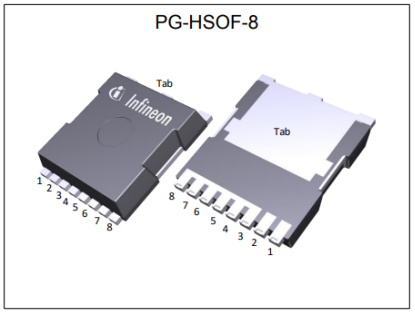
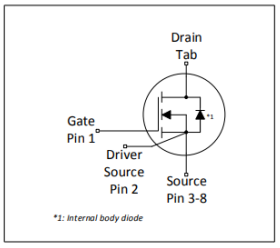
英飞凌MOSFET功率晶体管



英飞凌600V CoolMOS™ CM8 功率晶体管IPT60R016CM8

CoolMOS ™第 8 代平台是高压功率 MOSFET 的革命性技术，根据超结 (SJ) 原理设计，由英飞凌科技率先推出。600V CoolMOS ™ CM8 系列是 CoolMOS ™ 7 的后续产品。
它结合了快速开关 SJ MOSFET 的优点和出色的易用性，例如低振铃趋势、为所有产品实施快速体二极管 (CFD)，具有出色的抗硬换向稳健性和出色的 ESD 能力。此外，CM8 的开关和导通损耗极低，使得开关应用更加高效。



特性

- 由于具有出色的换向稳健性，适用于硬开关和软开关拓扑
- 显著减少开关和传导损耗
- 由于具有超低 $R_{DS(on)}$， 每封装产品具有同类最佳的$R_{DS(on)}$ *A

优点

- 低振铃趋势使其在PFC 和 PWM 阶段均可实现易于使用和快速设计
- 得益于我们先进的芯片贴装技术，简化了热管理
- 由于采用最先进的 ESD 保护技术，可以使用封装更小、制造质量更高的产品，实现更高的功率密度解决方案
- 适用于多种应用和功率范围

潜在应用

- 电源和转换器
- PFC 级和 LLC 谐振转换器
- 高效开关应用
- 例如 服务器、电信、电动汽车充电、UPS

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} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	16	mΩ
$Q_{g,typ}$	171	nC
$I_{D,pulse}$	505	A
E_{oss} @ 400V	22.9	µJ
Body diode di_F/dt	1300	A/µs
ESD class (HBM)	2	-

Type / Ordering Code	Package	Marking	Related Links
IPT60R016CM8	PG-HSOF-8	60R016C8	see Appendix A

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	- -	- -	142 89	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	505	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	297	mJ	I_D=10.1A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	1.48	mJ	I_D=10.1A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	10.1	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}	-	-	694	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	150	°C	-
Extended operating junction temperature	T_j	150	-	175	°C	≤50 h in the application lifetime
Mounting torque	-	-	-	-	Ncm	-
Continuous diode forward current	I_S	-	-	142	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	505	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	70	V/ns	V_{DS}=0...400V, I_{SD}≤142A, T_j=25°C see table 8
Maximum diode commutation speed	di_F/dt	-	-	1300	A/µs	V_{DS}=0...400V, I_{SD}≤142A, 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}	-	-	0.18	K/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	K/W	device on PCB, minimal footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	35	45	K/W	Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.
Soldering temperature, wave- & reflow soldering allowed	T_{sold}	-	-	260	°C	reflow MSL1

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	$V_{(GS)th}$	3.7	4.2	4.7	V	V_{DS}=V_{GS}, I_D=1.48mA
Zero gate voltage drain current	I_{DSS}	- -	- 244	2 -	µA	V_{DS}=600V, V_{GS}=0V, T_j=25°C V_{DS}=600V, V_{GS}=0V, T_j=150°C
Gate-source leakage current	I_{GSS}	-	-	0.1	µA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.013 0.029	0.016 -	Ω	V_{GS}=10V, I_D=62.5A, T_j=25°C V_{GS}=10V, I_D=62.5A, T_j=150°C
Gate resistance	R_G	-	1	-	Ω	f=1MHz

表 5 动态特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	7545	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	91	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	286	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	2976	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	29.4	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=29.7A, R_G=1.8Ω; see table 9
Rise time	t_r	-	9	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=29.7A, R_G=1.8Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	125.7	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=29.7A, R_G=1.8Ω; see table 9
Fall time	t_f	-	4.4	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=29.7A, R_G=1.8Ω; 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}	-	45	-	nC	V_{DD}=400V, I_D=29.7A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	61	-	nC	V_{DD}=400V, I_D=29.7A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	171	-	nC	V_{DD}=400V, I_D=29.7A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.9	-	V	V_{DD}=400V, I_D=29.7A, V_{GS}=0 to 10V

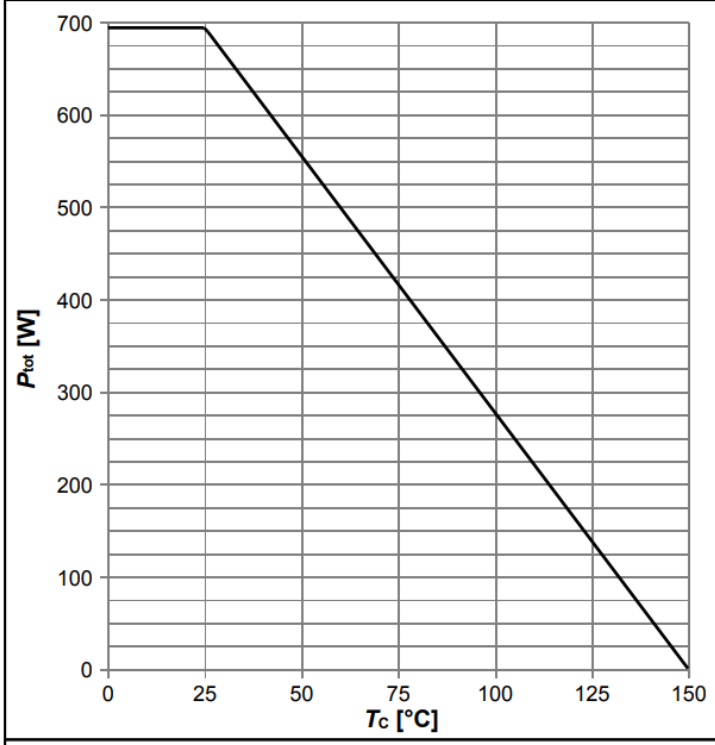
[1)] $C_{o(er)}$ 是一个固定电容， 当 V_{DS} 从 0 上升到 400V 时， 其存储的能量与 C_{oss}相同
[2)] $C_{o(tr)}$ 是一个固定电容， 当 V_{DS} 从 0 升至 400 V 时，其充电时间与 C_{oss} 相同

表7 反向二极管特性

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	V_{GS}=0V, I_F=29.7A, T_j=25°C
Reverse recovery time	t_{rr}	-	180	225	ns	V_R=400V, I_F=29.7A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	1.54	2.31	µC	V_R=400V, I_F=29.7A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	16.4	-	A	V_R=400V, I_F=29.7A, di_F/dt=100A/µs; see table 8

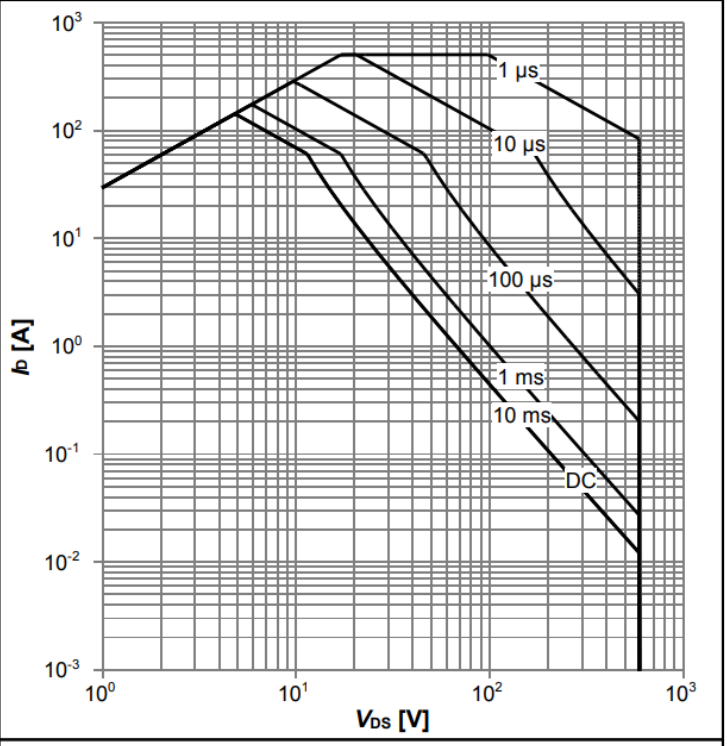
4 电气特性图

Diagram 1: Power dissipation



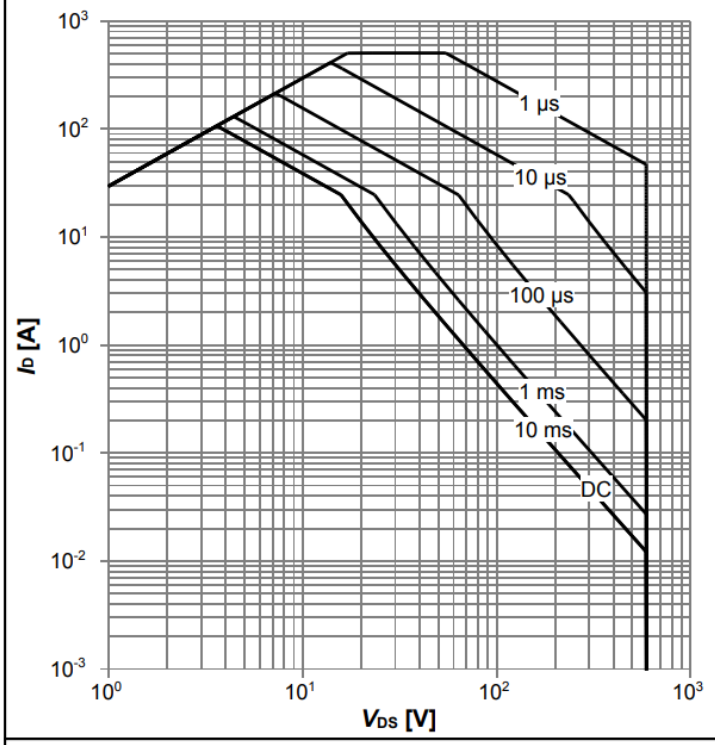
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



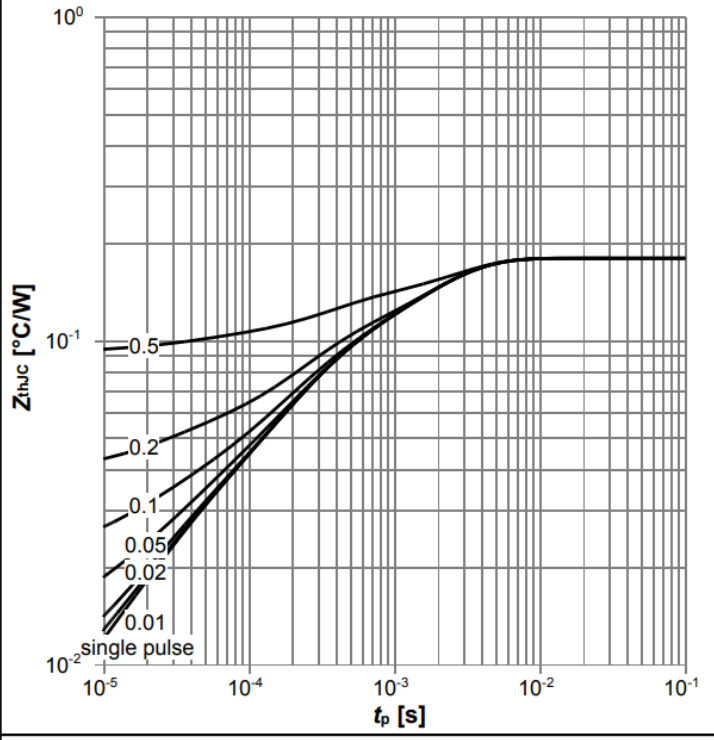
$I_D=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



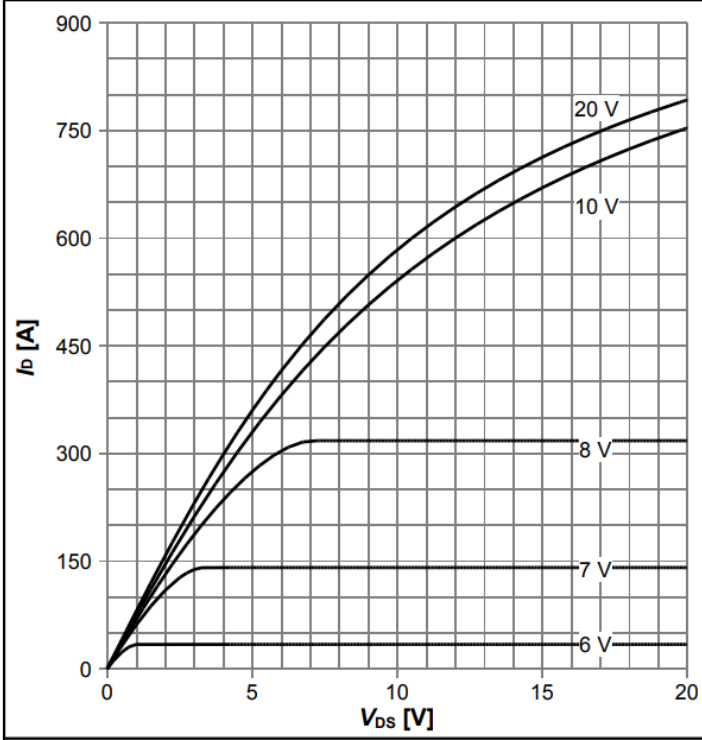
$I_D=f(V_{DS})$; T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



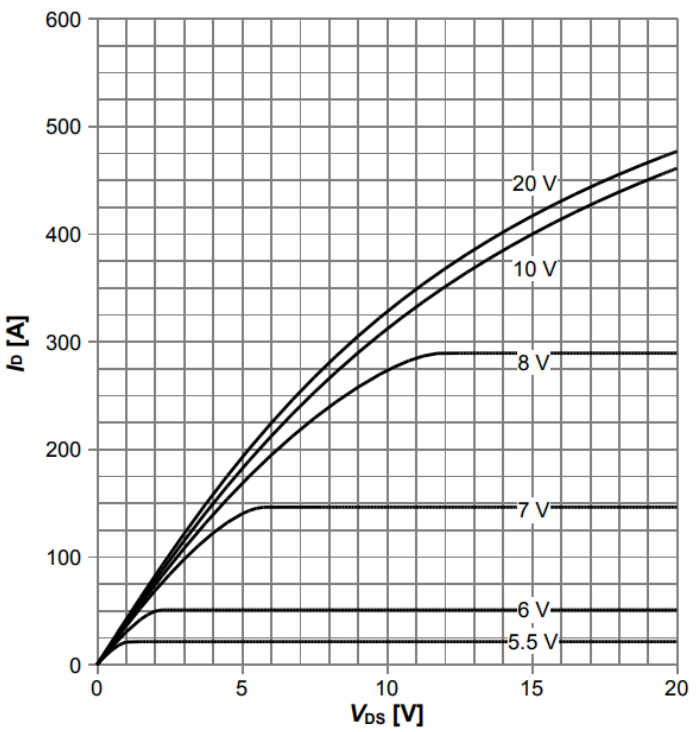
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



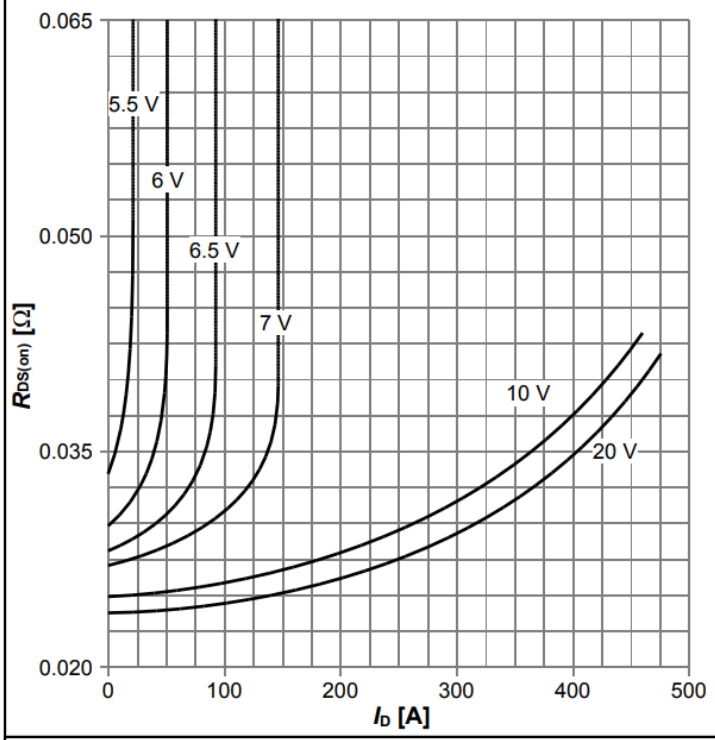
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



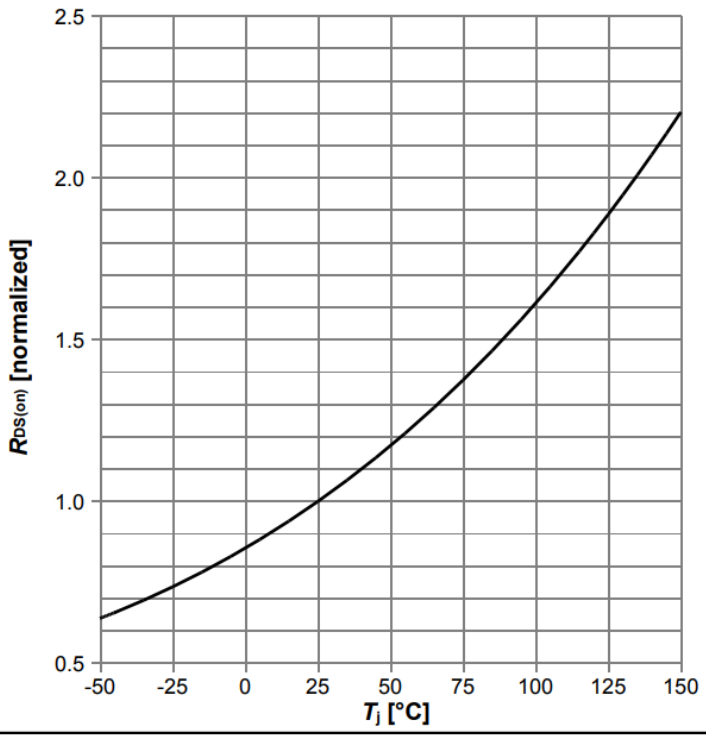
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



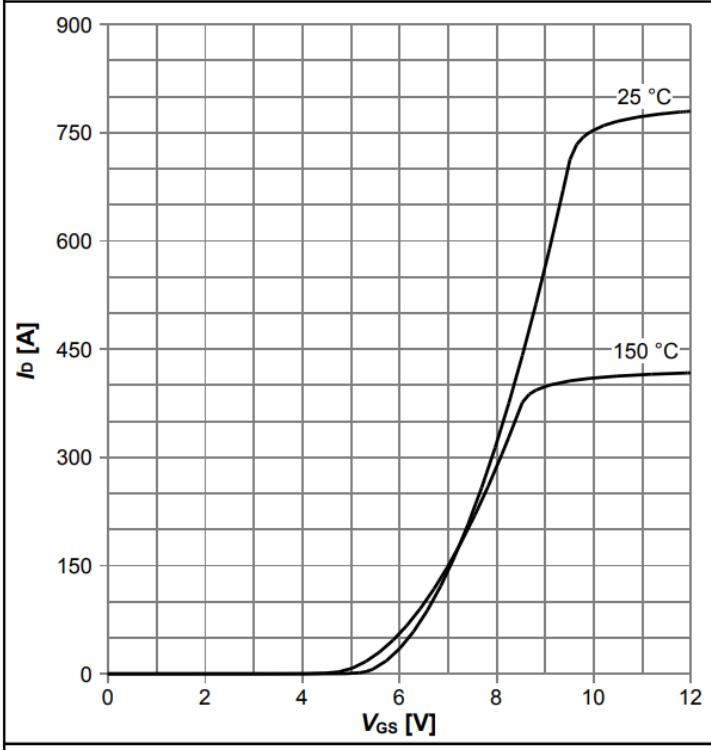
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



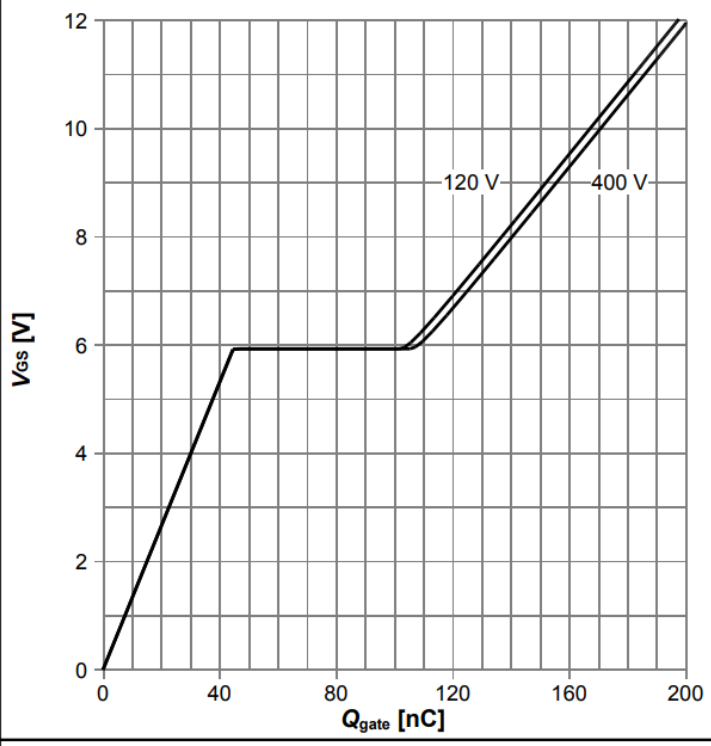
$R_{DS(on)}=f(T_j)$; $I_D=62.5$ A; $V_{GS}=10$ V

Diagram 9: Typ. transfer characteristics



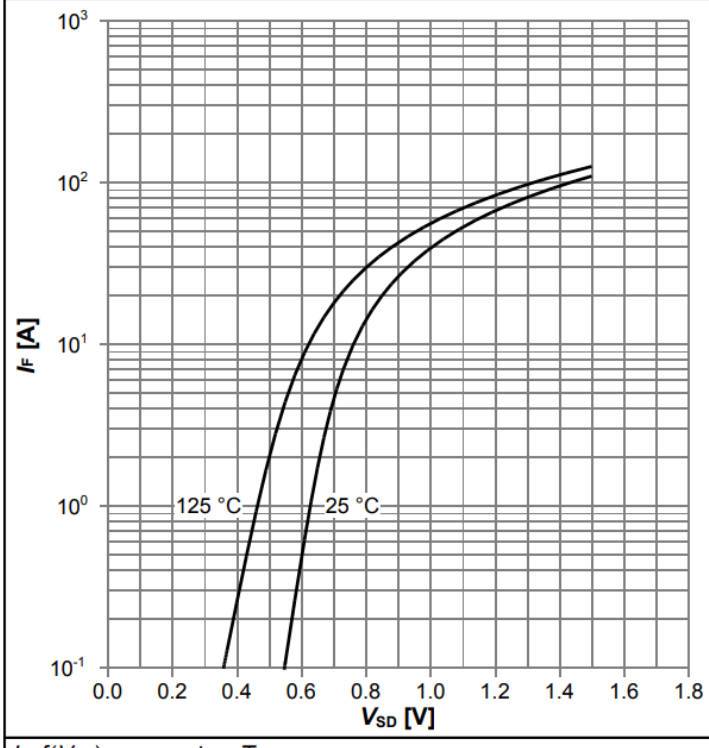
$I_D=f(V_{GS})$; V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



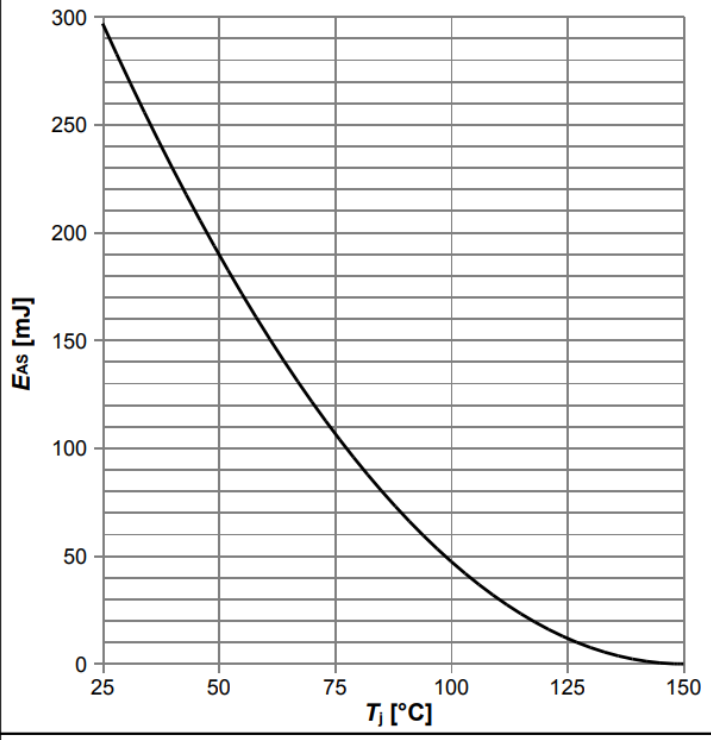
$V_{GS}=f(Q_{gate})$; I_D=29.7 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



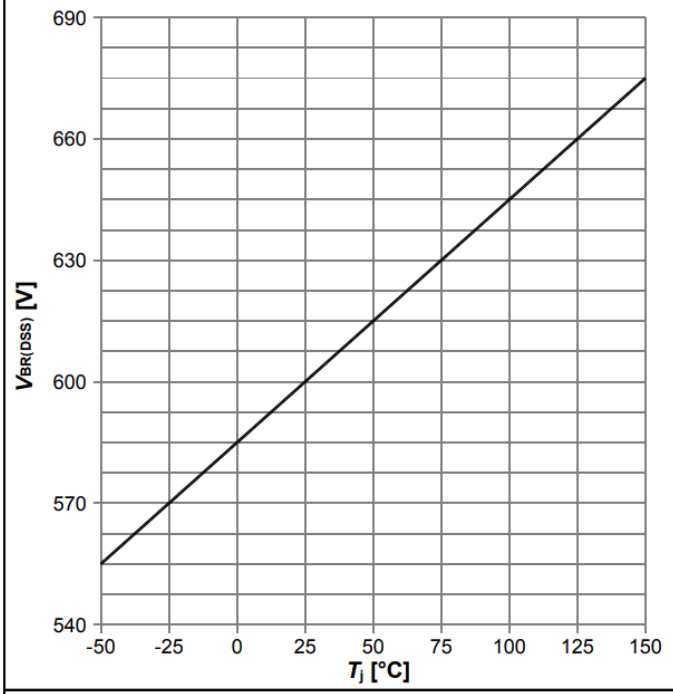
$I_F=f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



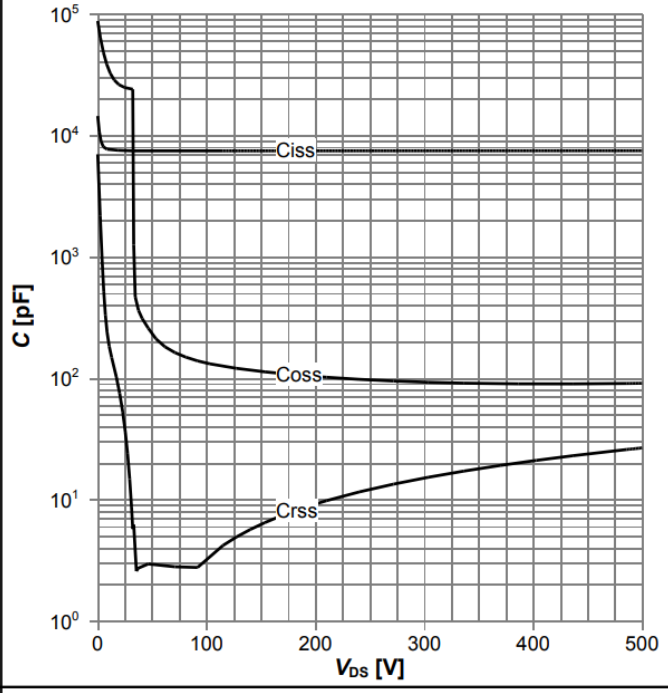
$E_{AS}=f(T_j)$; I_D=10.1 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



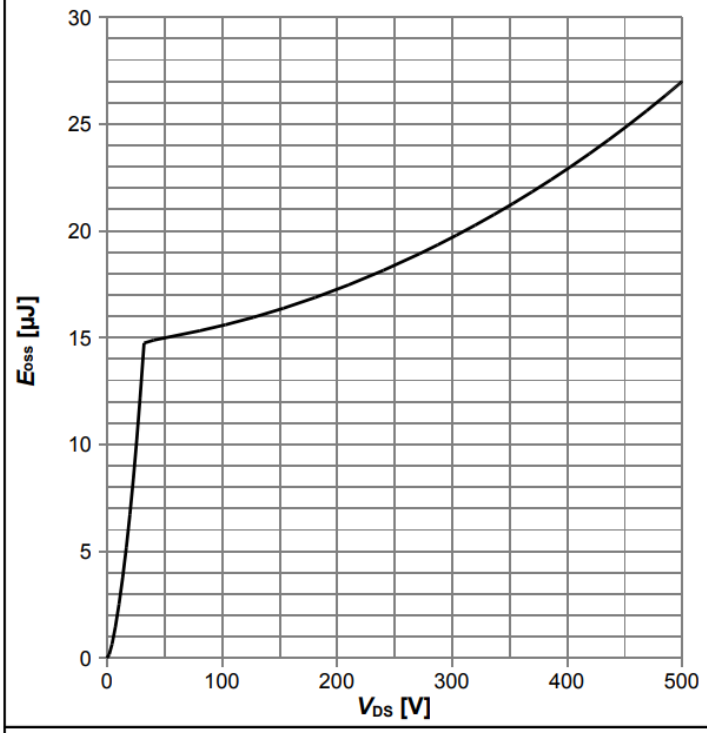
$V_{BR(DSS)}$=f(T_j); I_D=10 mA

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

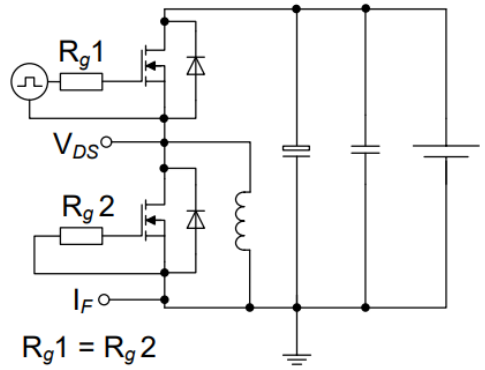
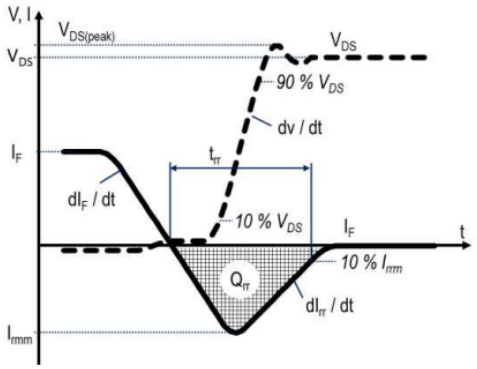
Test circuit for diode characteristics	Diode recovery waveform
	

表 9 切换时间 (ss)

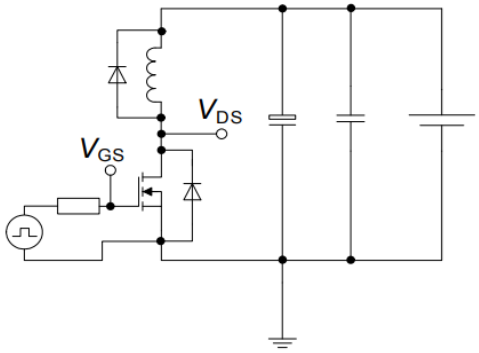
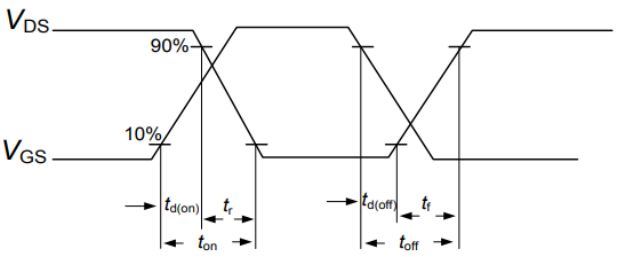
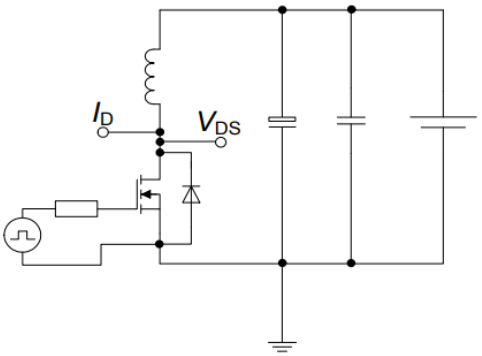
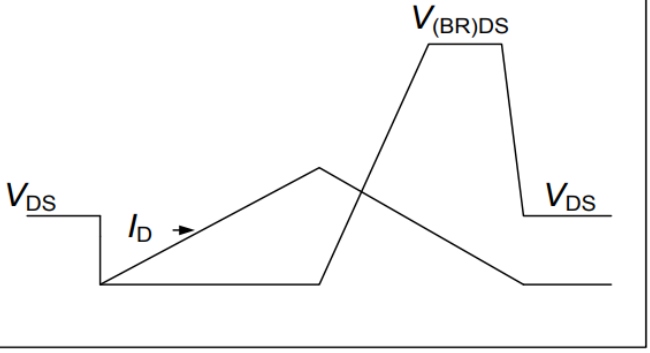
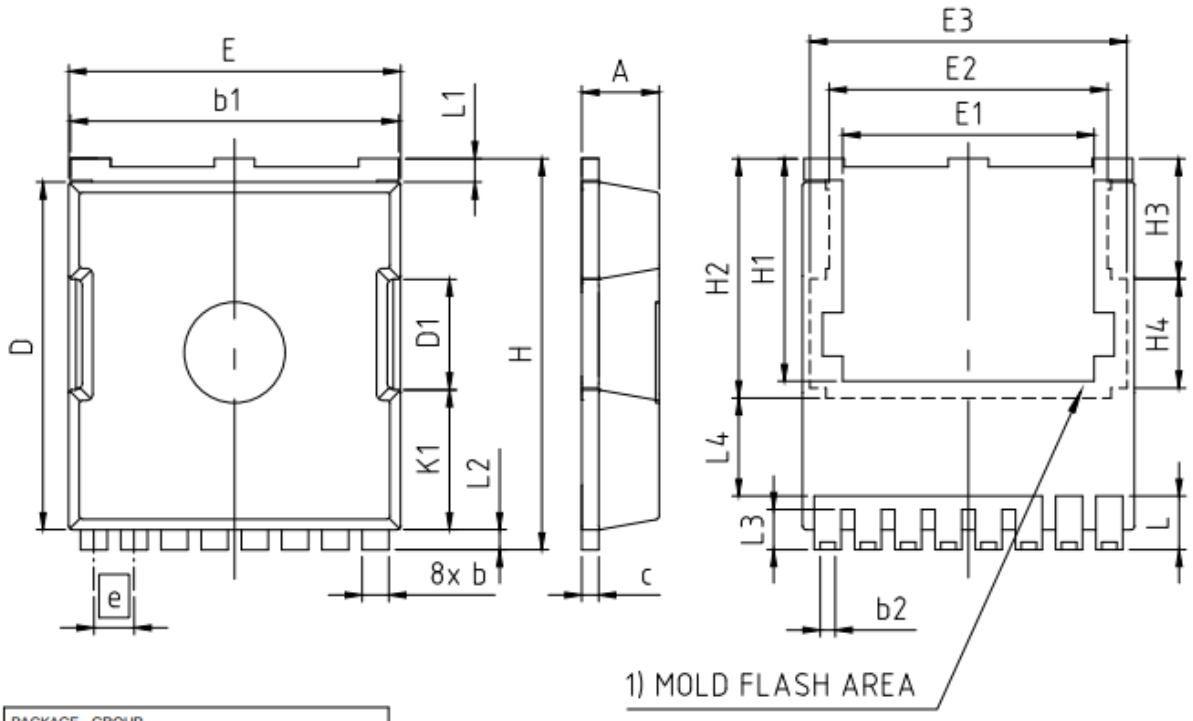
Switching times test circuit for inductive load	Switching times waveform
	

表 10 非钳位感性负载

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 封装外形



PACKAGE - GROUP NUMBER:	PG-HSOF-8-U02	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	2.20	2.40
b	0.70	0.90
b1	9.70	9.90
b2	0.42	0.50
c	0.40	0.60
D	10.28	10.58
D1	3.30	
E	9.70	10.10
E1	7.50	
E2	8.50	
E3	9.46	
e	1.20 (BSC)	
H	11.48	11.88
H1	6.55	6.95
H2	7.15	
H3	3.59	
H4	3.26	
N	8	
K1	4.18	
L	1.40	1.80
L1	0.50	0.90
L2	0.50	0.70
L3	1.00	1.30
L4	2.62	2.81

1) PARTIALLY COVERED WITH MOLD FLASH

图 1 PG-HSOF-8 外形图，尺寸单位为毫米

7 附录 A

表 11 相关链接

- **IFX CoolMOS CM8 网页：** www.infineon.com
- **IFX CoolMOS CM8 应用说明：** www.infineon.com
- **IFX CoolMOS CM8 仿真模型：** www.infineon.com
- **IFX 设计工具：** www.infineon.com

修订记录

IPT60R016CM8

Revision: 2024-03-21, Rev. 2.1

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.0	2023-10-27	Release of final version
2.1	2024-03-21	Update of R_{thJC}

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