

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

650V CoolMOS™ CE Power Transistor
IPS65R1K5CE

Data Sheet

Rev. 2.0
Final

1 Description

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.

Features

- Extremely low losses due to very low FOM $R_{DS(on)} \cdot Q_g$ and E_{oss}
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for consumer grade applications

Applications

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

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

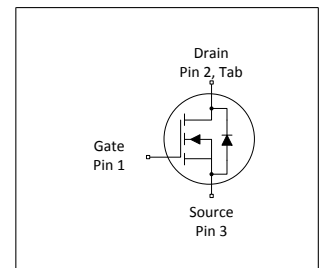
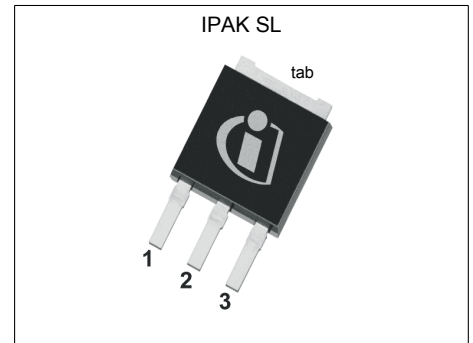


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	1500	$m\Omega$
$Q_{g,typ}$	10.5	nC
$I_{D,pulse}$	8.3	A
$E_{oss@400V}$	1.15	μJ
Body diode di/dt	500	$A/\mu s$

Type / Ordering Code	Package	Marking	Related Links
IPS65R1K5CE	PG-TO 251	65CE1K5	see Appendix A

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2 Maximum ratings

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	3.1 2.0	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	8.3	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	26	mJ	$I_D=0.6\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.10	mJ	$I_D=0.6\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche current, repetitive	I_{AR}	-	-	0.6	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	$V_{DS}=0\dots480\text{V}$
Gate source voltage (static)	V_{GS}	-20	-	20	V	static;
Gate source voltage (dynamic)	V_{GS}	-30	-	30	V	AC ($f>1\text{ Hz}$)
Power dissipation	P_{tot}	-	-	28	W	$T_C=25^\circ\text{C}$
Storage temperature	T_{stg}	-40	-	150	$^\circ\text{C}$	-
Operating junction temperature	T_j	-40	-	150	$^\circ\text{C}$	-
Continuous diode forward current	I_S	-	-	2.7	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	8.3	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	15	V/ns	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 8
Maximum diode commutation speed	di/dt	-	-	500	A/ μs	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 8

¹⁾ Limited by $T_{j,max}$. Maximum duty cycle $D=0.75$

²⁾ Pulse width t_p limited by $T_{j,max}$

³⁾ Identical low side and high side switch with identical R_G

3 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	4.4	°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

4 Electrical characteristics

at $T_j=25^\circ\text{C}$, 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	$V_{GS}=0\text{V}$, $I_D=1\text{mA}$
Gate threshold voltage	$V_{(GS)th}$	2.5	3.0	3.5	V	$V_{DS}=V_{GS}$, $I_D=0.1\text{mA}$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=650$, $V_{GS}=0\text{V}$, $T_j=25^\circ\text{C}$ $V_{DS}=650$, $V_{GS}=0\text{V}$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20\text{V}$, $V_{DS}=0\text{V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	1.26 3.28	1.50 -	Ω	$V_{GS}=10\text{V}$, $I_D=1\text{A}$, $T_j=25^\circ\text{C}$ $V_{GS}=10\text{V}$, $I_D=1\text{A}$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	6.5	-	Ω	$f=1\text{MHz}$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	225	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=100\text{V}$, $f=1\text{MHz}$
Output capacitance	C_{oss}	-	18	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=100\text{V}$, $f=1\text{MHz}$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	10	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=0\dots480\text{V}$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	42	-	pF	$I_D=\text{constant}$, $V_{GS}=0\text{V}$, $V_{DS}=0\dots480\text{V}$
Turn-on delay time	$t_{d(on)}$	-	7.7	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=1.5\text{A}$, $R_G=10.2\Omega$; see table 9
Rise time	t_r	-	5.9	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=1.5\text{A}$, $R_G=10.2\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	33	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=1.5\text{A}$, $R_G=10.2\Omega$; see table 9
Fall time	t_f	-	18.2	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=1.5\text{A}$, $R_G=10.2\Omega$; 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	$V_{DD}=480\text{V}$, $I_D=1.5\text{A}$, $V_{GS}=0$ to 10V
Gate to drain charge	Q_{gd}	-	5.8	-	nC	$V_{DD}=480\text{V}$, $I_D=1.5\text{A}$, $V_{GS}=0$ to 10V
Gate charge total	Q_g	-	10.5	-	nC	$V_{DD}=480\text{V}$, $I_D=1.5\text{A}$, $V_{GS}=0$ to 10V
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	$V_{DD}=480\text{V}$, $I_D=1.5\text{A}$, $V_{GS}=0$ 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	$V_{GS}=0V, I_F=1.5A, T_j=25^\circ C$
Reverse recovery time	t_{rr}	-	200	-	ns	$V_R=400V, I_F=1.5A, di_F/dt=100A/\mu s$; see table 8
Reverse recovery charge	Q_{rr}	-	0.9	-	μC	$V_R=400V, I_F=1.5A, di_F/dt=100A/\mu s$; see table 8
Peak reverse recovery current	I_{rrm}	-	8	-	A	$V_R=400V, I_F=1.5A, di_F/dt=100A/\mu s$; see table 8

5 Electrical characteristics diagrams

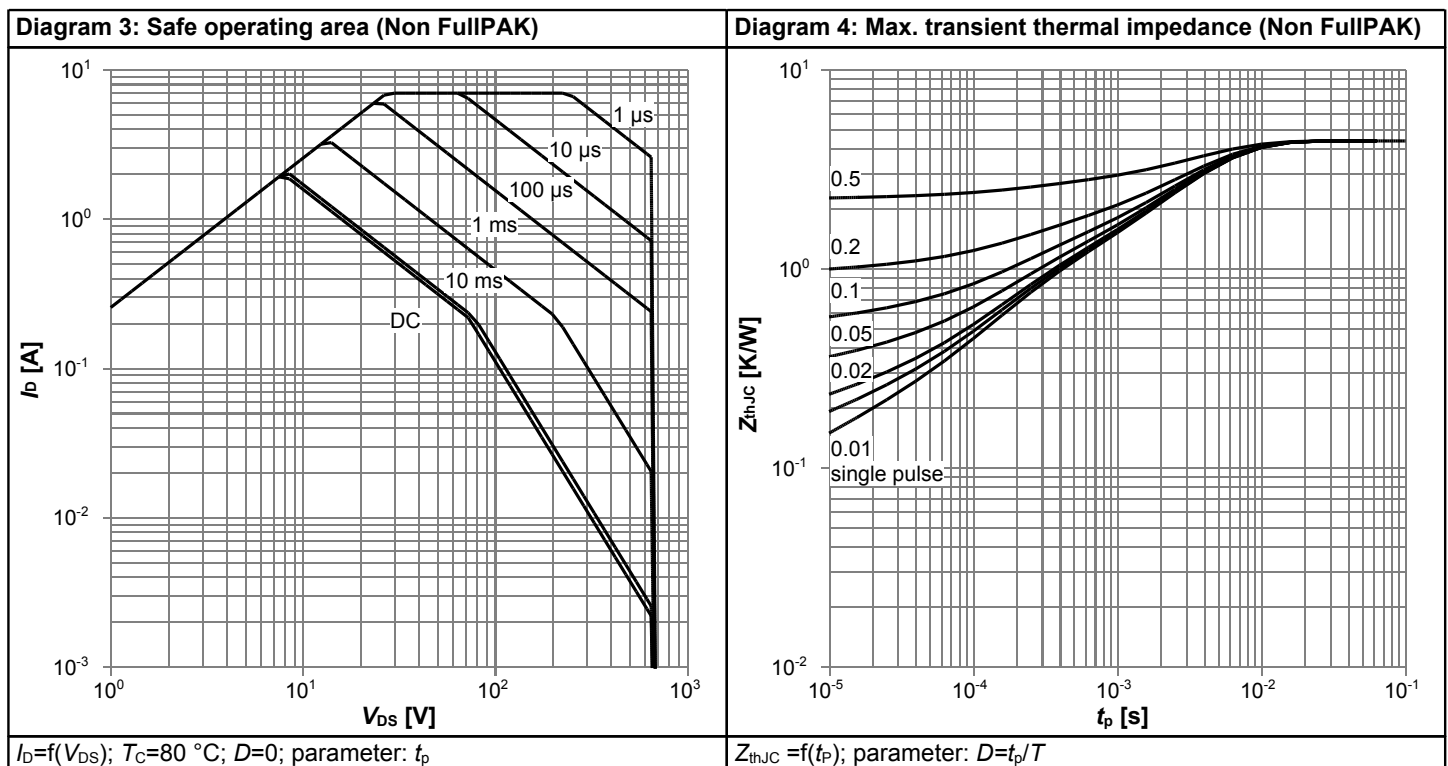
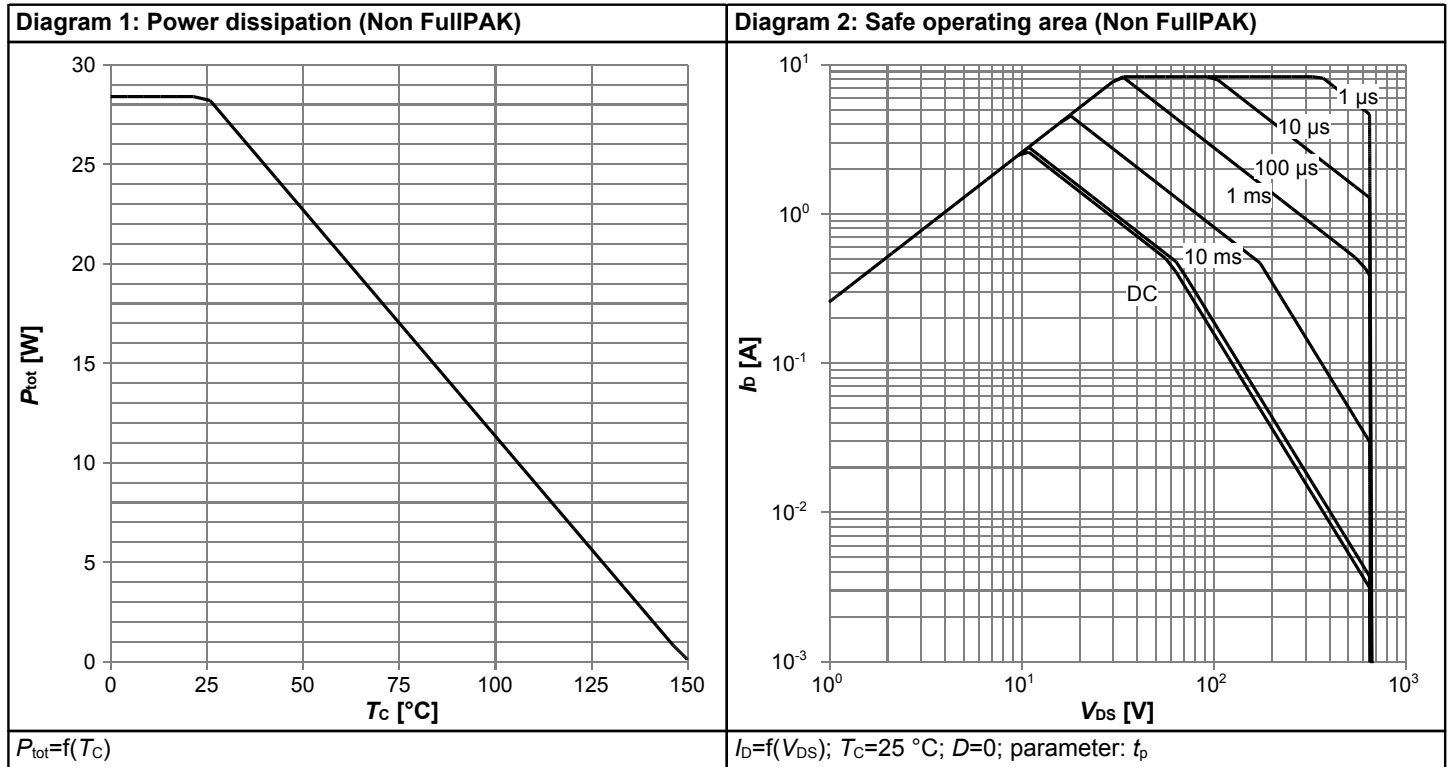
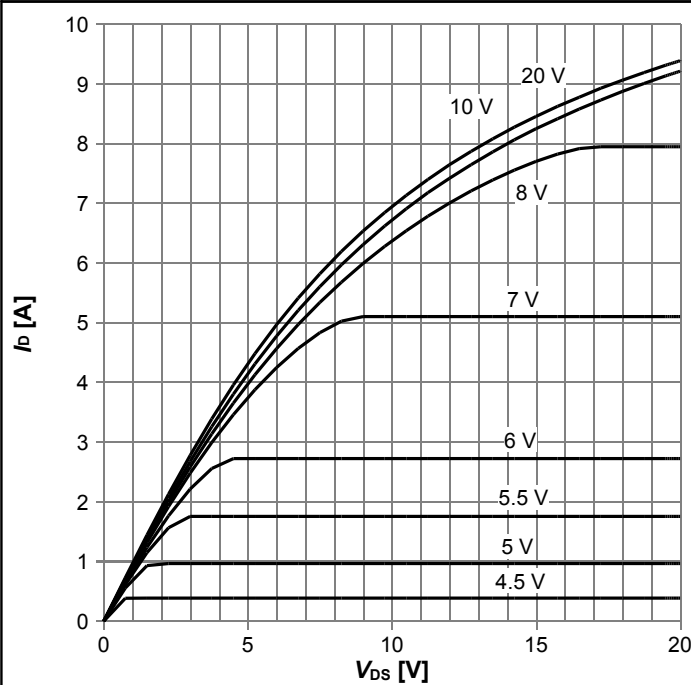
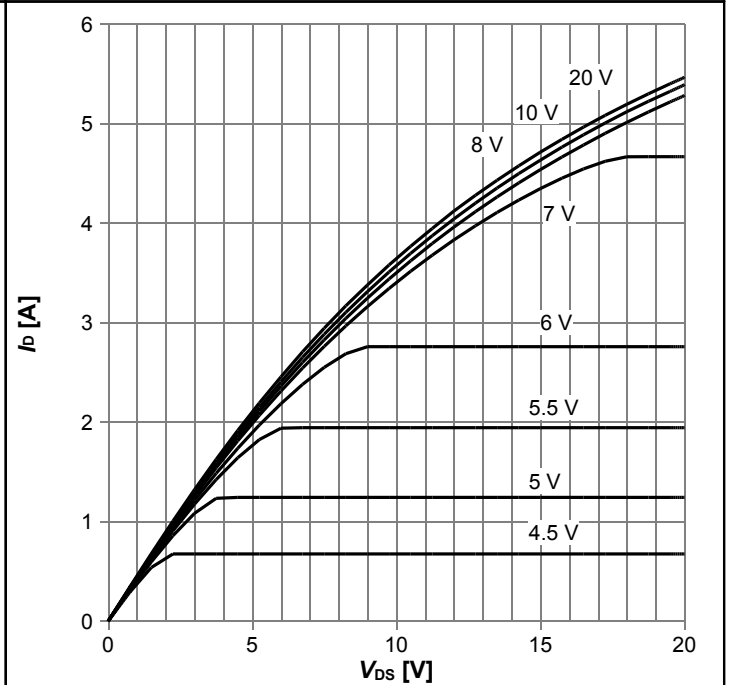


Diagram 5: Typ. output characteristics



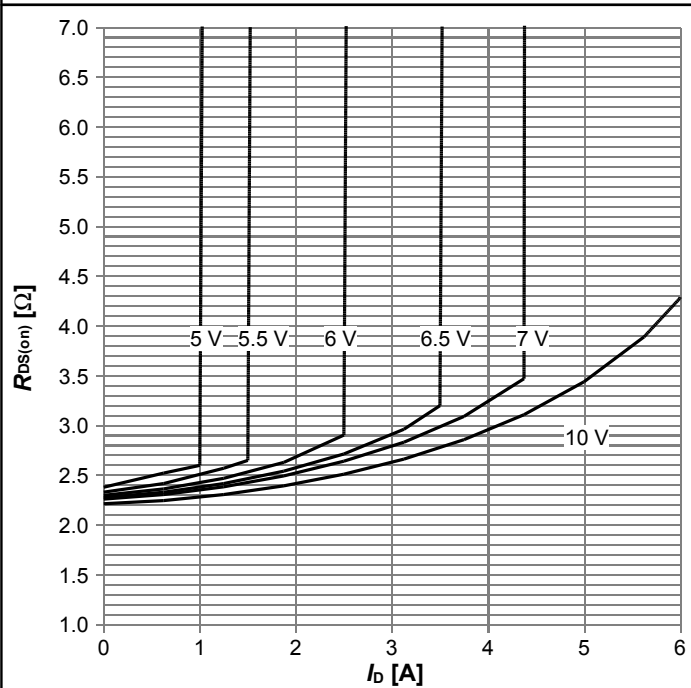
$I_D = f(V_{DS})$; $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. output characteristics



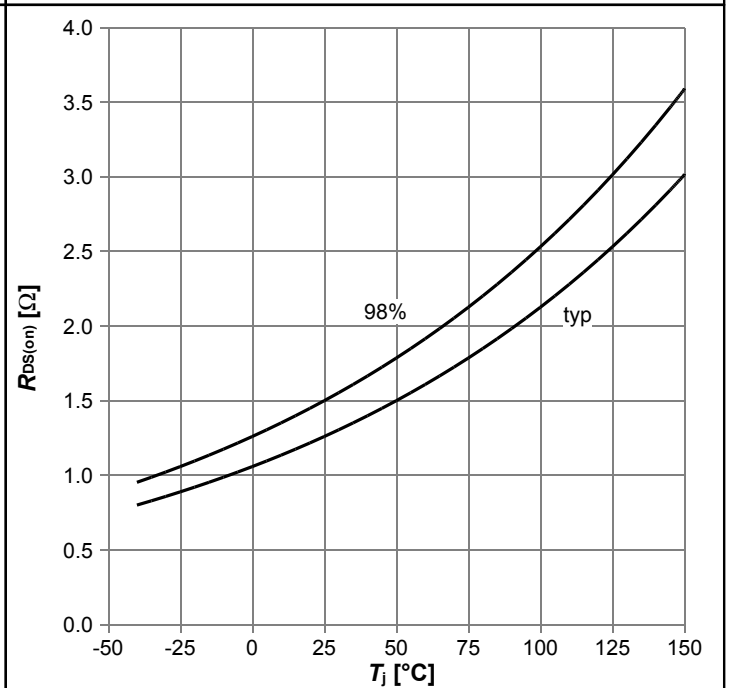
$I_D = f(V_{DS})$; $T_j = 125^\circ\text{C}$; parameter: V_{GS}

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



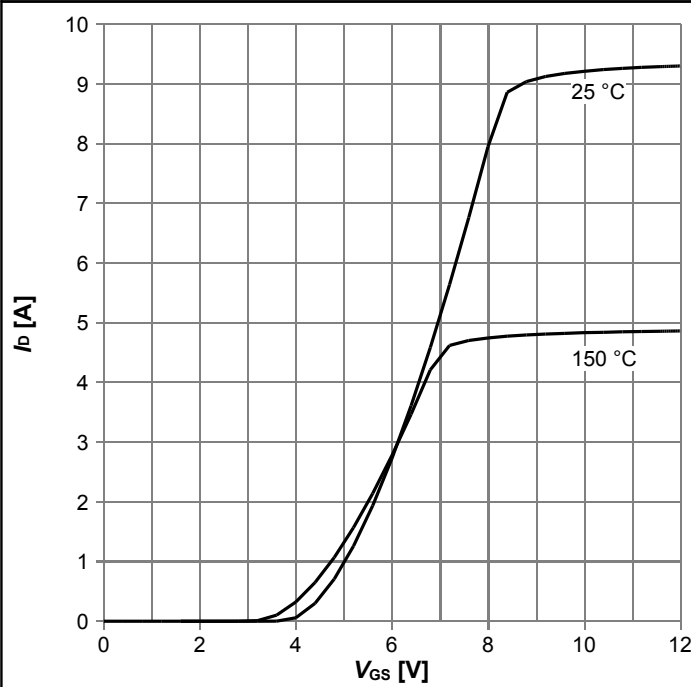
$R_{DS(on)} = f(I_D)$; $T_j = 125^\circ\text{C}$; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



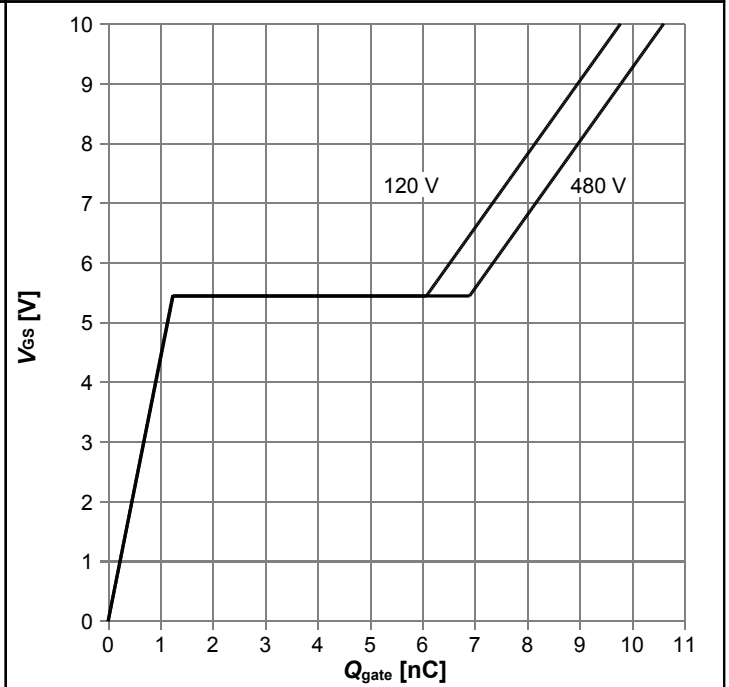
$R_{DS(on)} = f(T_j)$; $I_D = 1.0\text{ A}$; $V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics



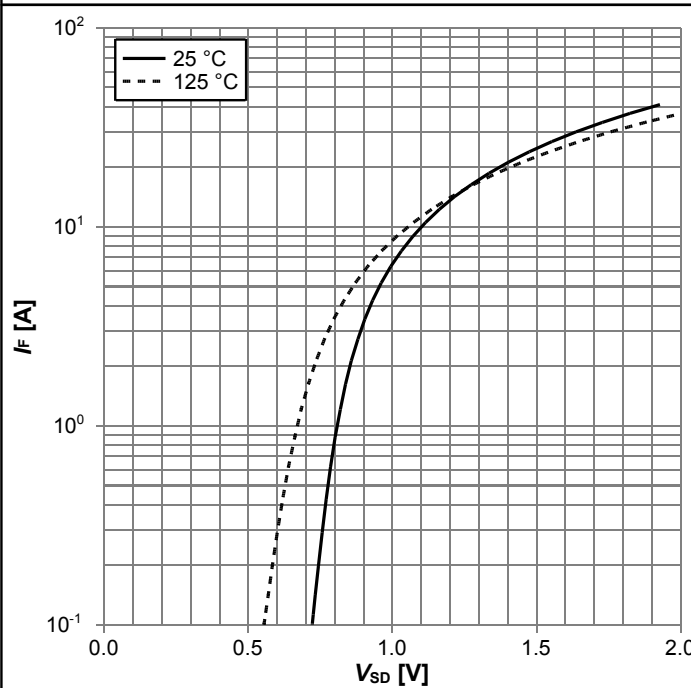
$I_D=f(V_{GS}); V_{DS}=20V; \text{parameter: } T_j$

Diagram 10: Typ. gate charge



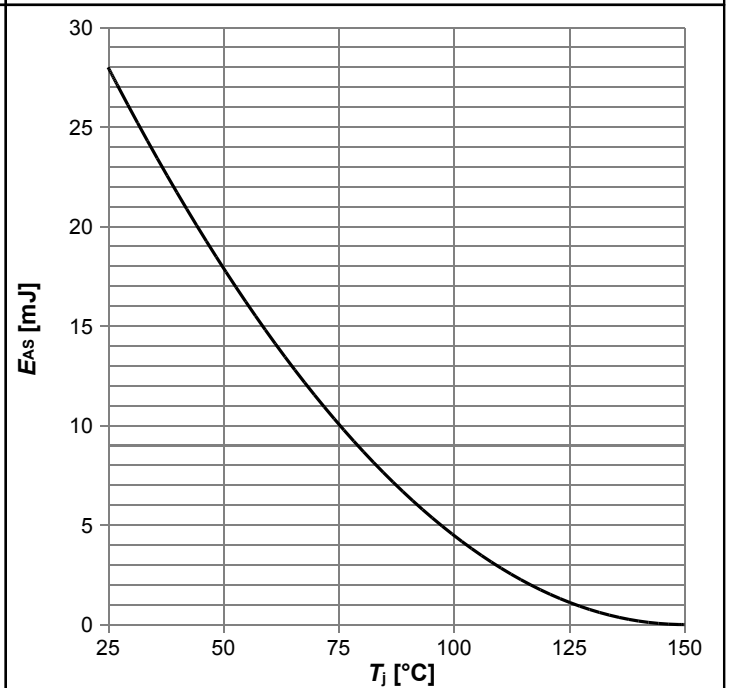
$V_{GS}=f(Q_{gate}); I_D=1.5 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 11: Forward characteristics of reverse diode



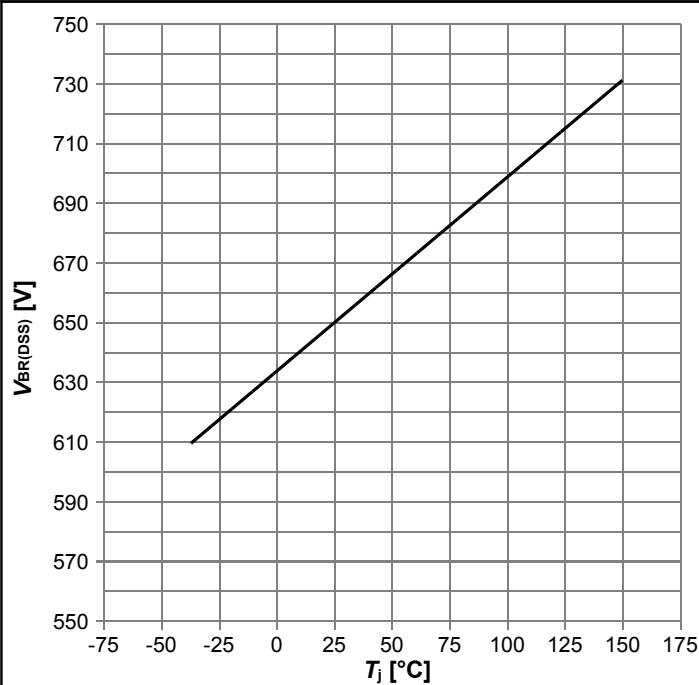
$I_F=f(V_{SD}); \text{parameter: } T_j$

Diagram 12: Avalanche energy



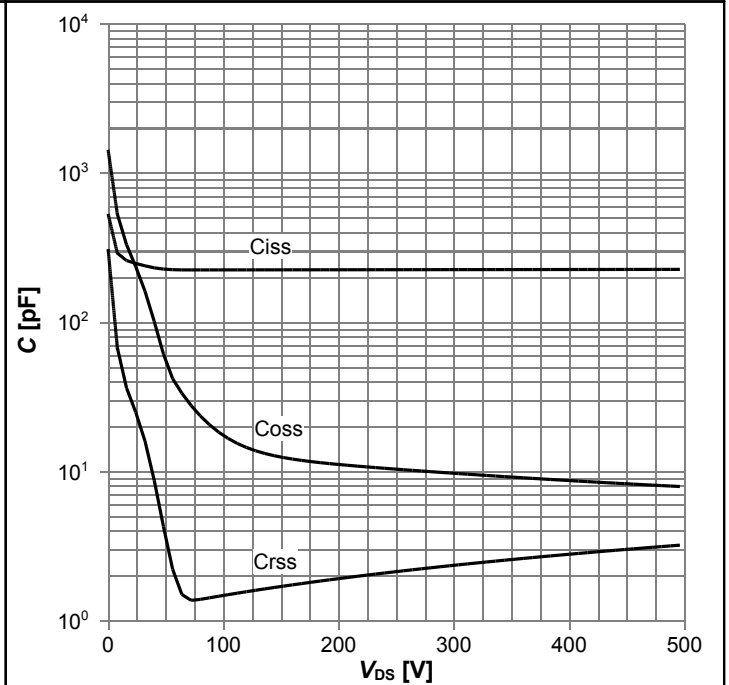
$E_{AS}=f(T_j); I_D=0.6 \text{ A}; V_{DD}=50 \text{ V}$

Diagram 13: Drain-source breakdown voltage



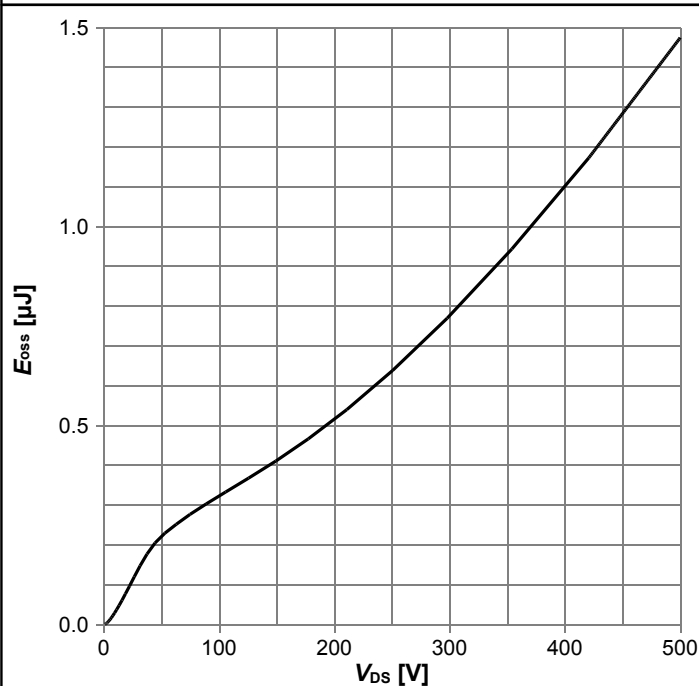
$V_{BR(DSS)}=f(T_j); I_D=1.0 \text{ mA}$

Diagram 14: Typ. capacitances



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

Diagram 15: Typ. Coss stored energy



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

6 Test Circuits

Table 8 Diode characteristics



Table 9 Switching times

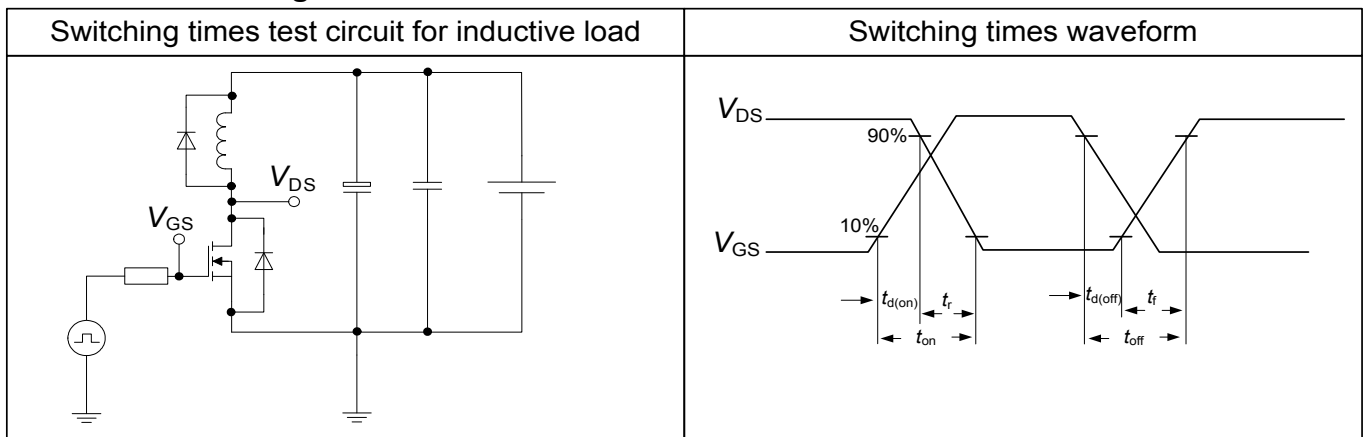
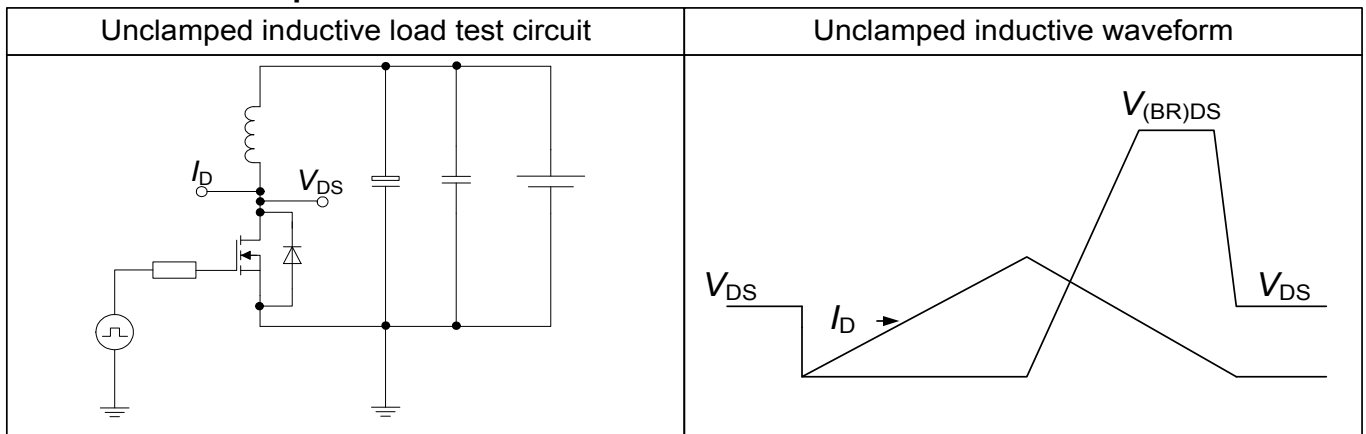
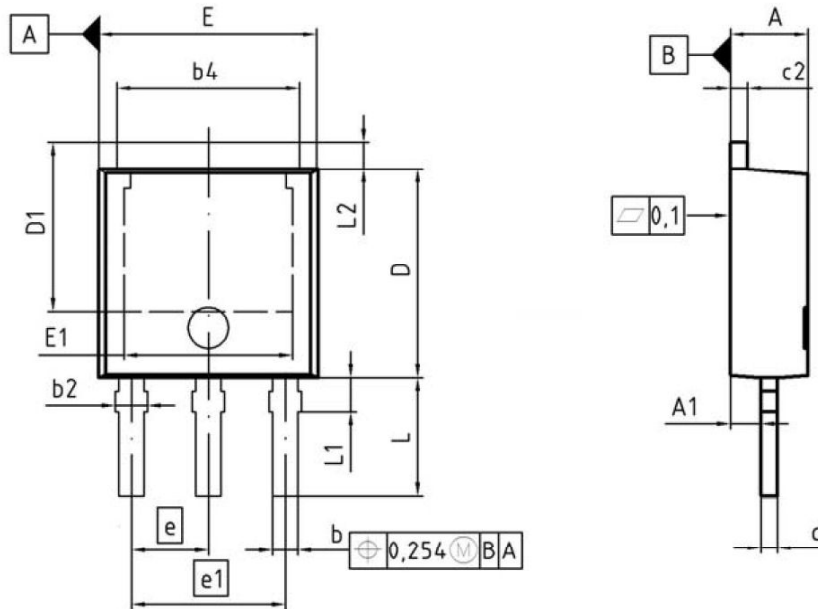


Table 10 Unclamped inductive load



7 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.18	2.39	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	0.58	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	5.44	0.198	0.214
E	6.35	6.73	0.250	0.265
E1	4.90	5.10	0.193	0.201
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
L	3.30	3.50	0.130	0.138
L1	0.90	1.10	0.035	0.043
L2	0.90	1.10	0.035	0.043

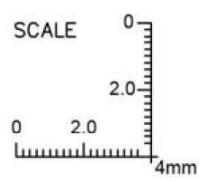
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SCALE 0 2.0 4mm
EUROPEAN PROJECTION 
ISSUE DATE 05-07-2012
REVISION 04

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

8 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: 2014-09-25, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2014-09-25	Release of final version

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Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:

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