJ
Body diode di_F/dt	1300	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPW60R070CFD7	PG-TO 247-3	60R070F7	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.cn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

表 2 最大额定值

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	- -	- -	31 20	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	129	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	151	mJ	I_D=6.3A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.76	mJ	I_D=6.3A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	6.3	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}	-	-	156	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	-	-	31	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	129	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	70	V/ns	V_{DS}=0...400V, I_{SD}<=31A, T_j=25°C see table 8
Maximum diode commutation speed	di_F/dt	-	-	1300	A/µs	V_{DS}=0...400V, I_{SD}<=31A, 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
[2] 脉冲宽度 t_p 受 $T_{j,max}$ 限制
[3] 相同的低边和高边开关，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}	-	-	0.8	°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	$V_{(BR)DSS}$	600	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	3.5	4	4.5	V	V_{DS}=V_{GS}, I_D=0.76mA
Zero gate voltage drain current[1]	I_{DSS}	- -	- 15	1 63	µA	V_{DS}=600V, V_{GS}=0V, T_j=25°C V_{DS}=600V, V_{GS}=0V, T_j=125°C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.057 0.13	0.07 -	Ω	V_{GS}=10V, I_D=15.1A, T_j=25°C V_{GS}=10V, I_D=15.1A, T_j=150°C
Gate resistance	R_G	-	5.9	-	Ω	f=1MHz, open drain

表 5 动态特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	2721	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	53	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[2]	$C_{o(er)}$	-	96	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[3]	$C_{o(tr)}$	-	990	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	26	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=11.0A, R_G=5.3Ω; see table 9
Rise time	t_r	-	23	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=11.0A, R_G=5.3Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	99	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=11.0A, R_G=5.3Ω; see table 9
Fall time	t_f	-	6	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=11.0A, 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}	-	15	-	nC	V_{DD}=400V, I_D=11.0A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	24	-	nC	V_{DD}=400V, I_D=11.0A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	67	-	nC	V_{DD}=400V, I_D=11.0A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.5	-	V	V_{DD}=400V, I_D=11.0A, V_{GS}=0 to 10V

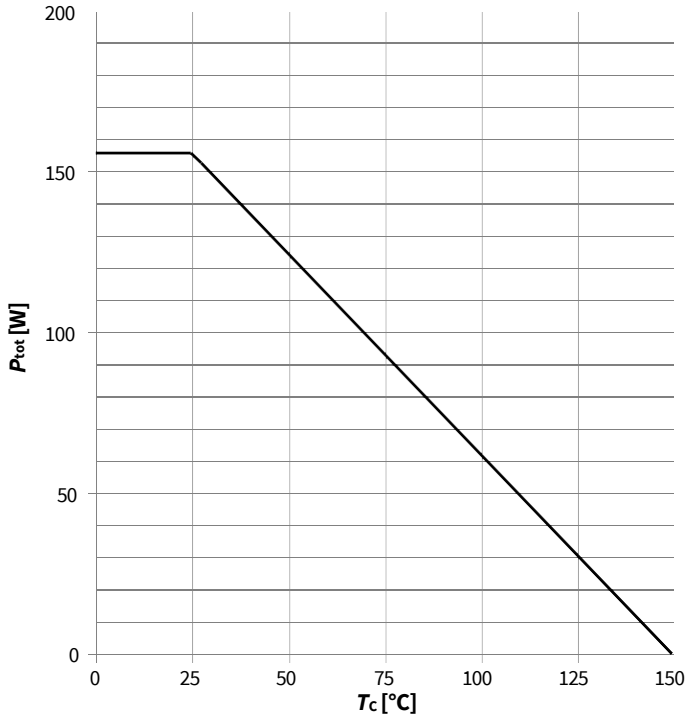
[1] 最大规格由计算出的六西格玛置信上限定义
[2] $C_{o(er)}$ 是一个固定电容，当 V_{DS} 从 0 V 上升到 400 V 时，其存储能量与 C_{oss} 相同
[3] $C_{o(tr)}$ 是一个固定电容，当 V_{DS} 从 0 V 上升到 400 V 时，其充电时间与 C_{oss} 相同

表 7　　反向二极管特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1.0	-	V	V_{GS}=0V, I_F=15.1A, T_j=25°C
Reverse recovery time	t_{rr}	-	124	186	ns	V_R=400V, I_F=11A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	0.57	1.14	µC	V_R=400V, I_F=11A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	7.8	-	A	V_R=400V, I_F=11A, di_F/dt=100A/µs; see table 8

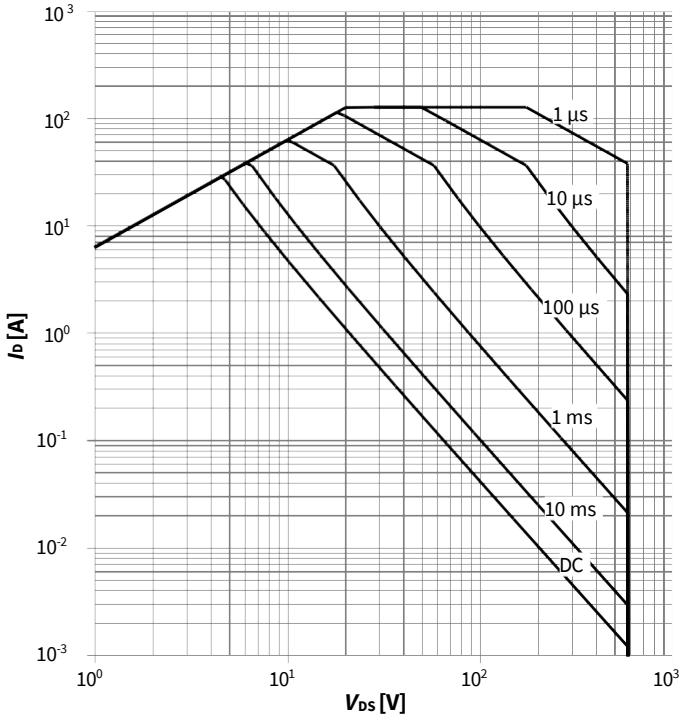
4 电气特性图

Diagram 1: Power dissipation



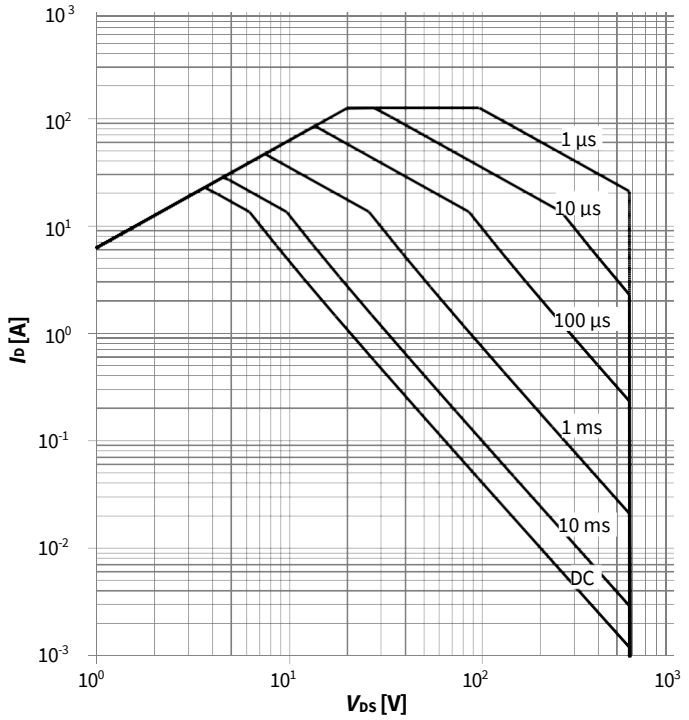
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



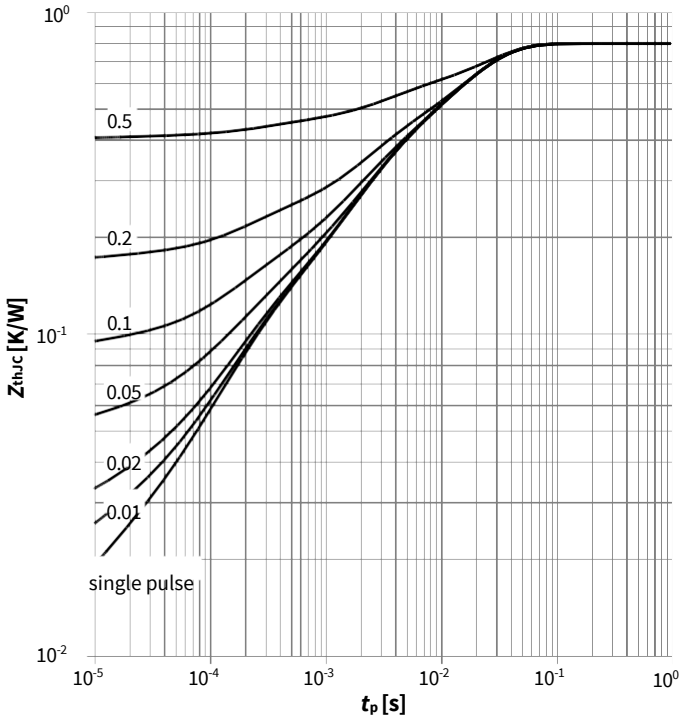
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Diagram 3: Safe operating area



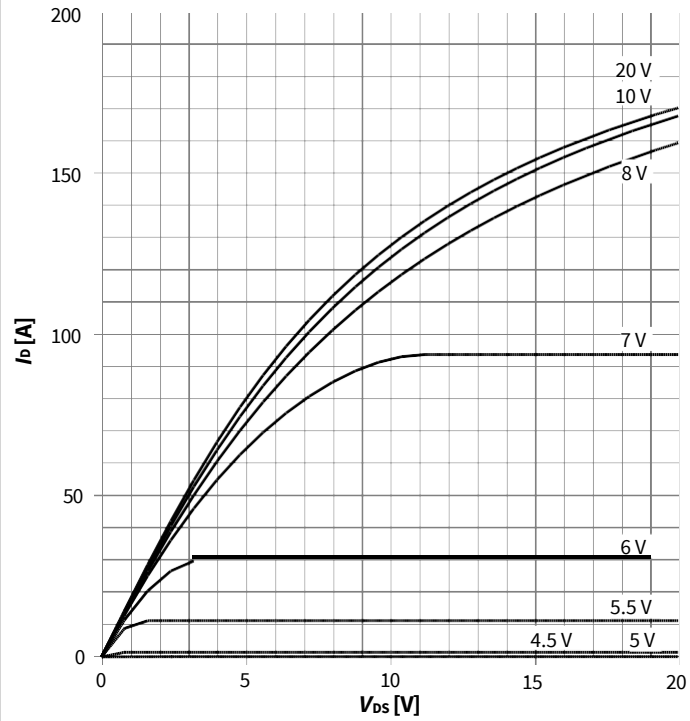
$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: t_p

Diagram 4: Max. transient thermal impedance



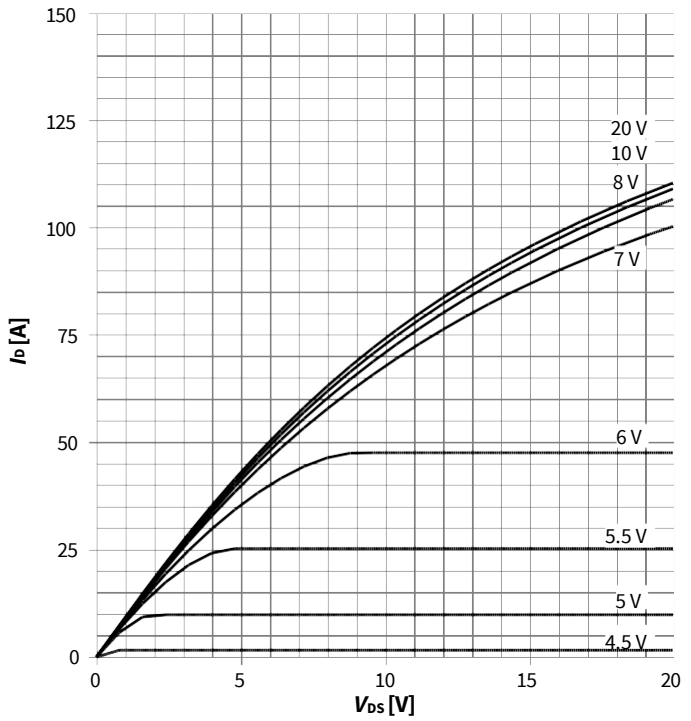
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



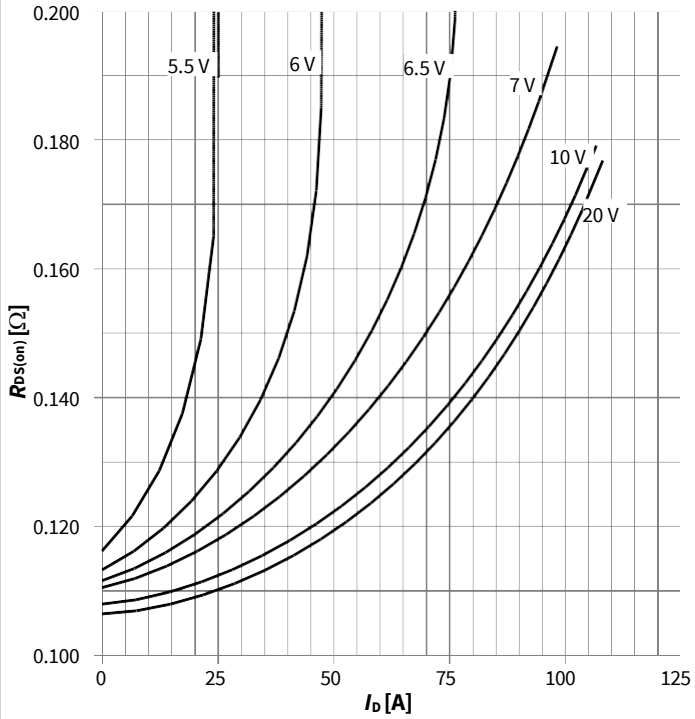
$I_D=f(V_{DS})$; T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



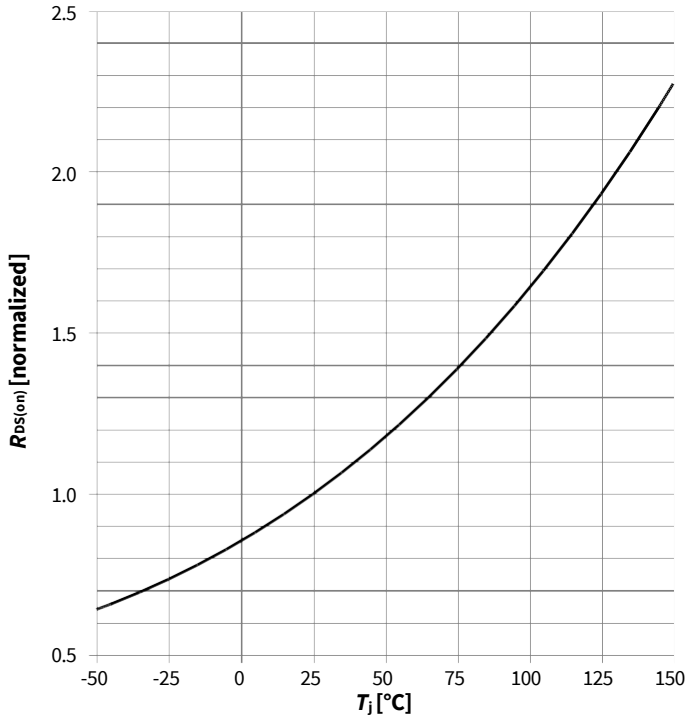
$I_D=f(V_{DS})$; T_j=125 °C; parameter: V_{GS}

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



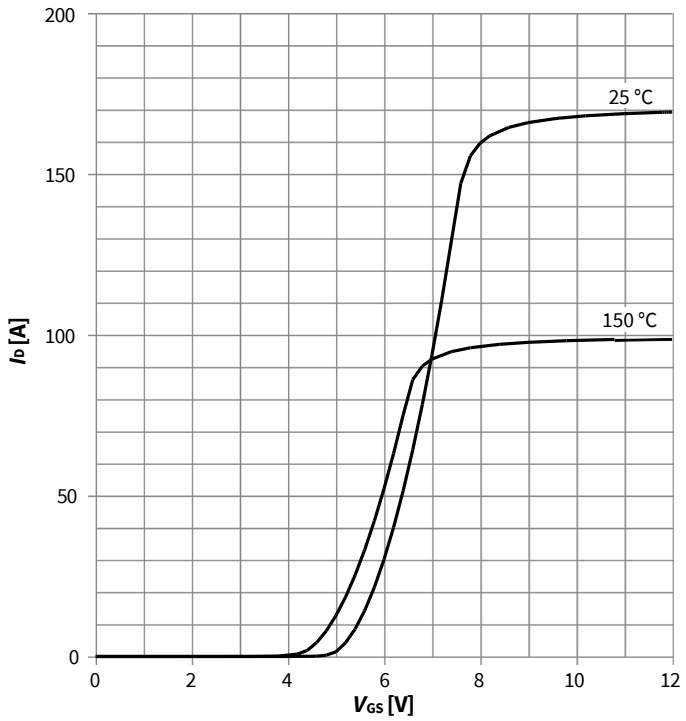
$R_{DS(on)}=f(I_D)$; T_j=125 °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



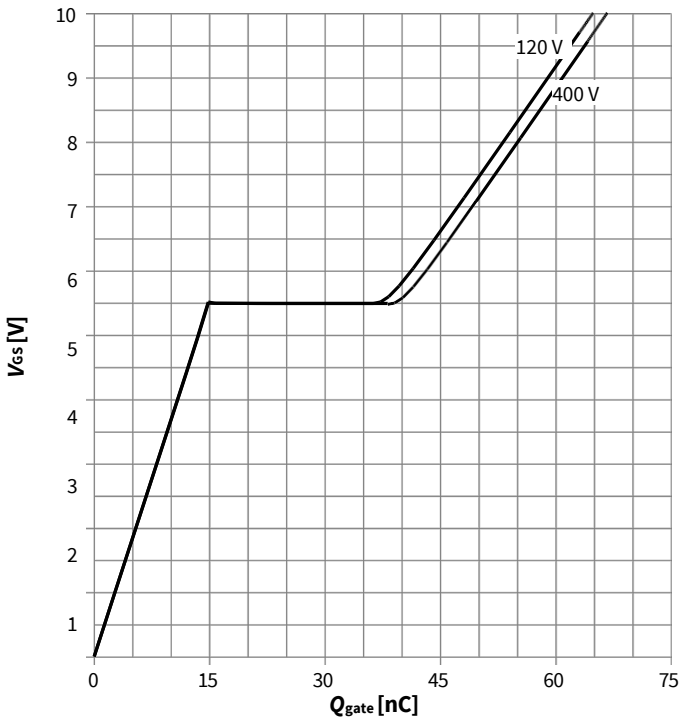
$R_{DS(on)}=f(T_j)$; I_D=15.1 A; V_{GS}=10 V

Diagram 9: Typ. transfer characteristics



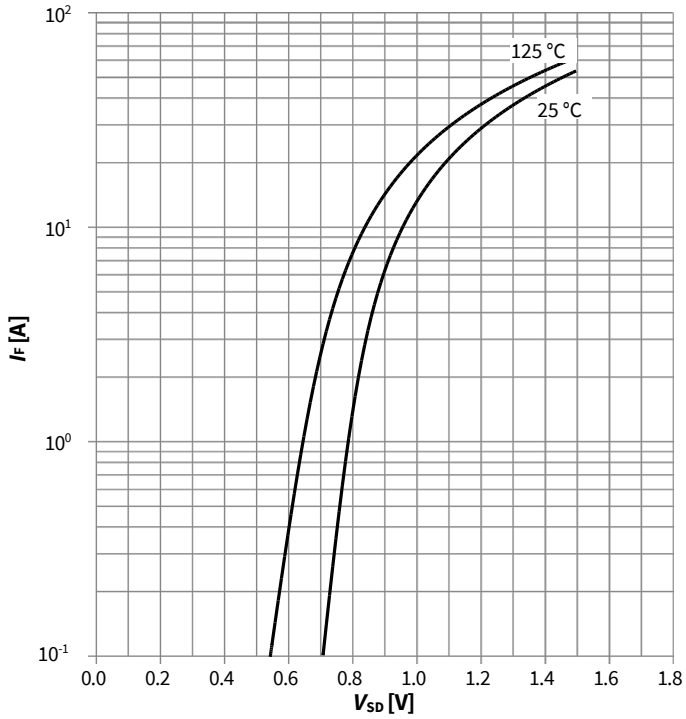
$I_D=f(V_{GS})$; V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



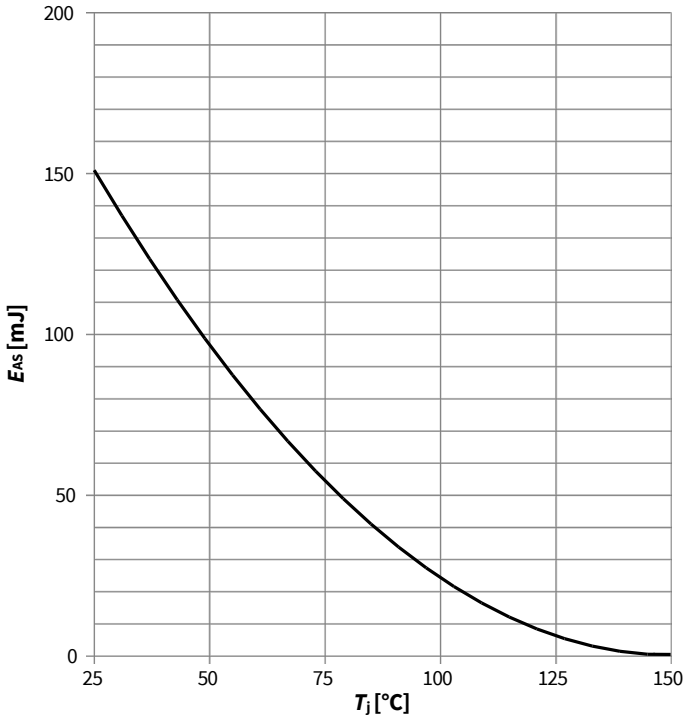
$V_{GS}=f(Q_{gate})$; I_D=11.0 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



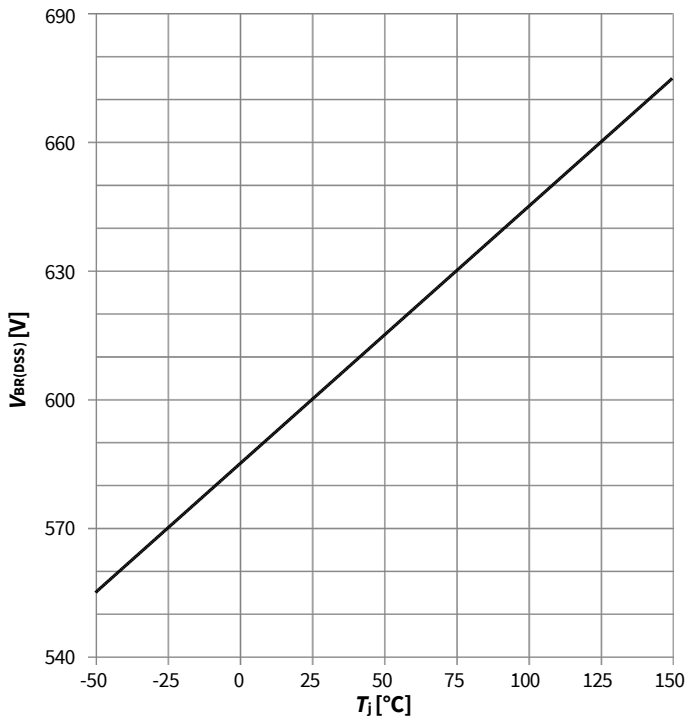
$I_F=f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



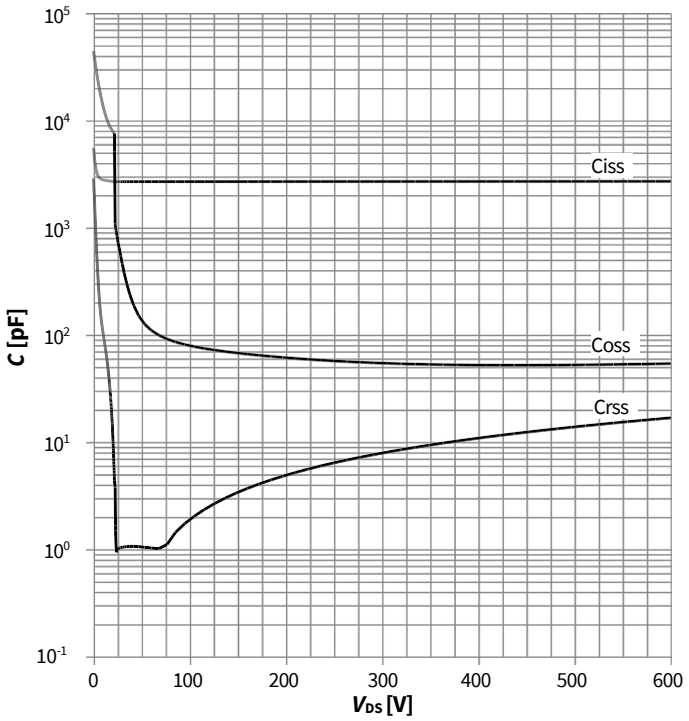
$E_{AS}=f(T_j)$; I_D=6.3 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



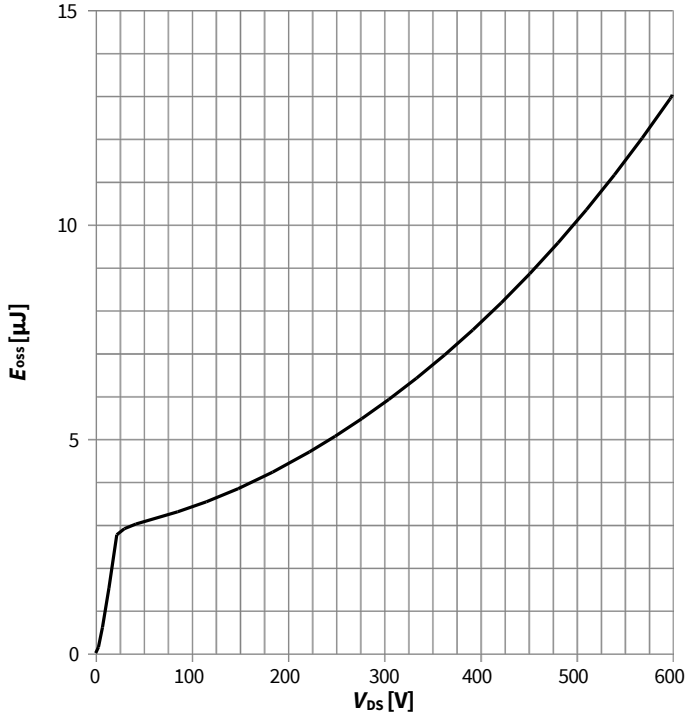
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

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 二极管特性

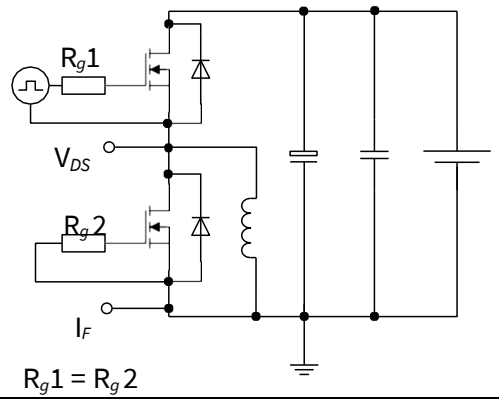
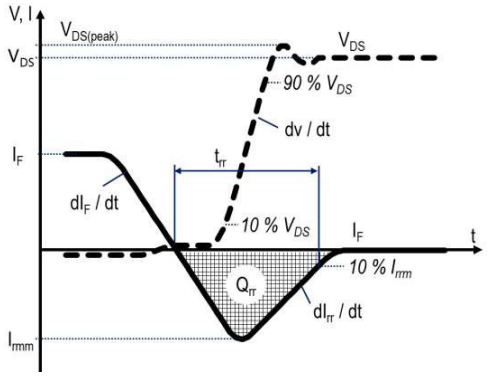
Test circuit for diode characteristics	Diode recovery waveform
	

表 9 切换时间

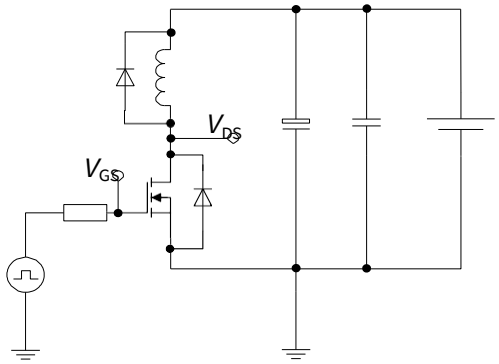
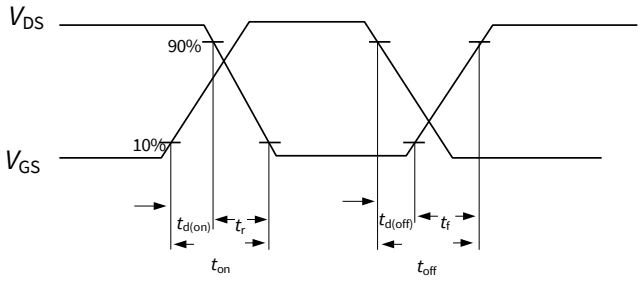
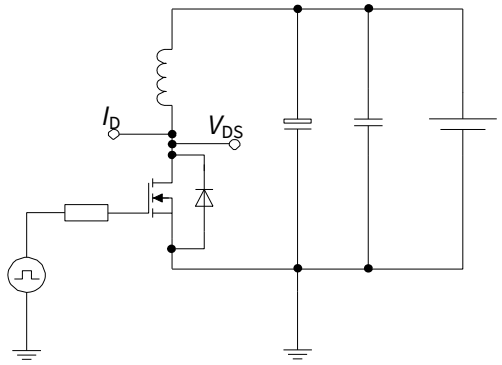
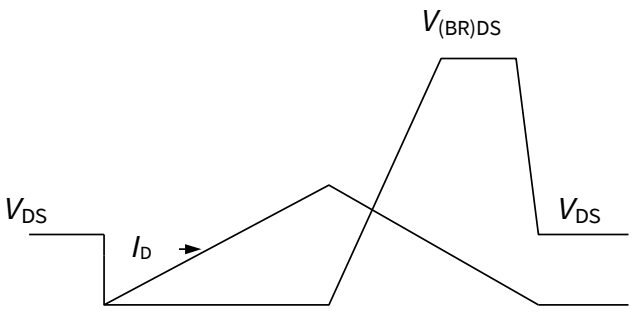
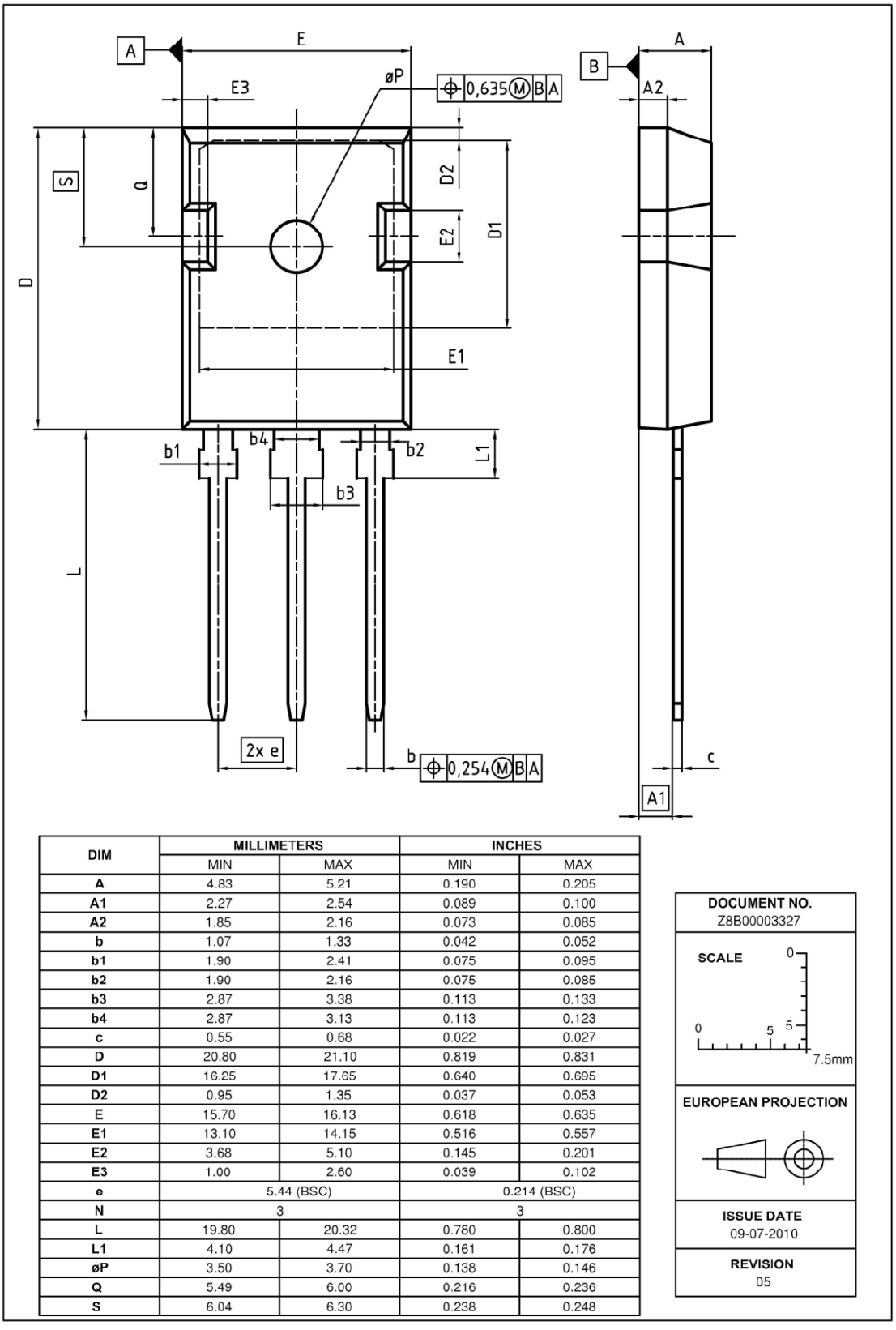
Switching times test circuit for inductive load	Switching times waveform
	

表 10 非钳位感性负载

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 封装外形



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

DOCUMENT NO.
Z8B00003327

SCALE
0 5 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

图 1 PG-TO 247-3 外形，尺寸单位：毫米/英寸

7 附录 A

表 11 相关链接

- **IFX CoolMOS CFD7 网页：** www.infineon.com
- **IFX CoolMOS CFD7 应用笔记:** www.infineon.com
- **IFX CoolMOS CFD7 仿真模型：** www.infineon.com
- **IFX 设计工具：** www.infineon.com

修订记录

IPW60R070CFD7

Revision: 2017-12-12, Rev. 2.1

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.0	2017-08-25	Release of final version
2.1	2017-12-12	Raised diode current for dv/dt and dif/dt (table 2) to value of continuous drain current; Changed internal Rg (table 4); Renamed related links (table 11)

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