MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C6

600V CoolMOS™ C6 Power Transistor
IPL60R2K1C6S

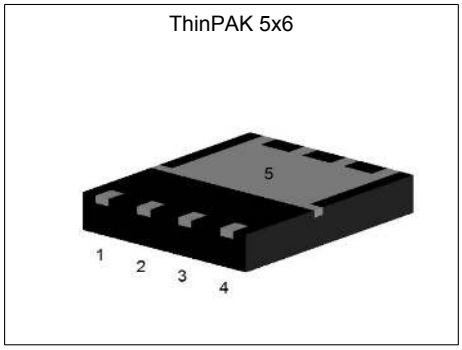
Data Sheet

Rev. 2.0
Final

Power Management & Multimarket

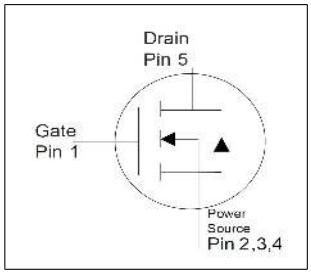
1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ C6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The offered devices provide all benefits of a fast switching SJ MOSFET while not sacrificing ease of use. Extremely low switching and conduction losses make switching applications even more efficient, more compact, lighter and cooler.



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 industrial grade applications according to JEDEC (J-STD20 and JESD22)



Applications

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

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

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	2.1	Ω
$Q_{g,typ}$	6.7	nC
$I_{D,pulse}$	5.4	A
E_{oss}@400V	0.76	µJ
Body diode di/dt	500	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPL60R2K1C6S	ThinPAK 5x6 SMD	60C62K1	see Appendix A

Table of Contents

2 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	- -	- -	2.3 1.5	A	T_C = 25°C T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	5.4	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	11	mJ	I_D =0.4A; V_{DD} = 50V
Avalanche energy, repetitive	E_{AR}	-	-	0.06	mJ	I_D =0.4A; V_{DD} = 50V
Avalanche current, repetitive	I_{AR}	-	-	0.4	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS} =0...480V
Gate source voltage	V_{GS}	-20 -30	- -	20 30	V	static; AC (f>1 Hz)
Power dissipation (non FullPAK)	P_{tot}	-	-	21.6	W	T_C=25°C
Operating and storage temperature	T_j, T_{stg}	-40	-	150	°C	-
Continuous diode forward current	I_S	-	-	2.0	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	5.4	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
Maximum diode commutation speed[3]	di_f/dt	-	-	500	A/µs	V_{DS} =0...400V, I_{SD}<=I_S, T_j=25°C

3 Thermal characteristics

Table 3 Thermal characteristics (non FullPAK)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	5.8	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	35	62	°C/W	Device on 40mm*40mm*1.5 epoxy PCB FR4 with 6cm^2 (one layer 70µm thick) copper area for drain connection and cooling. PCB is vertical without blown air.
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	reflow MSL1

[1] Limited by $T_{j\,max}$. Maximum duty cycle D=0.75
[2] Pulse width t_p limited by $T_{j,max}$
[3] V_{DClink}=400V; $V_{DS,peak}$<$V_{(BR)DSS}$; identical low side and high side switch with identical R_G

4 Electrical characteristics

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	600	-	-	V	V_{GS}=0V, I_D=0.25mA
Gate threshold voltage	$V_{(GS)th}$	2.50	3	3.50	V	V_{DS}=V_{GS}, I_D=0.06mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=600V, V_{GS}=0V, T_j=25°C V_{DS}=600V, V_{GS}=0V, T_j=150°C
Gate-source leakage curent	I_{GSS}	-	-	100	nA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	1.89 4.91	2.10 -	Ω	V_{GS}=10V, I_D=0.76A, T_j=25°C V_{GS}=10V, I_D=0.76A, T_j=150°C
Gate resistance	R_G	-	12	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	140	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	12	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	8.5	-	pF	V_{GS}=0V, V_{DS}=0...480V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	30	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...480V
Turn-on delay time	$t_{d(on)}$	-	7	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=0.9A, R_G=12.2Ω
Rise time	t_r	-	7	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=0.9A, R_G=12.2Ω
Turn-off delay time	$t_{d(off)}$	-	30	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=0.9A, R_G=12.2Ω
Fall time	t_f	-	50	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=0.9A, R_G=12.2Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	0.8	-	nC	V_{DD}=480V, I_D=0.9A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	3.6	-	nC	V_{DD}=480V, I_D=0.9A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	6.7	-	nC	V_{DD}=480V, I_D=0.9A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	V_{DD}=480V, I_D=0.9A, V_{GS}=0 to 10V

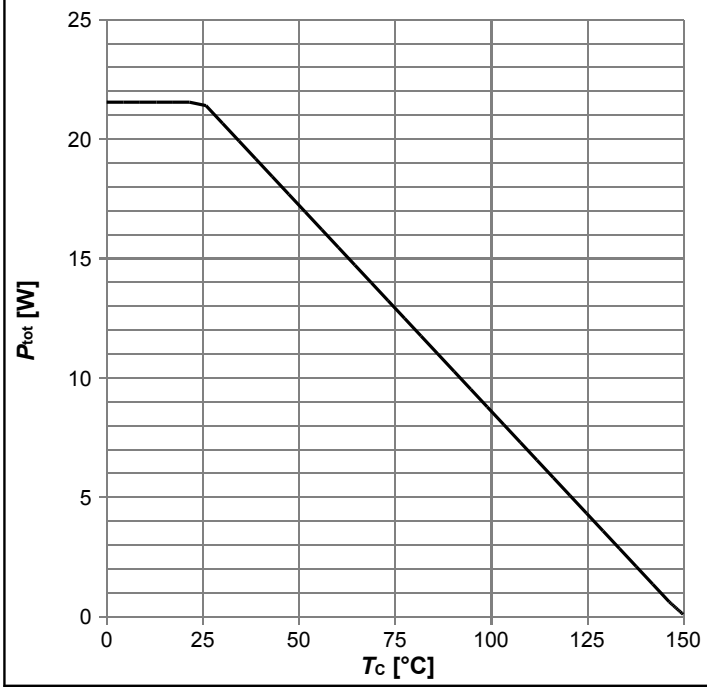
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

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=0.9A, T_f=25°C
Reverse recovery time	t_{rr}	-	180	-	ns	V_R=400V, I_F=0.9A, di_F/dt=100A/µs
Reverse recovery charge	Q_{rr}	-	0.67	-	µC	V_R=400V, I_F=0.9A, di_F/dt=100A/µs
Peak reverse recovery current	I_{rrm}	-	7.1	-	A	V_R=400V, I_F=0.9A, di_F/dt=100A/µs

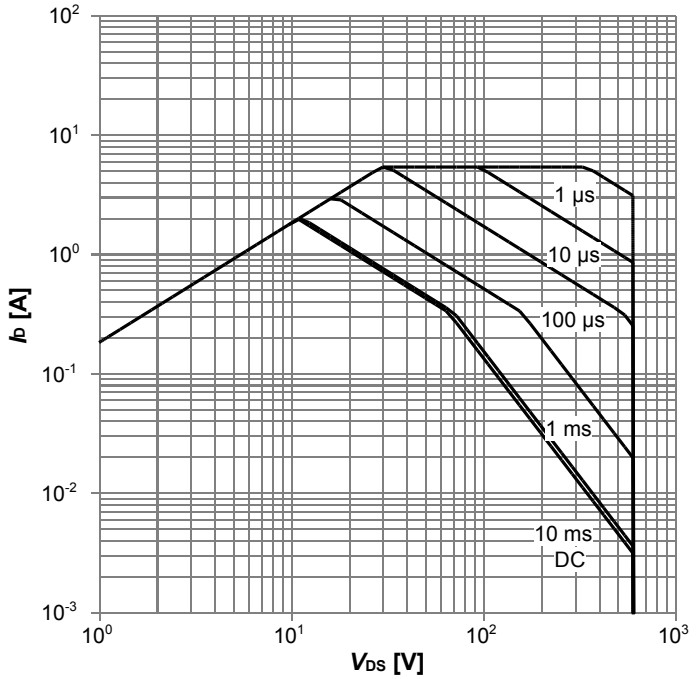
5 Electrical characteristics diagrams

Diagram 1: Power dissipation



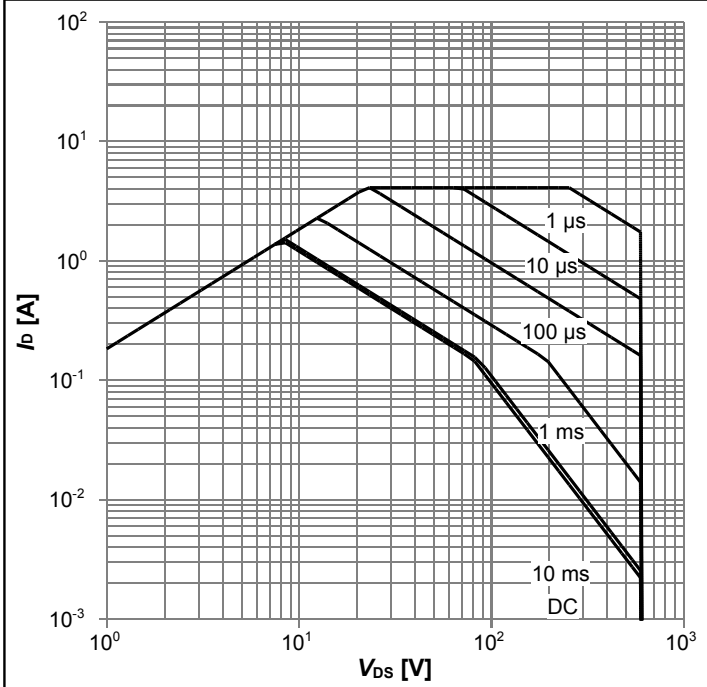
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



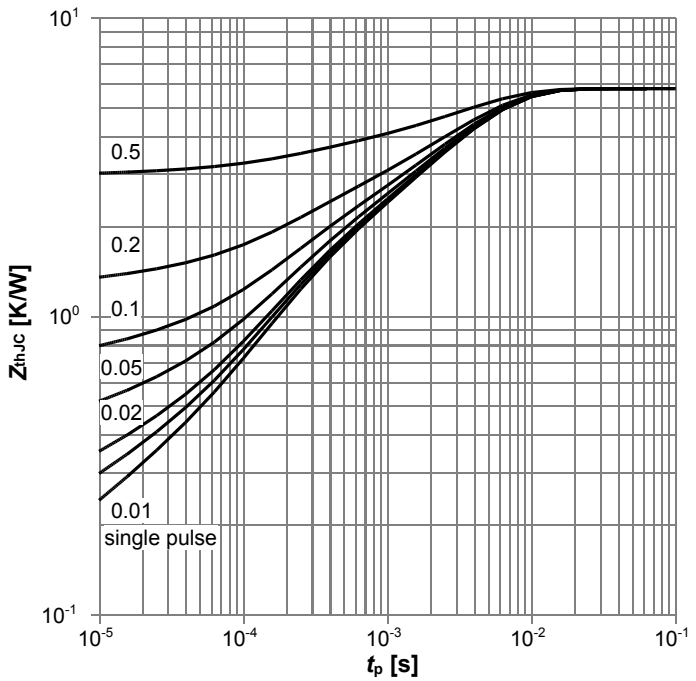
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Diagram 3: Safe operating area



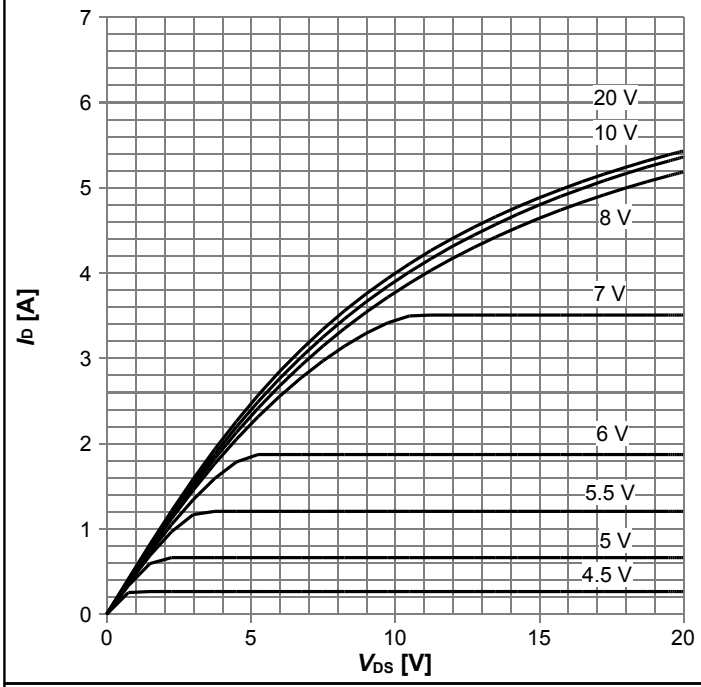
$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: t_p

Diagram 4: Max. transient thermal impedance



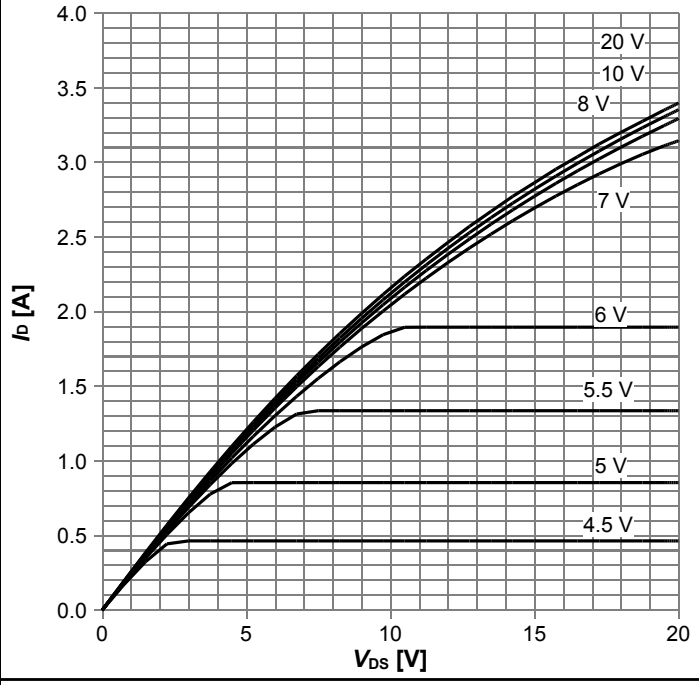
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



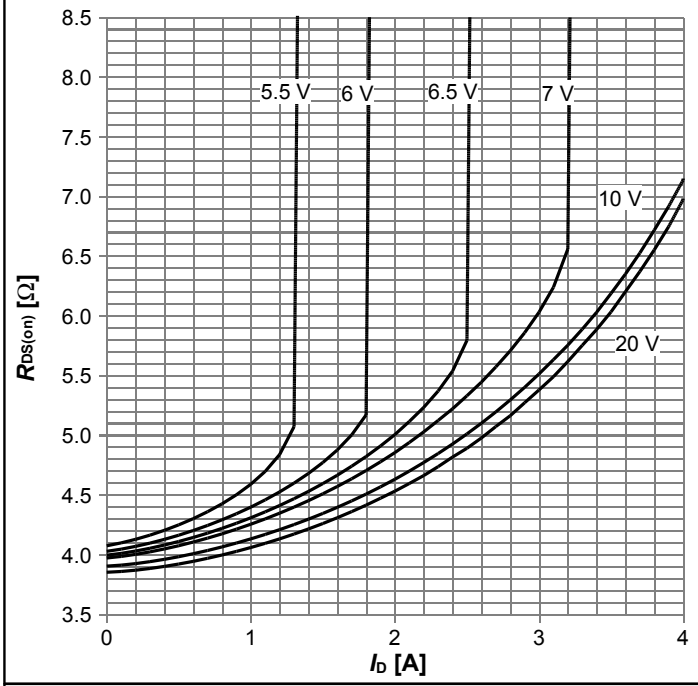
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



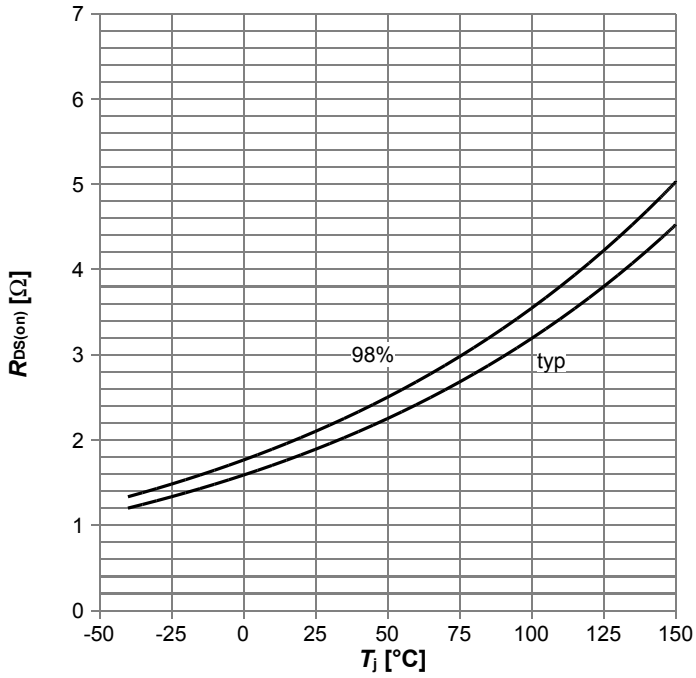
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

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



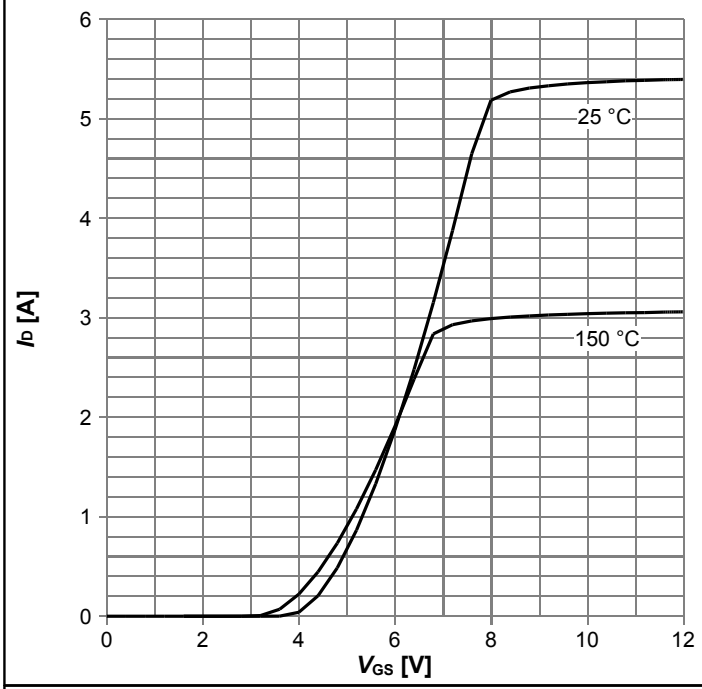
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



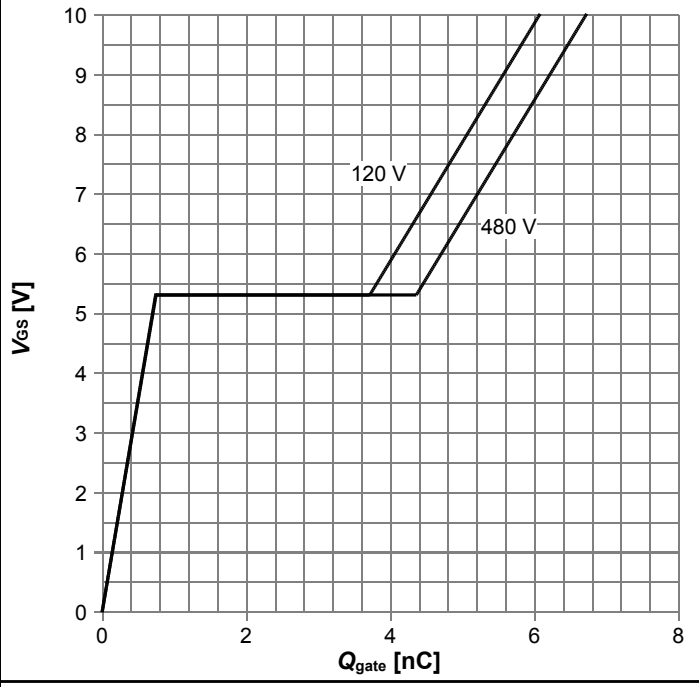
$R_{DS(on)}$=f(T_j); I_D=0.76 A; V_{GS}=10 V

Diagram 9: Typ. transfer characteristics



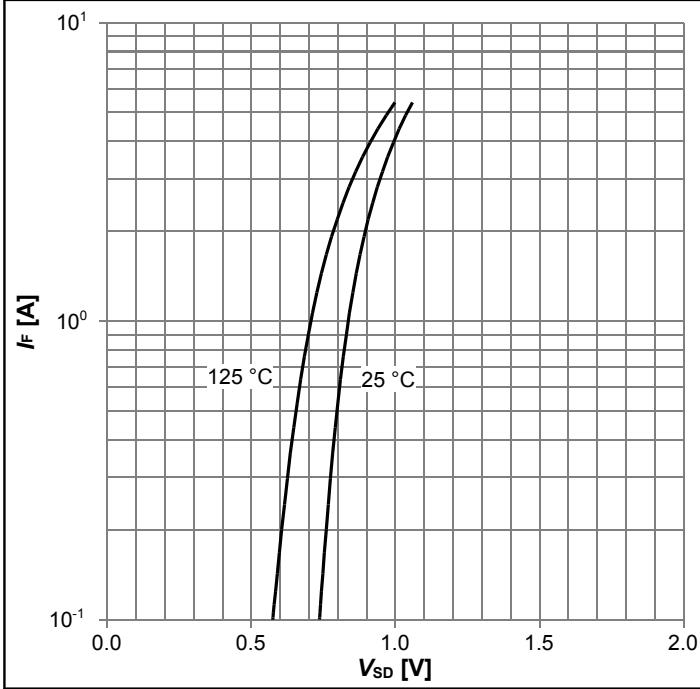
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



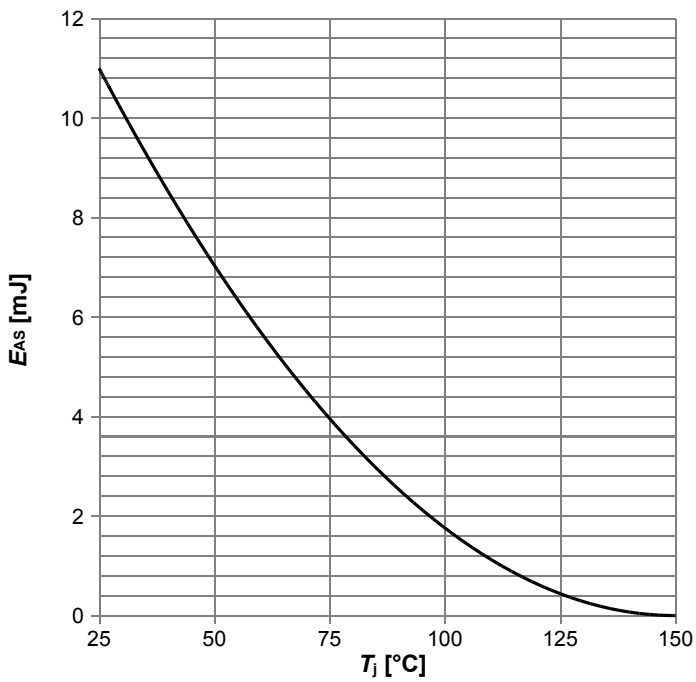
V_{GS}=f(Q_{gate}); I_D=0.9 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



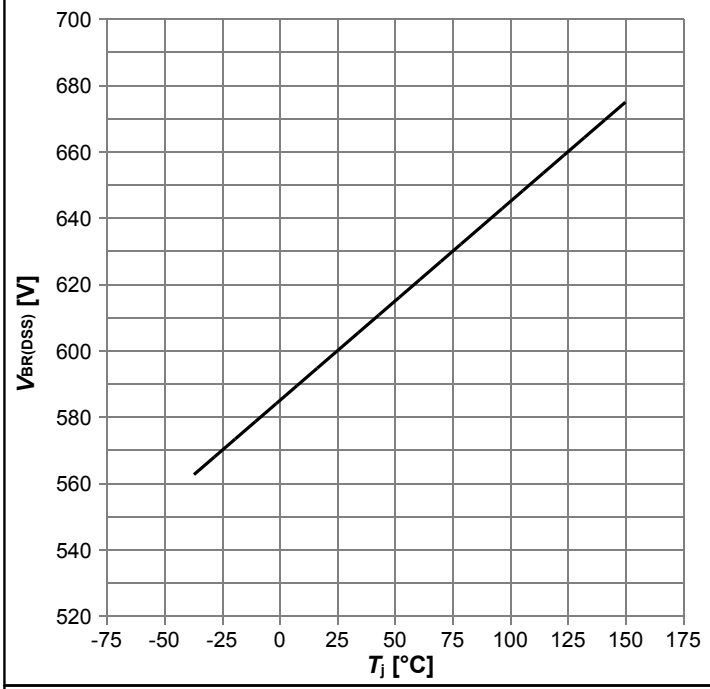
I_F=f(V_{SD}); parameter: T_j

Diagram 12: Avalanche energy



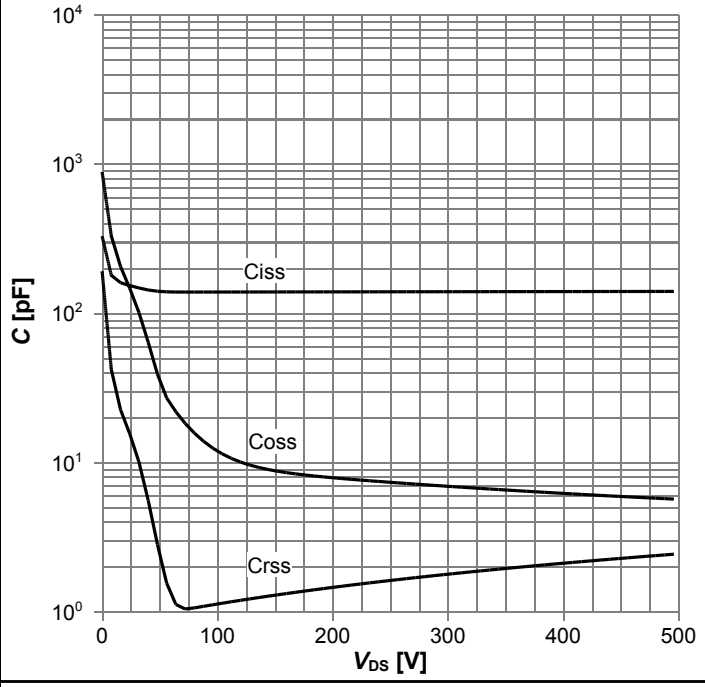
E_{AS}=f(T_j); I_D=0.4 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



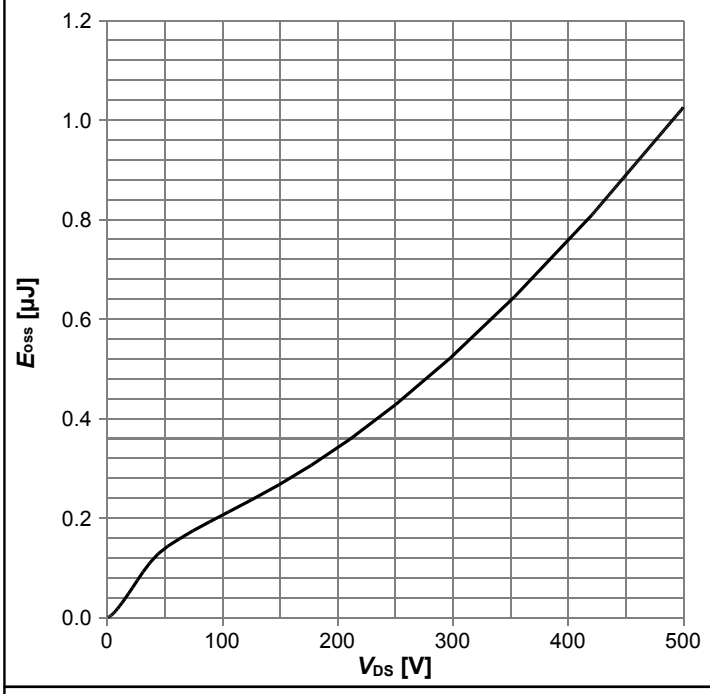
$V_{BR(DSS)}$=f(T_j); I_D=0.25 mA

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})

6 Test Circuits

Table 8 Diode characteristics

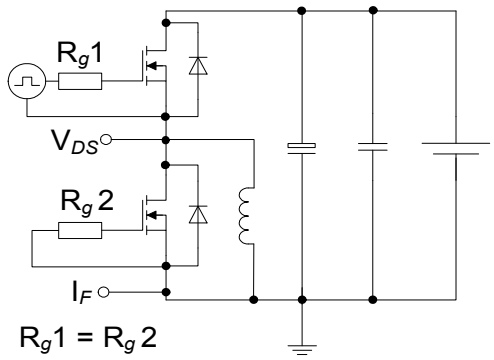
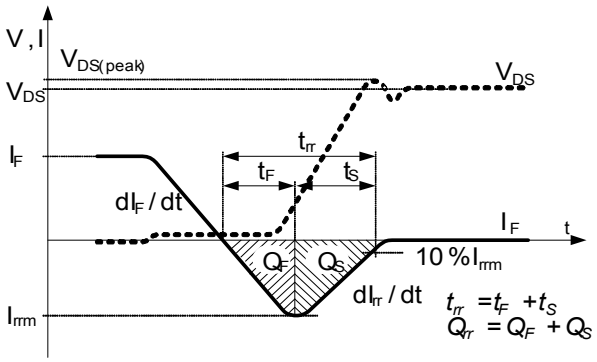
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

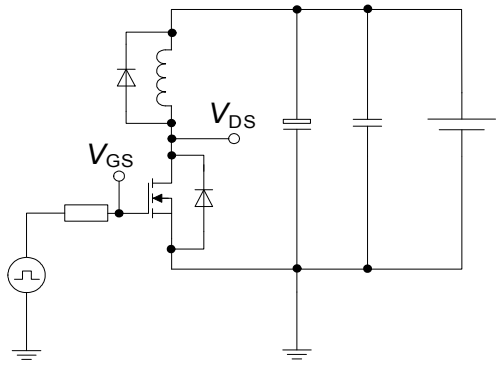
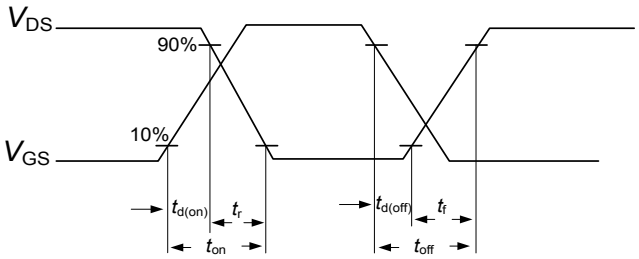
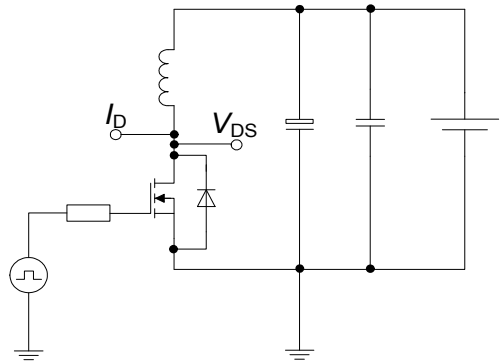
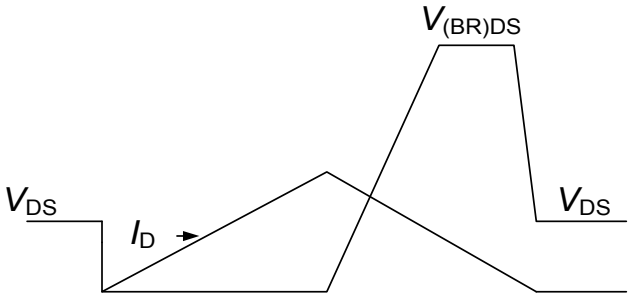
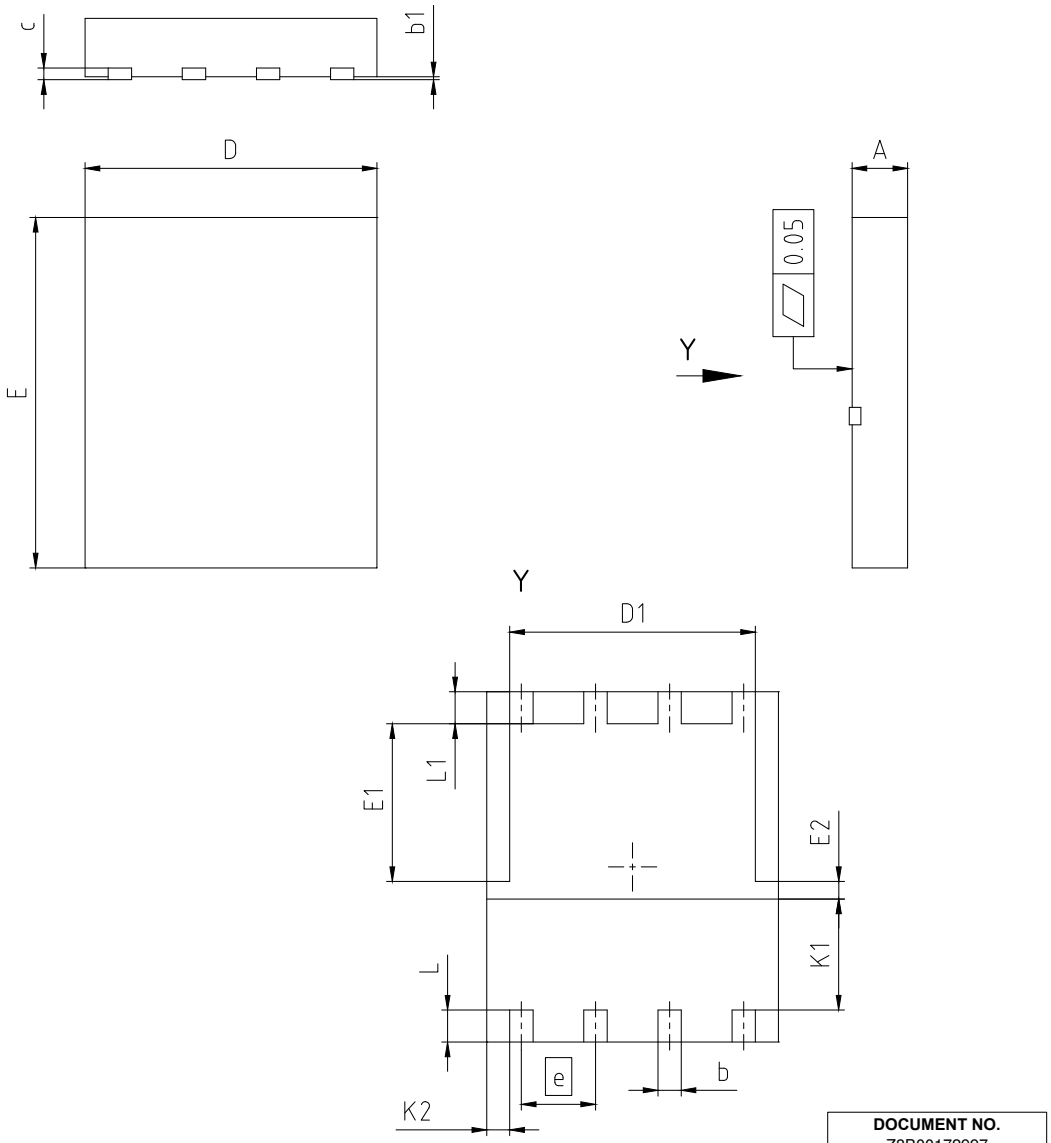
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.90	1.10	0.035	0.043
b	0.30	0.50	0.012	0.020
b1	0.00	0.05	0.000	0.002
c	0.10	0.30	0.004	0.012
D	4.90	5.10	0.193	0.201
D1	4.11	4.31	0.162	0.170
E	5.90	6.10	0.232	0.240
E1	2.60	2.80	0.102	0.110
E2	0.20	0.40	0.008	0.016
e	1.27 (BSC)		0.05 (BSC)	
K1	1.80	2.00	0.071	0.079
K2	0.30	0.50	0.012	0.020
L	0.45	0.65	0.018	0.026
L1	0.45	0.65	0.018	0.026
N	8		8	

DOCUMENT NO.	Z8B00172997
SCALE	0 1 2mm
EUROPEAN PROJECTION	
ISSUE DATE	17-04-2014
REVISION	01

Figure 1 Outline ThinPAK 5x6 SMD, dimensions in mm/inches

8 Appendix A

Table 11 Related Links

- **IFX CoolMOS Webpage:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPL60R2K1C6S

Revision: 2014-07-08, Rev. 2.0

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2014-07-08	Release of final version

We Listen to Your Comments
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:
erratum@infineon.com

Published by
Infineon Technologies AG
81726 München, Germany

Legal Disclaimer
The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information
For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (**www.infineon.com**).

Warnings
Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.
The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.