MOSFET

650V CoolMOS™ CE Power Transistor

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE is a price-performance optimized platform enabling to target cost sensitive applications in Consumer and Lighting markets by still meeting highest efficiency standards. The new series provides all benefits of a fast switching Superjunction MOSFET while not sacrificing ease of use and offering the best cost down performance ratio available on the market.

IPAK SL

Features

- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for standard grade applications

Applications

PFC stages, hard switching PWM stages and resonant switching stages for e.g. PC Silverbox, Adapter, LCD & PDP TV and indoor lighting.

Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	700	V
$R_{DS(on),max}$	1500	mΩ
$I_{d.}$	5.2	A
$Q_{g.typ}$	10.5	nC
$I_{D,pulse}$	8.3	A
E_{oss}@400V	1.15	µJ

Type / Ordering Code	Package	Marking	Related Links
IPS65R1K5CE	PG-TO 251	65S1K5CE	see Appendix A

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1 Maximum ratings

at T_j = 25°C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	- -	- -	5.2 3.3	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	8.3	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	26	mJ	I_D=0.6A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.10	mJ	I_D=0.6A; V_{DD}=50V; see table 10
Avalanche current, repetitive	I_{AR}	-	-	0.6	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS}=0...480V
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}	-	-	53	W	T_C=25°C
Storage temperature	T_{stg}	-40	-	150	°C	-
Operating junction temperature	T_j	-40	-	150	°C	-
Continuous diode forward current	I_S	-	-	3.7	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	8.3	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	15	V/ns	V_{DS}=0...400V, I_{SD}<=I_S, T_j=25°C see table 8
Maximum diode commutation speed	di_f/dt	-	-	500	A/µs	V_{DS}=0...400V, I_{SD}<=I_S, T_j=25°C see table 8

[1] Limited by $T_{j\,max}$. Maximum duty cycle D=0.50
[2] Pulse width t_p limited by $T_{j,max}$
[3] Identical low side and high side switch with identical R_G

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	2.37	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

3 Electrical characteristics

at T_j=25°C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	650	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.5	3.0	3.5	V	V_{DS}=V_{GS}, I_D=0.1mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=650, V_{GS}=0V, T_j=25°C V_{DS}=650, 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	$R_{DS(on)}$	- -	1.26 3.28	1.50 -	Ω	V_{GS}=10V, I_D=1A, T_j=25°C V_{GS}=10V, I_D=1A, T_j=150°C
Gate resistance	R_G	-	6.5	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	225	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	18	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	10	-	pF	V_{GS}=0V, V_{DS}=0...480V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	42	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...480V
Turn-on delay time	$t_{d(on)}$	-	7.7	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=1.5A, R_G=10.2Ω; see table 9
Rise time	t_r	-	5.9	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=1.5A, R_G=10.2Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	33	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=1.5A, R_G=10.2Ω; see table 9
Fall time	t_f	-	18.2	-	ns	V_{DD}=400V, V_{GS}=13 V, I_D=1.5A, R_G=10.2Ω; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	1.3	-	nC	V_{DD}=480V, I_D=1.5A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	5.8	-	nC	V_{DD}=480V, I_D=1.5A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	10.5	-	nC	V_{DD}=480V, I_D=1.5A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	V_{DD}=480V, I_D=1.5A, V_{GS}=0 to 10V

[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 480V
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 480V

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	V_{GS}=0V, I_F=1.5A, T_j=25°C
Reverse recovery time	t_{rr}	-	200	-	ns	V_R=400V, I_F=1.5A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	0.9	-	µC	V_R=400V, I_F=1.5A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	8	-	A	V_R=400V, I_F=1.5A, di_F/dt=100A/µs; see table 8

4 Electrical characteristics diagrams

Diagram 1: Power dissipation (Non FullPAK)

P_{tot}=f(T_C)

Diagram 2: Safe operating area (Non FullPAK)

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

Diagram 3: Safe operating area (Non FullPAK)

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

Diagram 4: Max. transient thermal impedance (Non FullPAK)

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=1.0 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=1.5 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=0.6 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage

$V_{BR(DSS)}$=f(T_j); I_D=1.0 mA

Diagram 14: Typ. capacitances

C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Diagram 15: Typ. Coss stored energy

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

5 Test Circuits

Table 8 Diode characteristics

Test circuit for diode characteristics	Diode recovery waveform

Table 9 Switching times

Switching times test circuit for inductive load	Switching times waveform

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform

6 Package Outlines

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.18	2.40	0.086	0.094
A1	0.80	1.14	0.031	0.045
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b4	4.95	5.50	0.195	0.217
c	0.46	0.59	0.018	0.023
c2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	5.04	5.55	0.198	0.219
E	6.35	6.73	0.250	0.265
E1	4.60	5.21	0.181	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
L	3.00	3.60	0.118	0.142
L1	0.80	1.25	0.031	0.049
L2	0.88	1.28	0.035	0.050

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Figure 1 Outline PG-TO 251, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS™ CE Webpage:** www.infineon.com
- **IFX CoolMOS™ CE application note:** www.infineon.com
- **IFX CoolMOS™ CE simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPS65R1K5CE

Revision: 2016-03-31

Previous Revision	
Date	Subjects (major changes since last revision)
2014-09-25	Release of final version
2016-03-31	Modified Rthjc and Id ratings. Modified SOA, Zhtjc curves

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