MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CFD2 650V Thinpak

650V CoolMOS™ CFD2 Power Transistor
IPL65R165CFD

Data Sheet

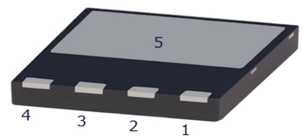
Rev. 2.0
Final

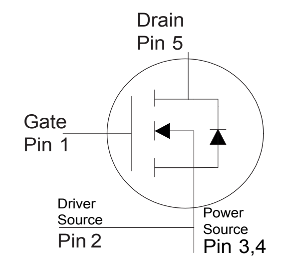
Industrial & Multimarket

1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. 650V CoolMOS™ CFD2 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The resulting devices provide all benefits of a fast switching SJ MOSFET while offering an extremely fast and robust body diode. This combination of extremely low switching, commutation and conduction losses together with highest robustness make especially resonant switching applications more reliable, more efficient, lighter and cooler.

ThinPAK 8x8





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 D²PAK) and a very low profile with only 1mm height (vs. 4.4mm for the D²PAK). 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
- Ultra-fast body diode
- Very high commutation ruggedness
- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Easy to use/drive
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)
- Pb-free plating, Halogen free mold compound

Applications

650V CoolMOS™ CFD2 is especially suitable for resonant switching stages for e.g. PC Silverbox, LCD TV, Lighting, Server and Telecom.

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j\,max}$	700	V
RDS(on),max	0.165	Ω
Qg,typ	86	nC
ID,pulse	67	A
Eoss @ 400V	6.8	µJ
Body diode di/dt	900	A/µs
Qrr	0.7	µC
trr	140	ns
Irrm	8.8	A

Type / Ordering Code	Package	Marking	Related Links
IPL65R165CFD	PG-VSON-4	65F6165	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			21.3	A	T_C = 25°C
				13.5		T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$			67	A	T_C = 25°C
Avalanche energy, single pulse	E_{AS}			614	mJ	I_D = 4.3A, V_{DD} = 50V (see table 10)
Avalanche energy, repetitive	E_{AR}			0.93	mJ	I_D = 4.3A, V_{DD} = 50V
Avalanche current, repetitive	I_{AR}			4.3	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	V_{DS} = 0 ... 400V
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC (f > 1 Hz)
Operating and storage temperature	T_j, T_{stg}	-40		150	°C	
Continuous diode forward current	I_S			21.3	A	T_C = 25°C
Diode pulse current	$I_{S,pulse}$			67	A	T_C = 25°C
Reverse diode dv/dt[3]	dv/dt			50	V/ns	V_{DS} = 0 ... 400V, $I_{SD} \leq I_D$, T_j = 25°C (see table 8)
Maximum diode commutation speed	di_f/dt			900	A/µs	
Power dissipation	P_{tot}			195	W	T_C=25°C

[1] Limited by $T_{j\,max}$.
[2] Pulse width t_p limited by $T_{j\,max}$
[3] $V_{peak}<V_{(BR)DSS}$, $T_j<T_{j\,max}$, identical low side and high side switch with same Rg

3 Thermal characteristics

Table 3 Thermal characteristics ThinPAK 8x8

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.64	°C/W	
Thermal resistance, junction - ambient[1)]	R_{thJA}			62	°C/W	SMD version, device on PCB, minimal footprint
				45		SMD version, device on PCB, 6cm² cooling area
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}			260	°C	reflow MSL 3

[1)] Device on 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm² copper area (thickness 70µm) for drain connection. PCB is vertical without air stream cooling.

4 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	$V_{GS(th)}$	3.5	4	4.5	V	V_{DS} = V_{GS}, I_D = 0.9mA
Zero gate voltage drain current	I_{DSS}			1	µA	V_{DS} = 650V, V_{GS} = 0V, T_j = 25°C
			300			V_{DS} = 650V, 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	$R_{DS(on)}$		0.149	0.165	Ω	V_{GS} = 10V, I_D = 9.3A, T_j = 25°C
			0.386			V_{GS} = 10V, I_D = 9.3A, T_j = 150°C
Gate resistance	R_G		1.5		Ω	f = 1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		2340		pF	V_{GS} = 0V, V_{DS} = 100V, f = 1MHz
Output capacitance	C_{oss}		110		pF	
Effective output capacitance, energy related[1)]	$C_{o(er)}$		90		pF	V_{GS} = 0V, V_{DS} = 0 ... 400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$		420		pF	I_D = constant, V_{GS} = 0V, V_{DS} = 0 ... 400V
Turn-on delay time	$t_{d(on)}$		12.4		ns	V_{DD} = 400V, V_{GS} = 13V, I_D = 14.0A, R_G = 1.8Ω (see table 9)
Rise time	t_r		7.6		ns	
Turn-off delay time	$t_{d(off)}$		52.8		ns	
Fall time	t_f		5.6		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		15		nC	V_{DD} = 480V, I_D = 14A, V_{GS} = 0 to 10V
Gate to drain charge	Q_{gd}		47		nC	
Gate charge total	Q_g		86		nC	
Gate plateau voltage	$V_{plateau}$		6.4		V	

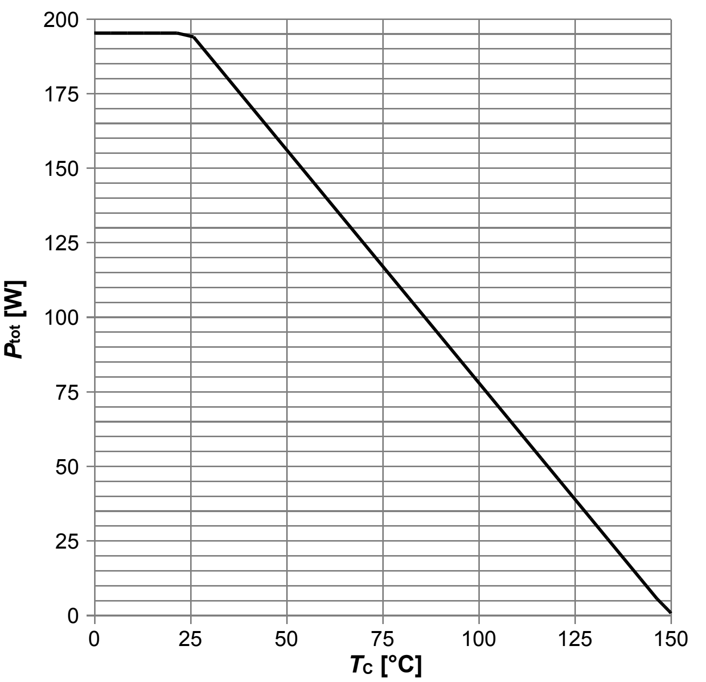
1) $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
2) $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

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 = 14.0A, T_j = 25°C
Reverse recovery time	t_{rr}		140		ns	V_R = 400V, I_F = 14.0A, di_F/dt = 100A/µs (see table 8)
Reverse recovery charge	Q_{rr}		0.7		µC	
Peak reverse recovery current	I_{rrm}		8.8		A	

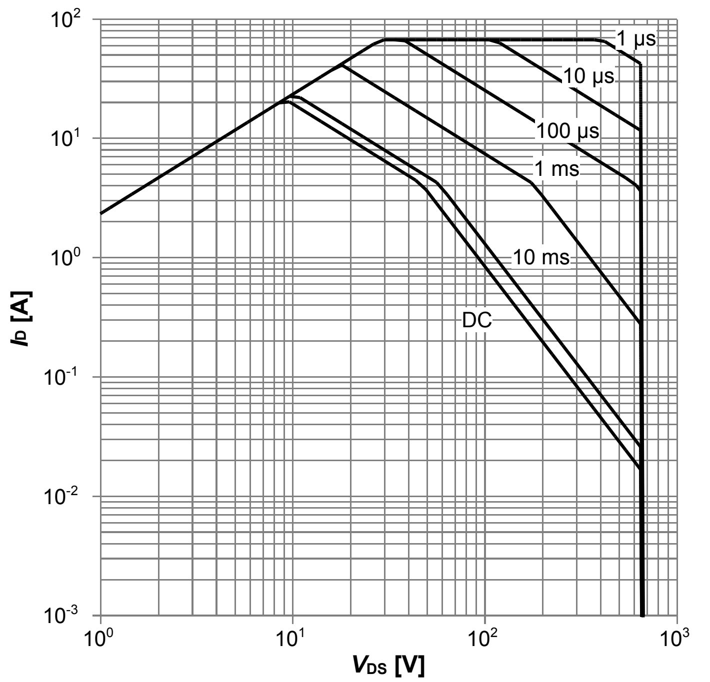
5 Electrical characteristics diagrams

Diagram 1: Power dissipation



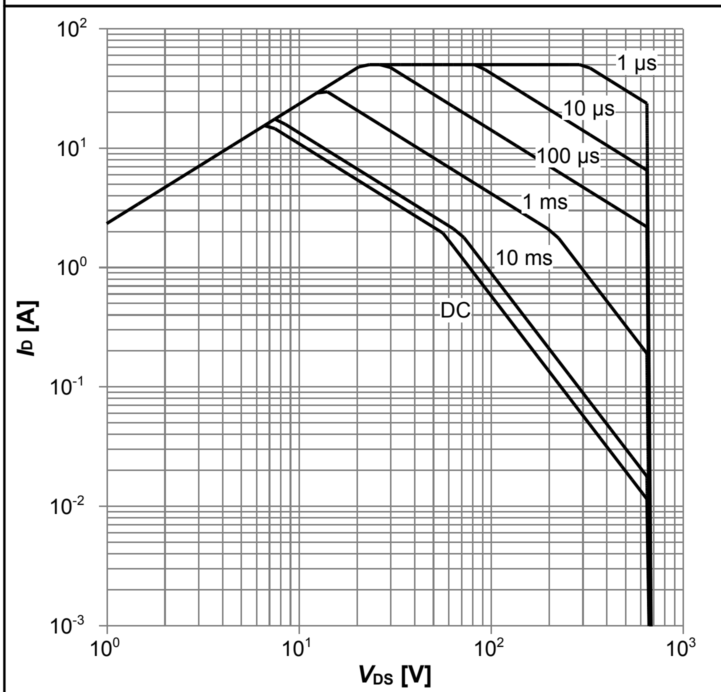
P_{tot}=f(T_C)

Diagram 2: Safe operating area



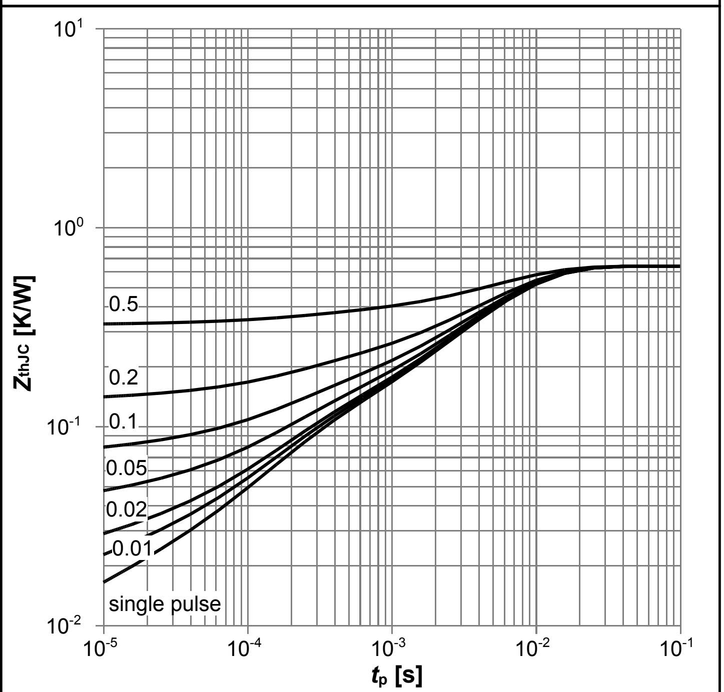
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

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

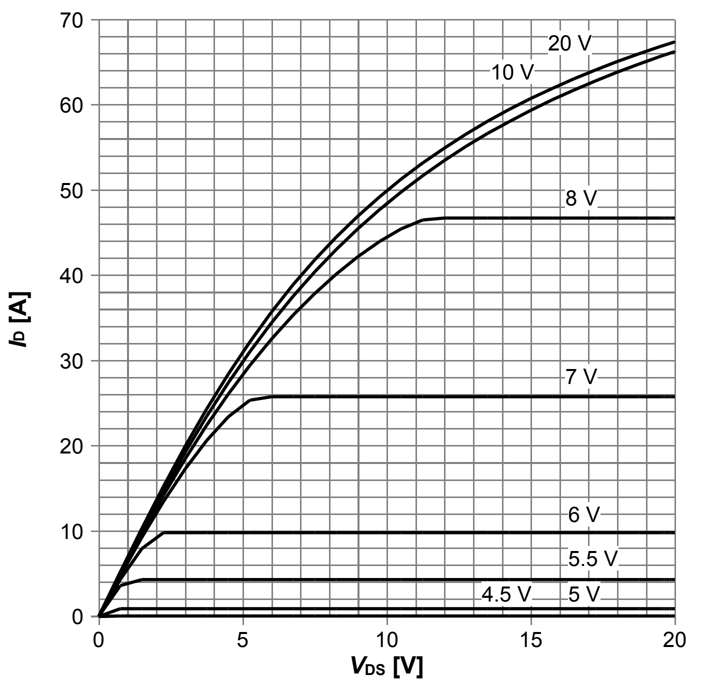
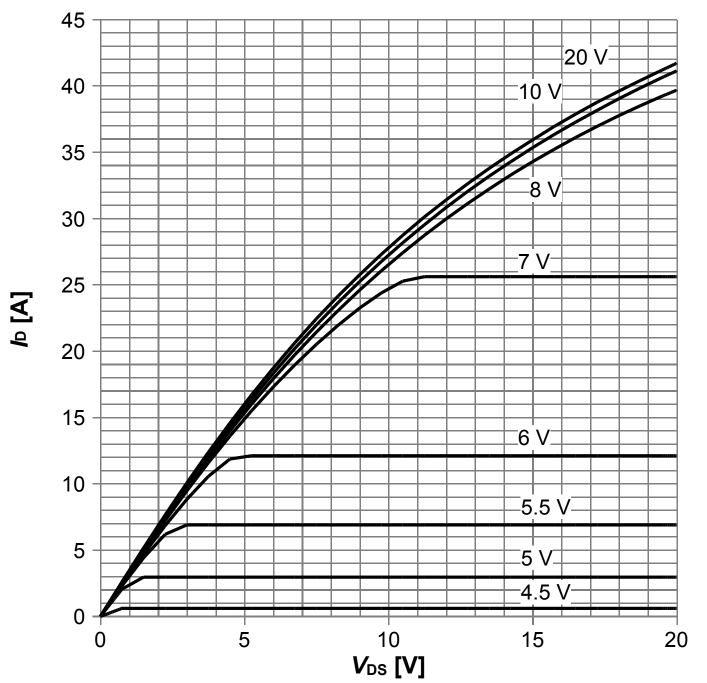
Diagram 5: Typ. output characteristics	Diagram 6: Typ. output characteristics
	
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}	I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

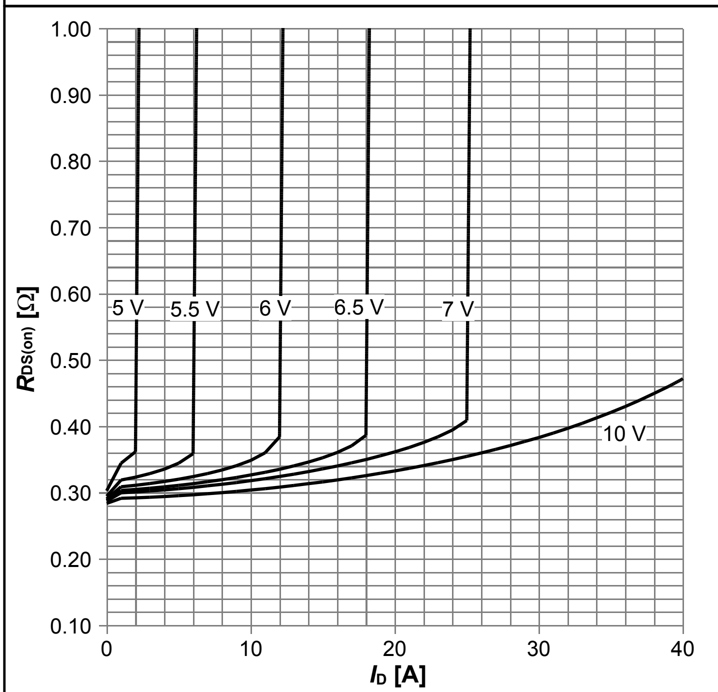
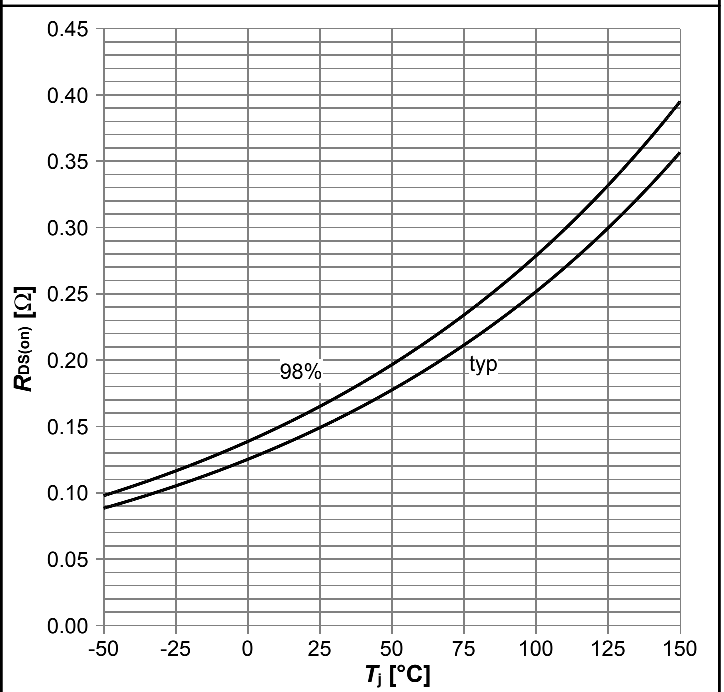
Diagram 7: Typ. drain-source on-state resistance	Diagram 8: Drain-source on-state resistance
	
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}	$R_{DS(on)}$=f(T_j); I_D=9.3 A; V_{GS}=10 V

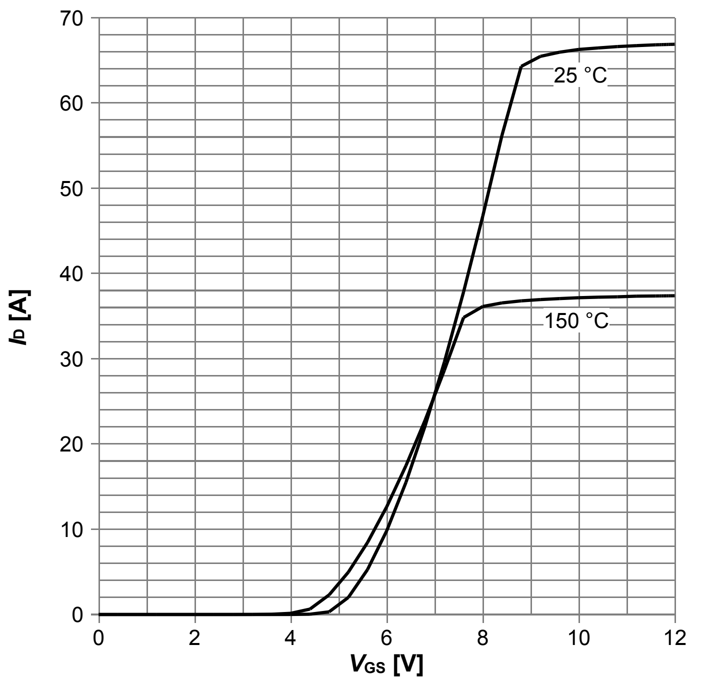
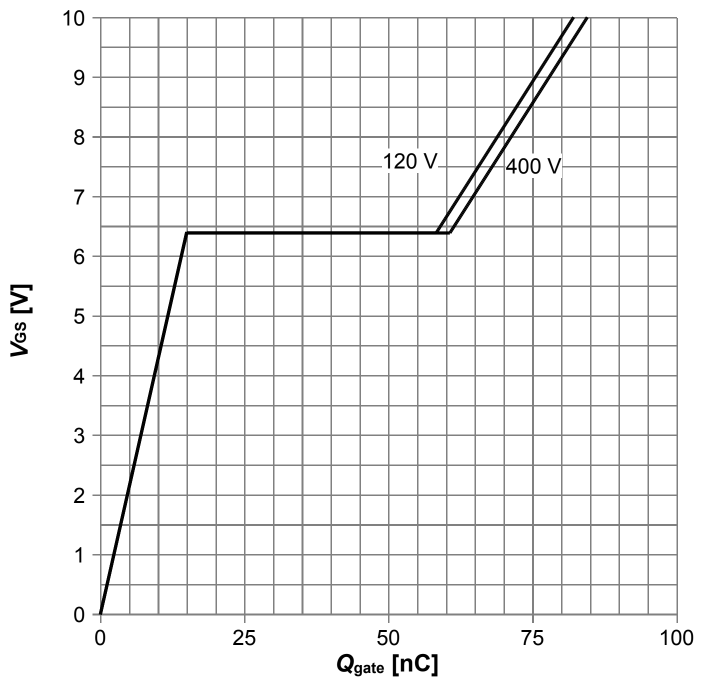
Diagram 9: Typ. transfer characteristics	Diagram 10: Typ. gate charge
	
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j	V_{GS}=f(Q_{gate}); I_D=14 A pulsed; parameter: V_{DD}

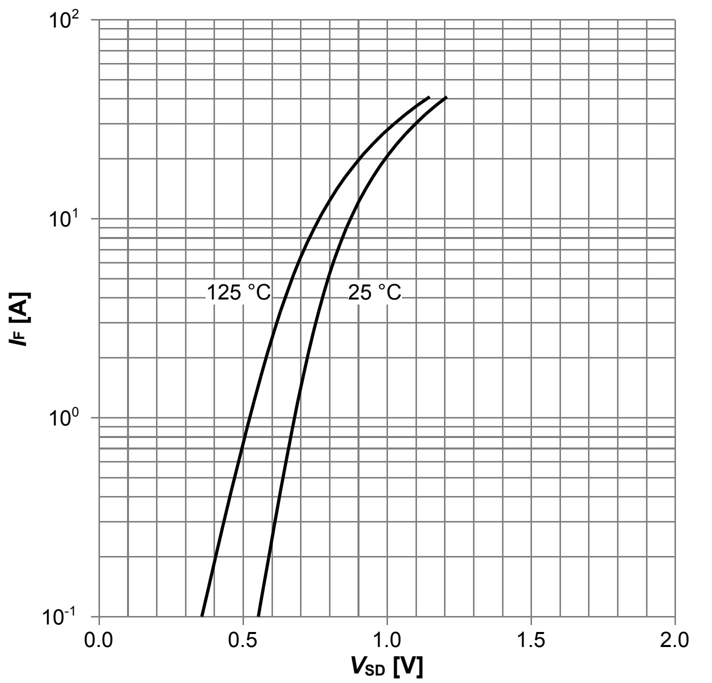
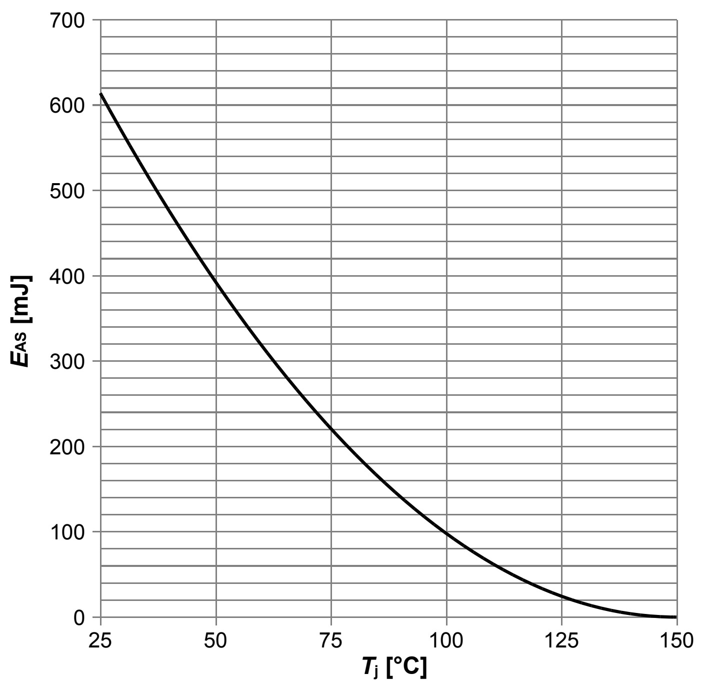
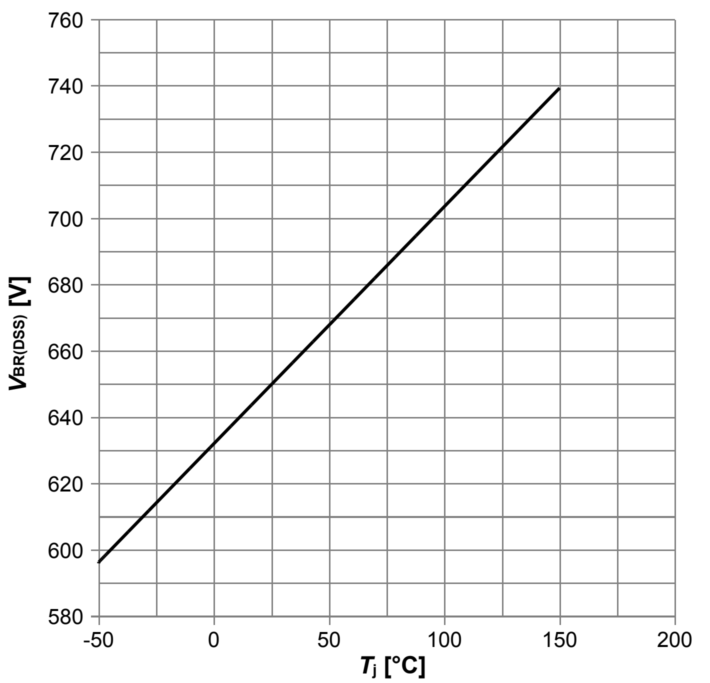
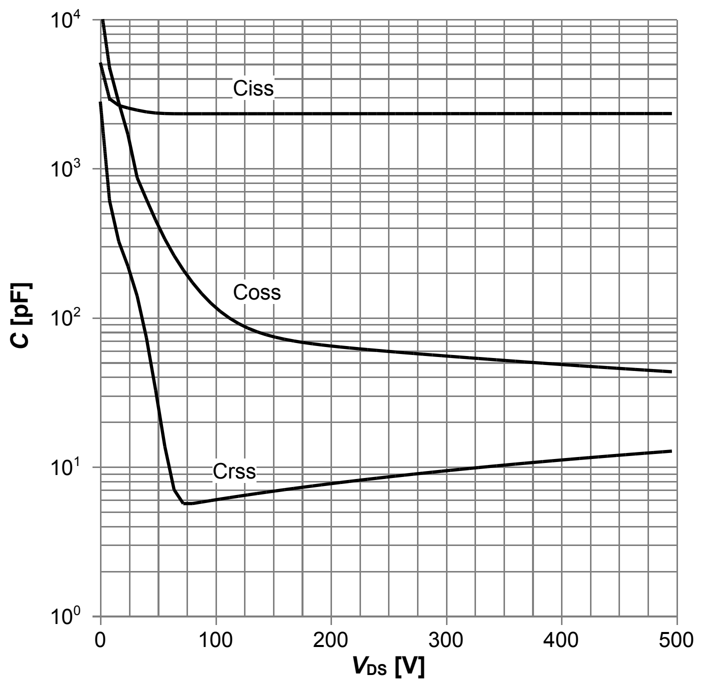
Diagram 11: Forward characteristics of reverse diode	Diagram 12: Avalanche energy
	
I_F=f(V_{SD}); parameter: T_j	E_{AS}=f(T_j); I_D=4.3 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



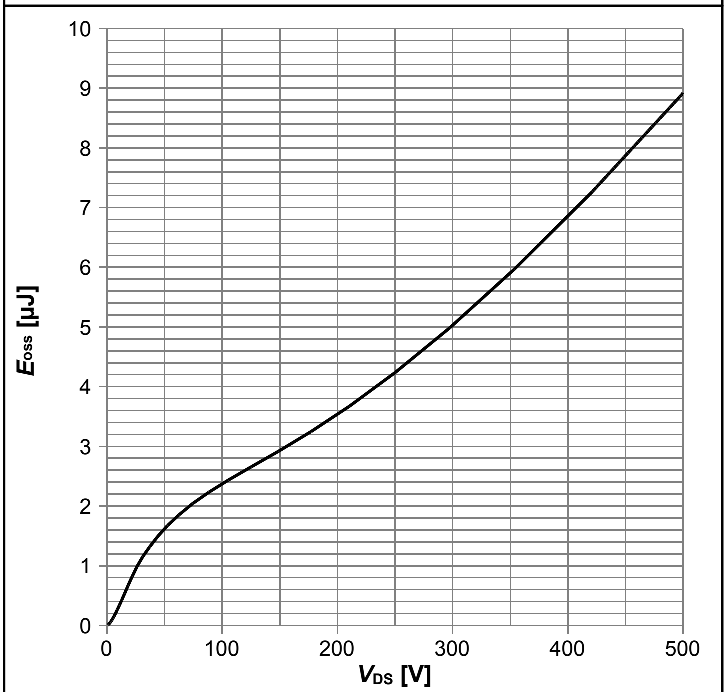
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Diagram 14: Typ. capacitances



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

Diagram 15: Typ. Coss stored energy

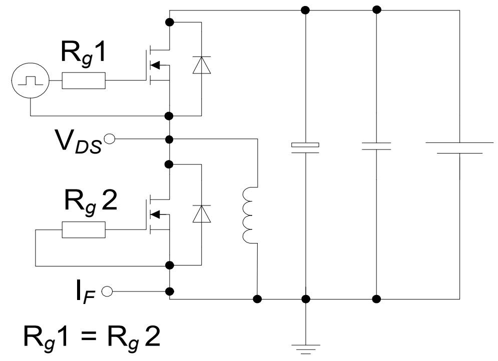


E_{oss}=f(V_{DS})

6 Test Circuits

Table 8 Diode characteristics

Test circuit for diode characteristics	Diode recovery waveform



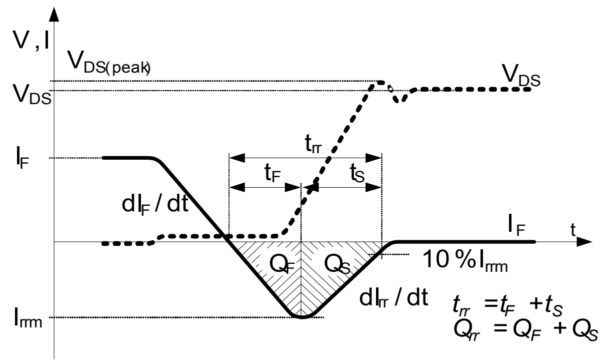
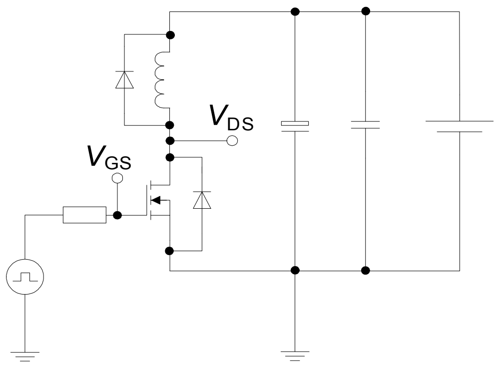


Table 9 Switching times

Switching times test circuit for inductive load	Switching times waveform



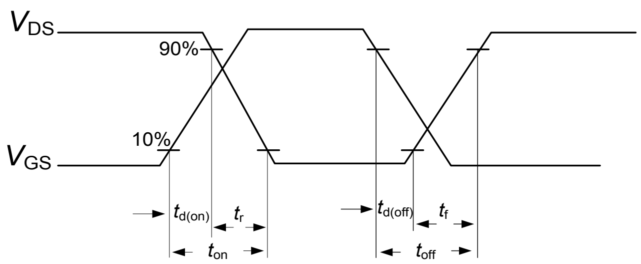
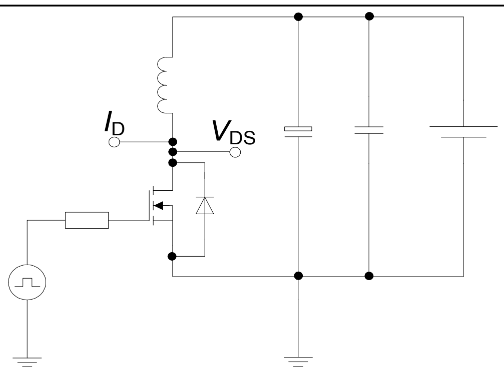
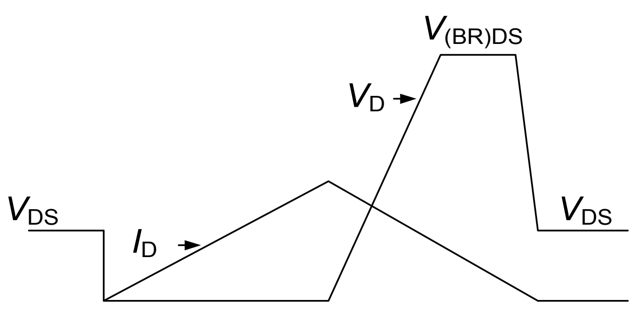


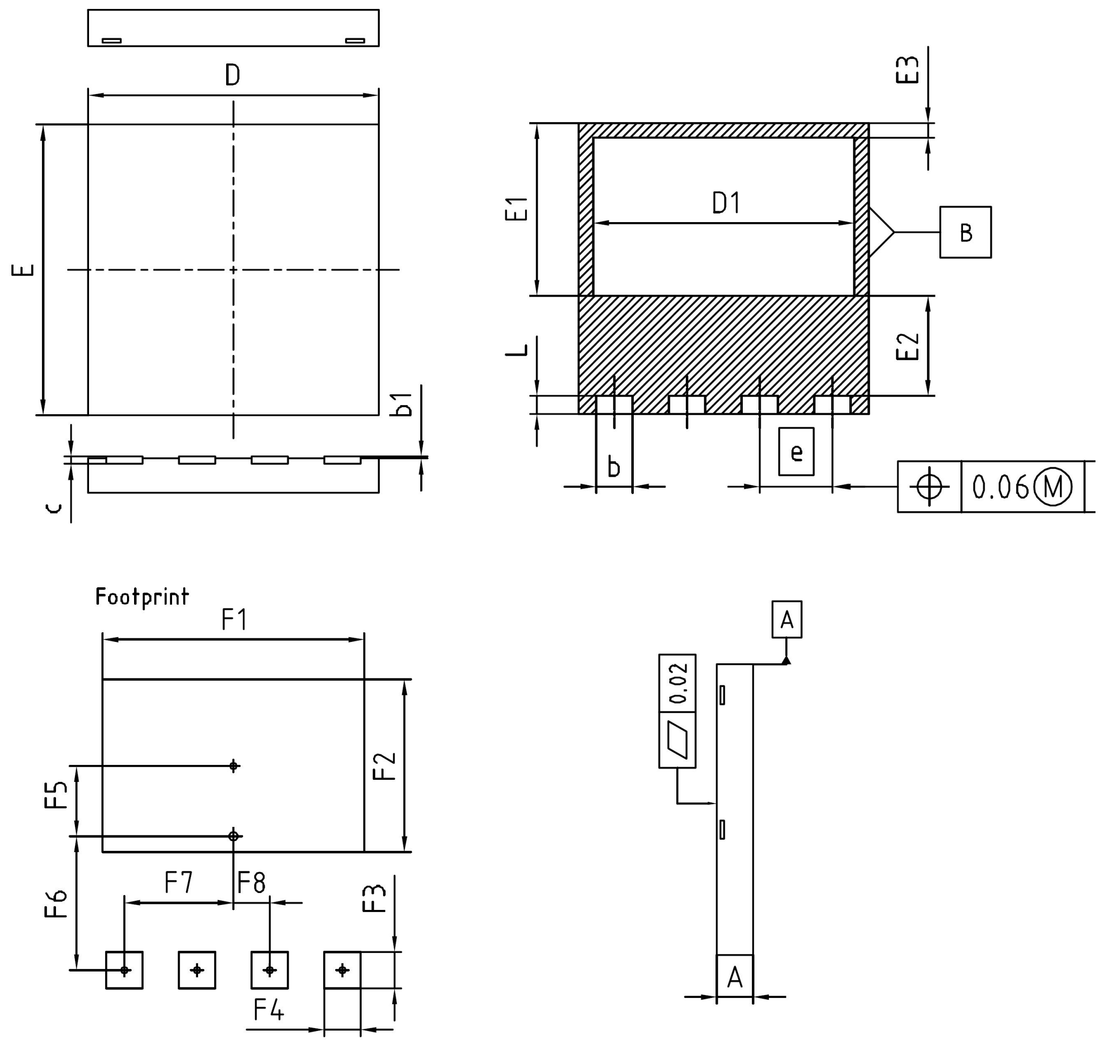
Table 10 Unclamped inductive load

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	0.90	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	

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SCALE 0 2.5 5mm

EUROPEAN PROJECTION

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01

Figure 1 Outline PG-VSON-4, dimensions in mm/inches

8 Appendix A

Table 11 Related Links

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

Revision History

IPL65R165CFD

Revision: 2014-03-19, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2014-03-19	Release of final version

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