MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS CP

600V CoolMOS™ CP Power Transistor
IPL60R199CP

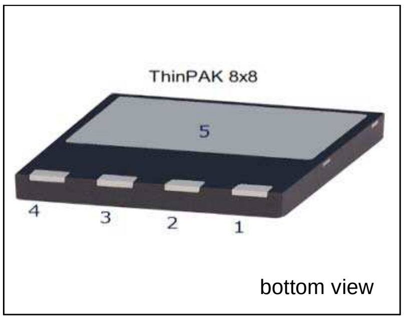
Data Sheet

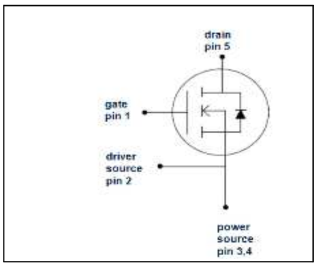
Rev. 2.3, 2015-10-23
Final

Industrial & Multimarket

1 Description

The CoolMOS™ CP series offers devices which 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.





ThinPAK

ThinPAK is a a new leadless SMD package for HV MOSFETs. The new package has a very small footprint of only 64mm² (vs. 150mm² for the D^2PAK) and a very low profile with only 1mm height (vs. 4.4mm for the D^2PAK). The significantly smaller package size, combined with benchmark low parasitic inductances, provides designers with a new and effective way to decrease system solution size in power-density driven designs.

Features

- Reduced board space consumption
- Increased power density
- Short commutation loop
- Smooth switching waveform
- easy to use products
- Extremely low losses due to very low FOM R_{dson}*Q_g and E_{oss}
- Quallfied according to JEDEC[1)] for target applications (Server, Adapter)
- Pb-free plating, Halogen free

Applications: Server, Adapter

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	0.199	Ω
$Q_{g,typ}$	32	nC
$I_{D,pulse}$	63	A
E_{oss} @ 400V	6.1	µJ
Body diode di/dt	200	A/µs

Related Links
IFX CP Product Brief
IFX CP Portfolio
IFX ThinPAK Webpage
IFX Design tools

Type	Package	Marking
IPL60R199CP	PG-VSON-4	6R199P

1) J-STD20 and JESD22

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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	-	-	16.4	A	T_C= 25 °C
				10		T_C= 100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	63	A	T_C=25 °C
Avalanche energy, single pulse	E_{AS}	-	-	436	mJ	I_D=6.6 A,V_{DD}=50 V (see table 17)
Avalanche energy, repetitive[2)3)]	E_{AR}	-	-	0.66		I_D=6.6 A,V_{DD}=50 V
Avalanche current, repetitive[2)3)]	I_{AR}	-	-	6.6	A	
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS}=0...480 V
Gate source voltage	V_{GS}	-20	-	20	V	static
		-30		30		AC (f>1 Hz)
Power dissipation	P_{tot}	-	-	139	W	T_C=25 °C
Operating temperature	T_j	-40	-	150	°C	
Storage temperature	T_{stg}	-40	-	125	°C	
Continuous diode forward current	I_S	-	-	16.4	A	T_C=25 °C
Diode pulse current[2]	$I_{S,pulse}$	-	-	63	A	T_C=25 °C
Reverse diode dv/dt[4]	dv/dt	-	-	15	V/ns	V_{DS}=0...400 V, $I_{SD} \leq I_D$, T_j=25 °C
Maximum diode commutation speed[4]	di_f/dt	-	-	200	A/µs	(see table 18)

1) Limited by $T_{j,max.}$ Maximum duty cycle
2) Pulse width t_p limited by $T_{j,max}$
3) Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.
4) 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}	-	-	0.9	°C/W	
Thermal resistance, junction - ambient	R_{thJA}	-	-	45		SMD version, device on PCB, 6cm^2 cooling area[1]
Reflow soldering temperature	T_{sold}	-	-	260	°C	reflow MSL 3

1) Device on 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm^2 copper area (thickness 70µm) for drain connection. PCB is vertical without air stream cooling.

4 Electrical characteristics

Electrical characteristics, at Tj=25 °C, unless otherwise specified.

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	600	-	-	V	V_{GS}=0 V, I_D=0.25 mA
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5		V_{DS}=V_{GS}, I_D=0.66 mA
Zero gate voltage drain current	I_{DSS}	-	-	1	µA	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C
		-	10	-		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	0.18	0.199	Ω	V_{GS}=10 V, I_D=9.9 A, T_j=25 °C
		-	0.47	-		V_{GS}=10 V, I_D=9.9 A, T_j=150 °C
Gate resistance	R_G	-	2	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	1520	-	pF	V_{GS}=0 V, V_{DS}=100 V, f=1 MHz
Output capacitance	C_{oss}	-	72	-		
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	69	-		V_{GS}=0 V, V_{DS}=0...480 V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	180	-		I_D=constant, V_{GS}=0 V V_{DS}=0...480V
Turn-on delay time	$t_{d(on)}$	-	10	-	ns	V_{DD}=400 V, V_{GS}=13 V, I_D=9.9 A, R_G= 3.3Ω (see table 16)
Rise time	t_r	-	5	-		
Turn-off delay time	$t_{d(off)}$	-	50	-		
Fall time	t_f	-	5	-		

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 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	8	-	nC	V_{DD}=480 V, I_D=9.9 A, V_{GS}=0 to 10 V
Gate to drain charge	Q_{gd}	-	11	-		
Gate charge total	Q_g	-	32	-		
Gate plateau voltage	$V_{plateau}$	-	5	-	V	

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}=0 V, I_F=9.9 A, T_j=25 °C
Reverse recovery time	t_{rr}	-	340	-	ns	V_R=400 V, I_F=9.9 A, di_F/dt=100 A/µs (see table 18)
Reverse recovery charge	Q_{rr}	-	5.5	-	µC	
Peak reverse recovery current	I_{rrm}	-	33	-	A	

5 Electrical characteristics diagrams

Table 8

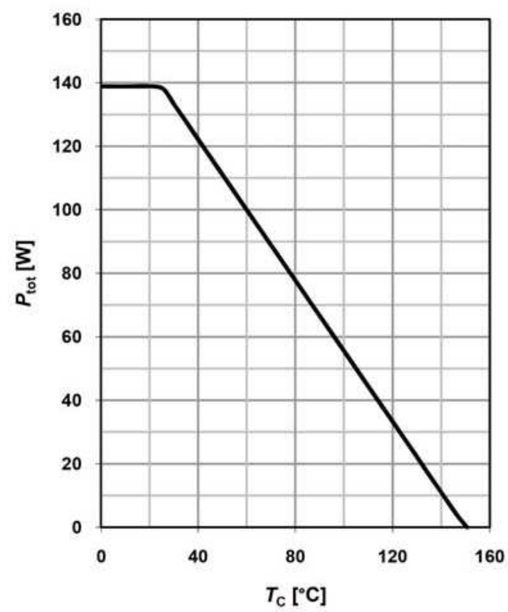
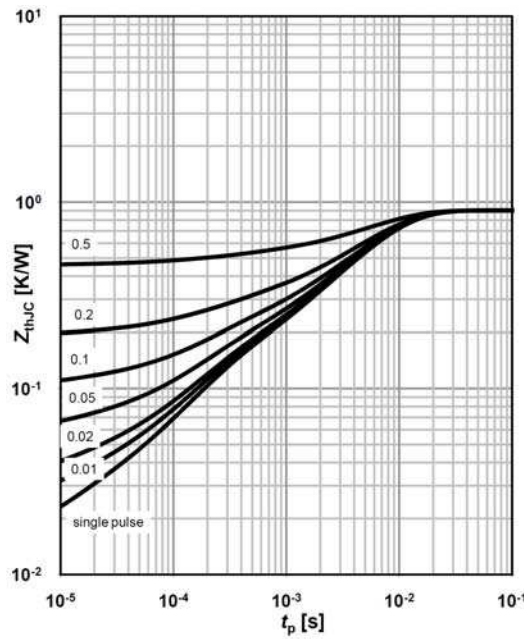
Power dissipation	**Max. transient thermal impedance**
	
$P_{tot} = f(T_C)$	$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

Table 9

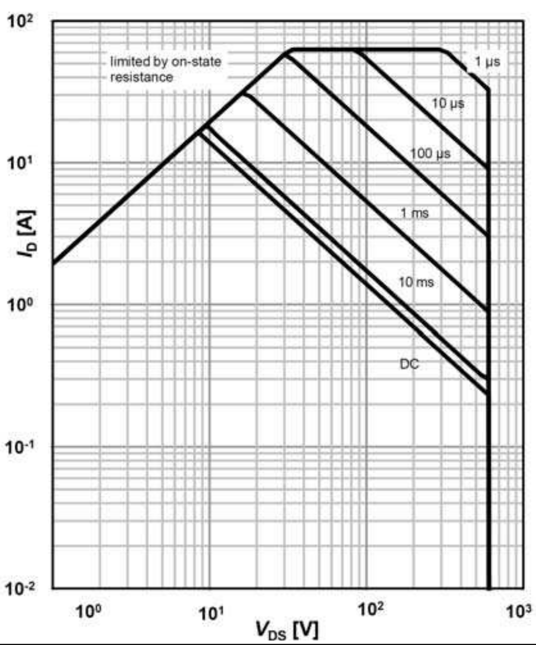
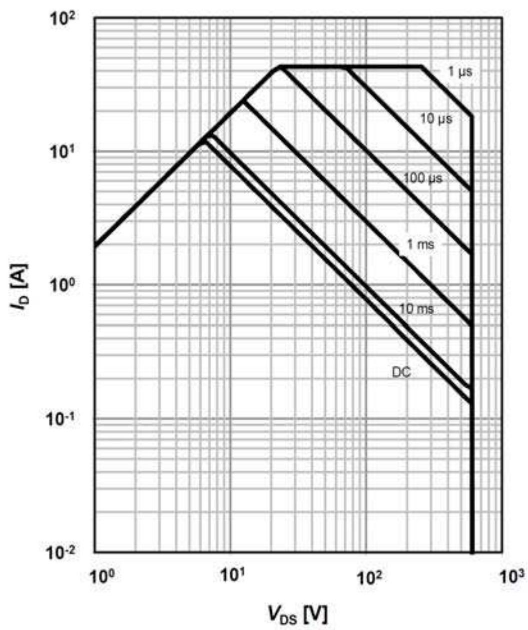
Safe operating area T_C=25 °C	**Safe operating area T_C=80 °C**
	
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p	I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

Table 10

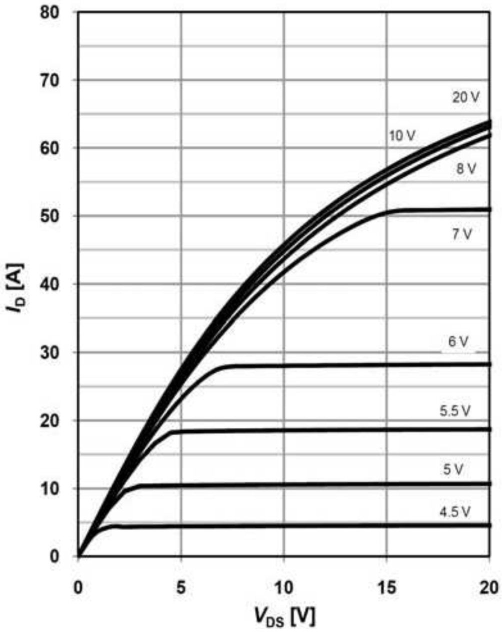
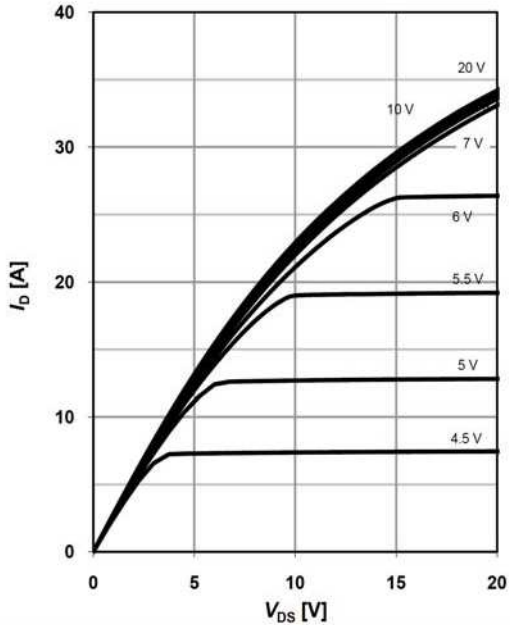
<table>
<tr><th>Typ. output characteristics T_j=25 °C</th><th>Typ. output characteristics T_j=125 °C</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}</td><td>I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}</td></tr>
</table>

Table 11

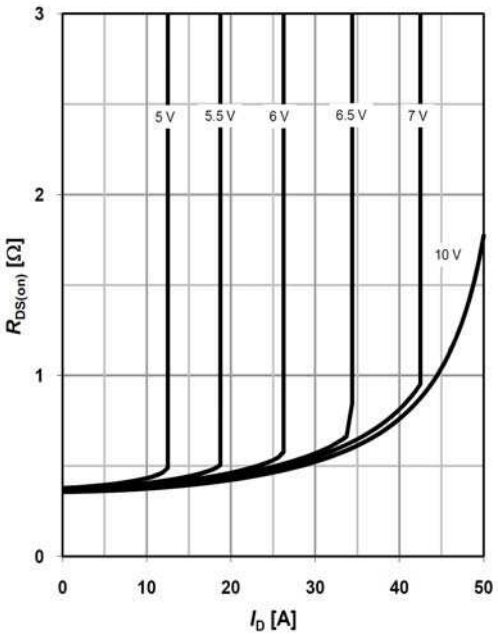
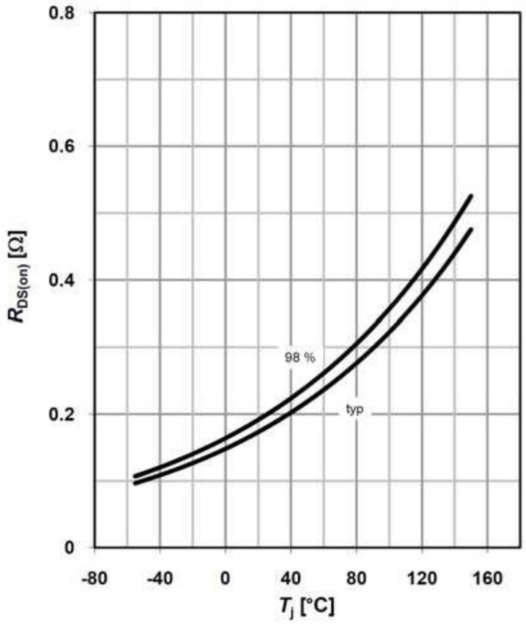
<table>
<tr><th>Typ. drain-source on-state resistance</th><th>Drain-source on-state resistance</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}</td><td>$R_{DS(on)}$=f(T_j); I_D=9.9 A; V_{GS}=10 V</td></tr>
</table>

Table 12

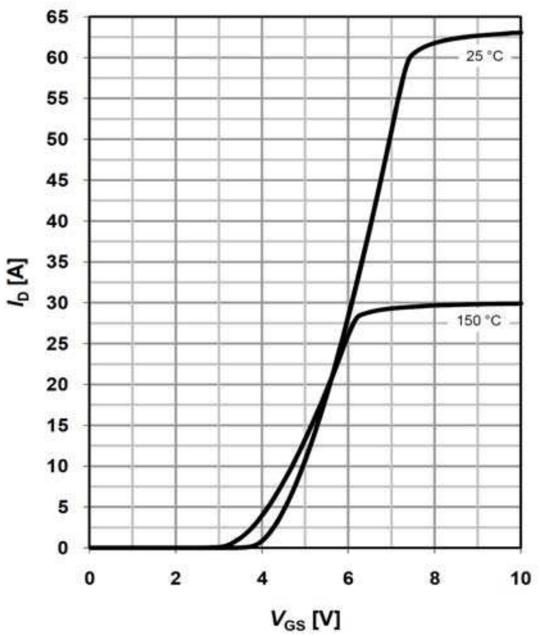
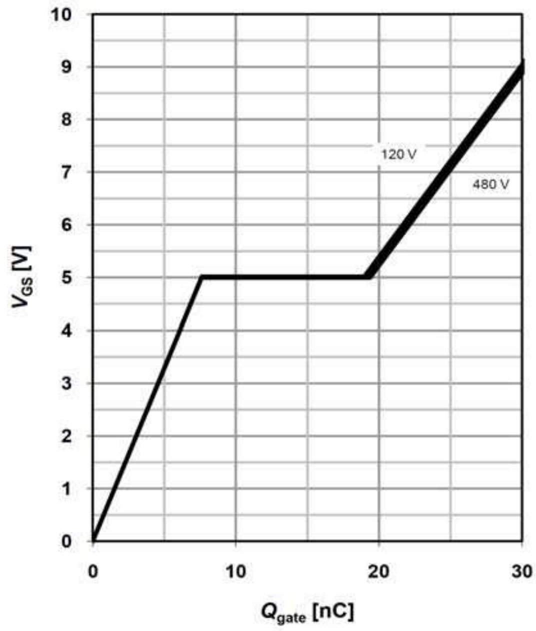
<table>
<tr><th>Typ. transfer characteristics</th><th>Typ. gate charge</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>I_D=f(V_{GS}); V_{DS}=20V</td><td>V_{GS}=f(Q_{gate}), I_D=9.9 A pulsed</td></tr>
</table>

Table 13

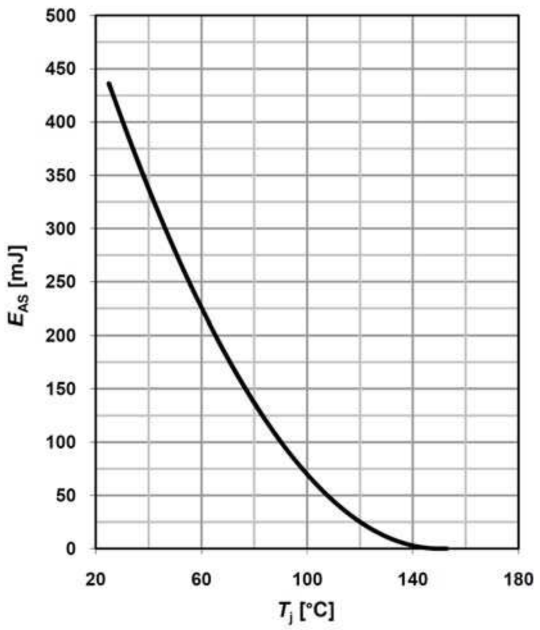
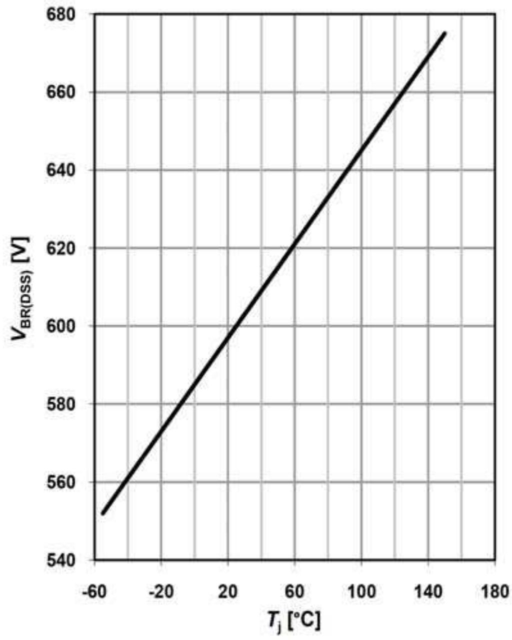
<table>
<tr><th>Avalanche energy</th><th>Drain-source breakdown voltage</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>E_{AS}=f(T_j); I_D=6.6 A; V_{DD}=50 V</td><td>$V_{BR(DSS)}$=f(T_j); I_D=0.25 mA</td></tr>
</table>

Table 14

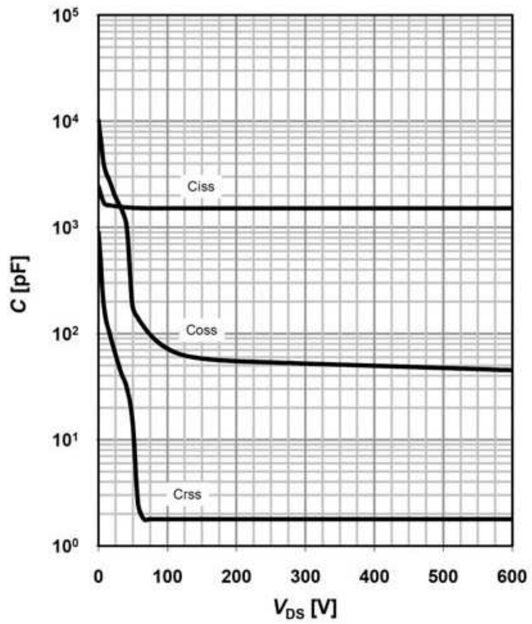
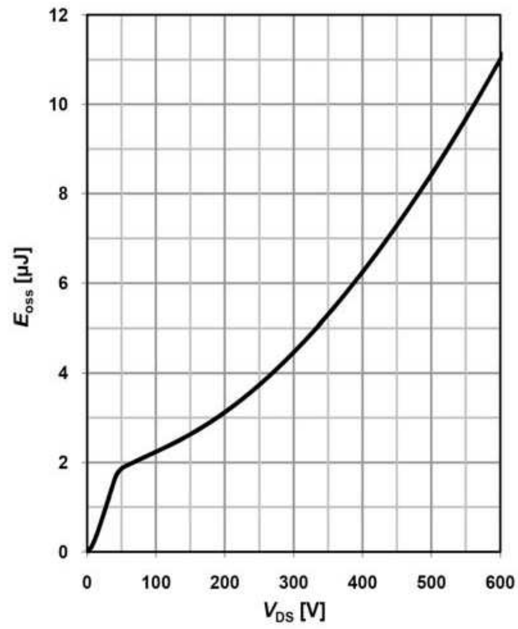
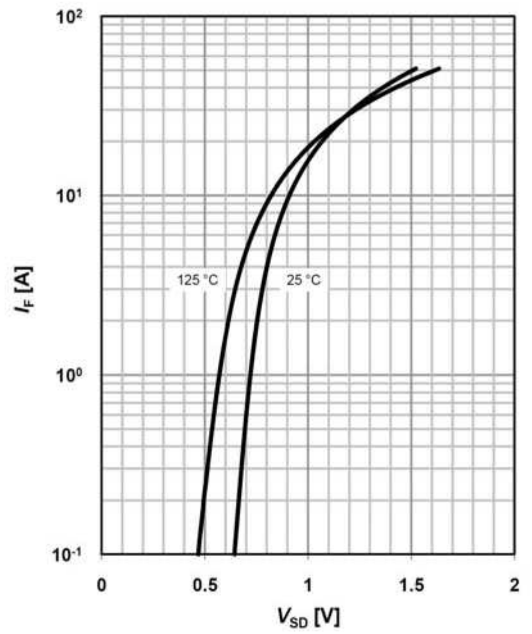
Typ. capacitances	Typ. C_{oss} stored energy
	
C=f(V_{DS}); V_{GS}=0 V; *f*=1 MHz	E_{oss}=f(V_{DS})

Table 15

Forward characteristics of reverse diode

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

6 Test circuits

Table 16 Switching times test circuit and waveform for inductive load

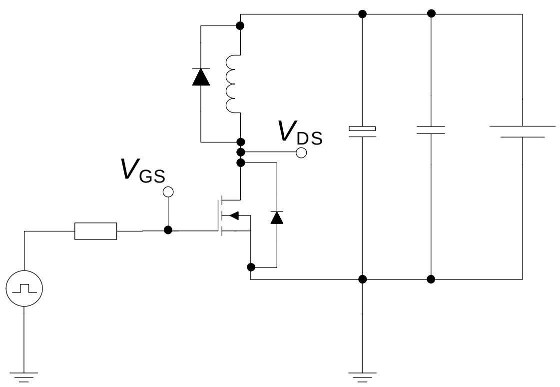
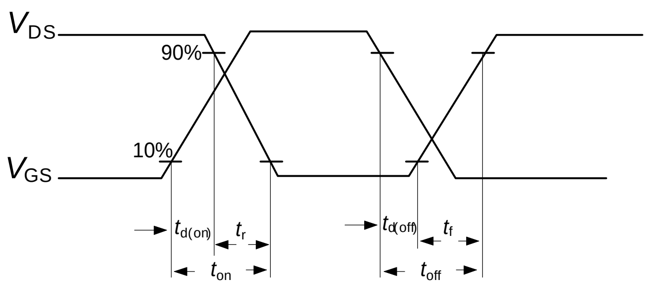
Switching times test circuit for inductive load	Switching time waveform
	

Table 17 Unclamped inductive load test circuit and waveform

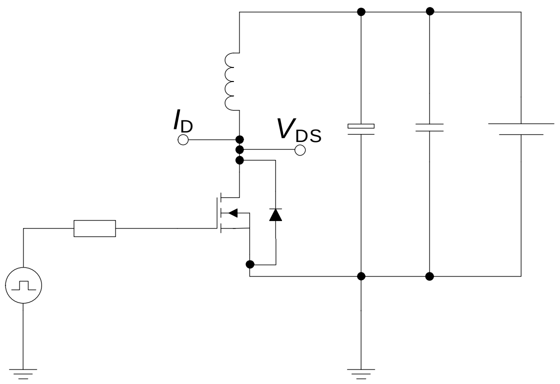
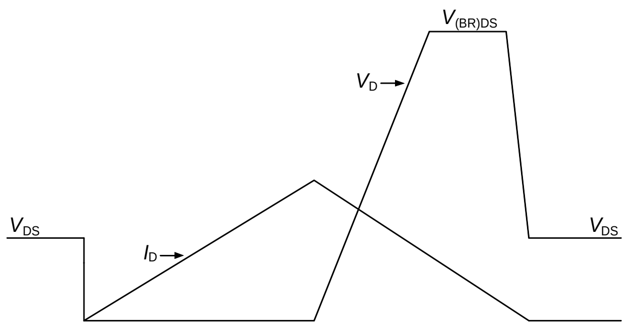
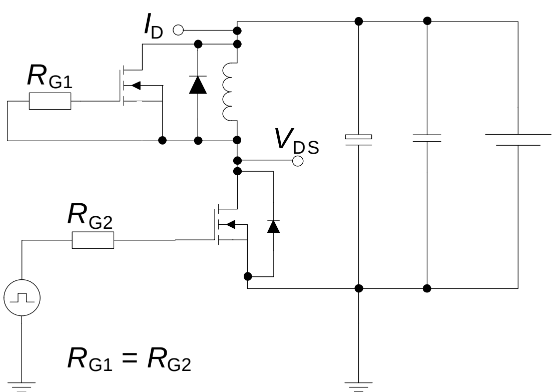
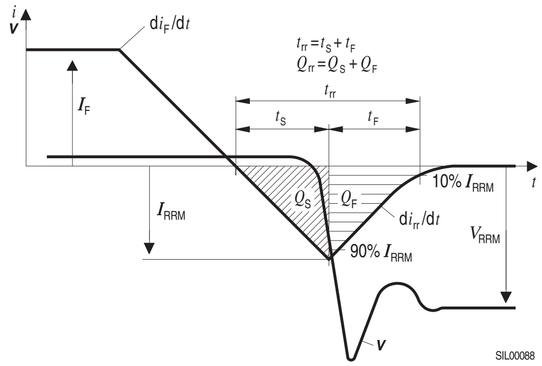
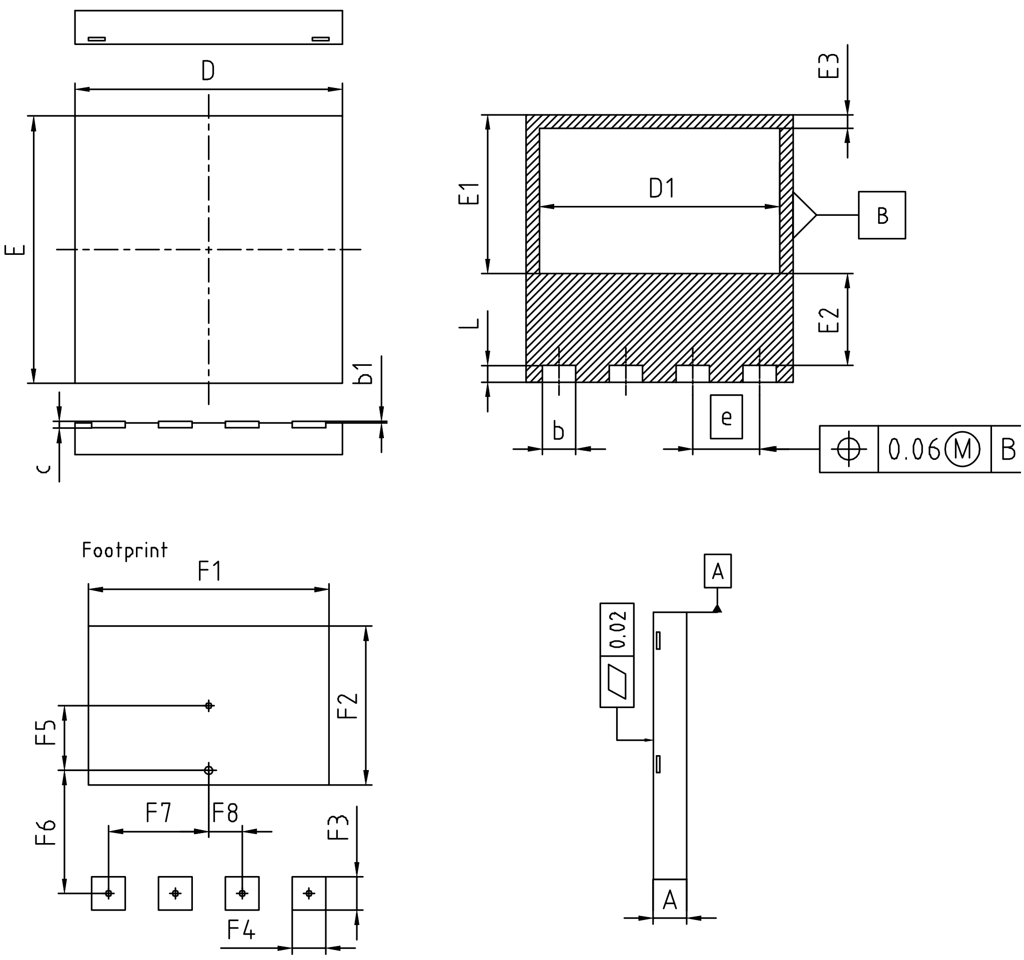
Unclamped inductive load test circuit	Unclamped inductive waveform
	

Table 18 Test circuit and waveform for diode characteristics

Test circuit for diode characteristics	Diode recovery waveform
	

7 Package outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.90	1.10	0.035	0.043
b	0.90	1.10	0.035	0.043
b1	0.00	0.05	0.000	0.002
c	0.10	0.30	0.004	0.012
D	7.90	8.10	0.311	0.319
D1	7.10	7.30	0.280	0.287
E	7.90	8.10	0.311	0.319
E1	4.65	4.85	0.183	0.191
E2	2.65	2.85	0.104	0.112
E3	0.30	0.50	0.012	0.020
e	2.00 (BSC)		0.079 (BSC)	
L	0.40	0.60	0.016	0.024
N	4		4	
F1	7.20		0.283	
F2	4.75		0.187	
F3	1.00		0.039	
F4	1.00		0.039	
F5	1.43		0.056	
F6	4.20		0.165	
F7	3.00		0.118	
F8	1.00		0.039	

DOCUMENT NO.
Z8B00156707

SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
05-04-2010

REVISION
01

Figure 1 Outlines ThinPAK 8x8, dimensions in mm/inches

8 Revision History

Revision History: 2015-10-23, Rev. 2.3

Previous Revision:

Page	Subjects (major changes since last revision)
2.0	Release of final data sheet
2.2	Update package drawing and schematic
2.3	Update ID pulse according to SOA Diagram on pages 2 and 4

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Edition 2012-01-09

Published by
Infineon Technologies AG
81726 Munich, Germany

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