MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CFD2 650V

650V CoolMOS™ CFD2 Power Transistor
IPD65R1K4CFD

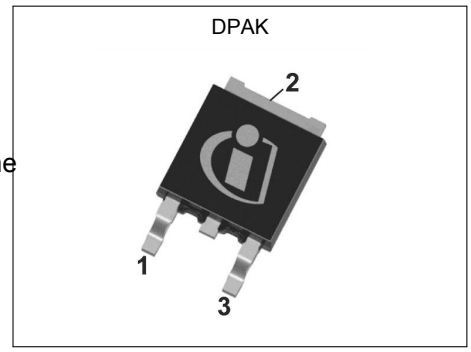
Data Sheet

Rev. 2.1, 2013-07-31
Final

Industrial & Multimarket

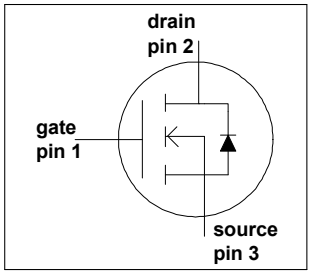
1 Description

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.



Features

- Ultra-fast body diode
- Easy to use/drive
- Very high commutation ruggedness
- Pb-free plating, available in Halogen free mold compound[1)]
- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)



Applications

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

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j\ max}$	700	V
RDS(on),max	1.4	Ω
Qg,typ	10	nC
ID,pulse	8.2	A
Eoss @ 400V	1	µJ
Body diode di/dt	900	A/µs
Qrr	0.1	µC
trr	50	ns
Irrm	3.2	A

Type / Ordering Code	Package	Marking	Related Links
IPD65R1K4CFD	PG-TO 252	65F61K4	see Appendix A

1) non-Halogen free (OPN: IPD65R1K4CFDBT); Halogen free (OPN: IPD65R1K4CFDAT)

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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			2.8	A	T_C = 25°C
				1.8		T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$			8.2	A	T_C = 25°C
Avalanche energy, single pulse	E_{AS}			26	mJ	I_D = 0.6A, V_{DD} = 50V (see table 18)
Avalanche energy, repetitive	E_{AR}			0.10	mJ	I_D = 0.6A, V_{DD} = 50V
Avalanche current, repetitive	I_{AR}			0.6	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}	-55		150	°C	
Continuous diode forward current	I_S			2.8	A	T_C = 25°C
Diode pulse current	$I_{S,pulse}$			8.2	A	T_C = 25°C
Reverse diode dv/dt[3]	dv/dt			50	V/ns	V_{DS} = 0 ... 400V, $I_{SD} \le I_D$, T_j = 25°C (see table 16)
Maximum diode commutation speed	di_f/dt			900	A/µs	
Power dissipation	P_{tot}			28.4	W	T_C=25°C

[1] Limited by $T_{j\,max}$. Maximum

[2] Pulse width t_p limited by $T_{j\,max}$

[3] $V_{peak}<V_{(BR)DSS}$, $T_j<T_{j\,max}$, identical low and high side switch with same Rg

3 Thermal characteristics

Table 3 Thermal characteristics DPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			4.4	°C/W	
Thermal resistance, junction - ambient[1)]	R_{thJA}			62	°C/W	SMD version, device on PCB, minimal footprint
			35			SMD version, device on PCB, 6cm² cooling area
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}			260	°C	reflow MSL

[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 = 0.1mA
Zero gate voltage drain current	I_{DSS}			1	µA	V_{DS} = 650V, V_{GS} = 0V, T_j = 25°C
			100			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	$R_{DS(on)}$		1.260	1.4	Ω	V_{GS} = 10V, I_D = 1.0A, T_j = 25°C
			3.276			V_{GS} = 10V, I_D = 1A, T_j = 150°C
Gate resistance	R_G		9.5		Ω	f = 1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		262		pF	V_{GS} = 0V, V_{DS} = 100V, f = 1MHz
Output capacitance	C_{oss}		18		pF	
Effective output capacitance, energy related[1]	$C_{o(er)}$		12		pF	V_{GS} = 0V, V_{DS} = 0 ... 400V
Effective output capacitance, time related[2]	$C_{o(tr)}$		49		pF	I_D = constant, V_{GS} = 0V, V_{DS} = 0 ... 400V
Turn-on delay time	$t_{d(on)}$		8		ns	V_{DD} = 400V, V_{GS} = 13V, I_D = 1.5A, R_G = 10.2Ω (see table 17)
Rise time	t_r		6		ns	
Turn-off delay time	$t_{d(off)}$		33		ns	
Fall time	t_f		18.2		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		1.78		nC	V_{DD} = 480V, I_D = 1.5A, V_{GS} = 0 to 10V
Gate to drain charge	Q_{gd}		5.5		nC	
Gate charge total	Q_g		10		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 = 1.5A, T_j = 25°C
Reverse recovery time	t_{rr}		50		ns	V_R = 400V, I_F = 1.5A, di_F/dt = 100A/µs (see table 16)
Reverse recovery charge	Q_{rr}		0.1		µC	
Peak reverse recovery current	I_{rrm}		3.2		A	

5 Electrical characteristics diagrams

Table 8

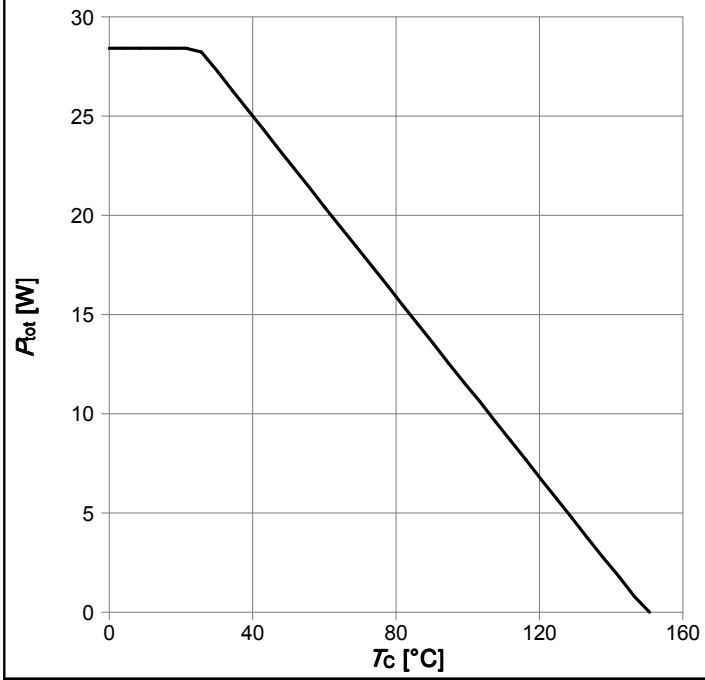
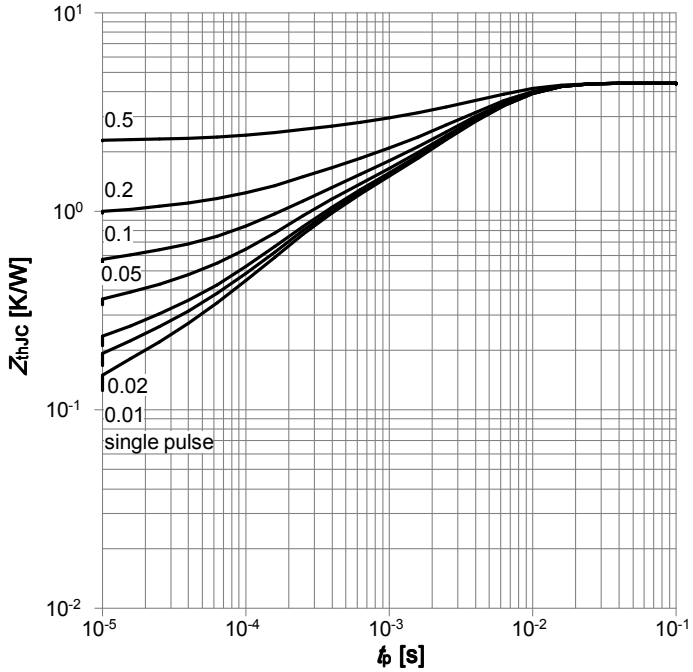
Power dissipation	Max. transient thermal impedance
	
P_{tot}=f(T_C)	Z_{thJC} =f(t_P); parameter: $D=t_p/T$

Table 9

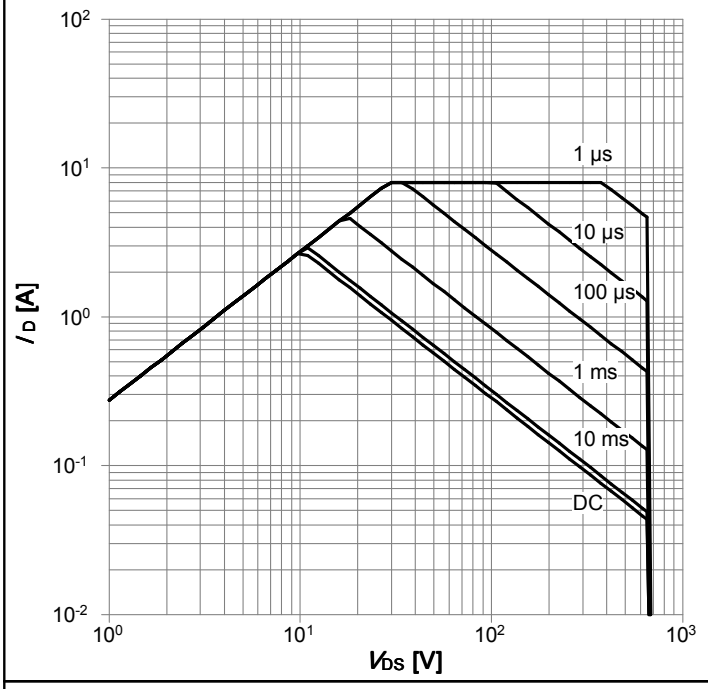
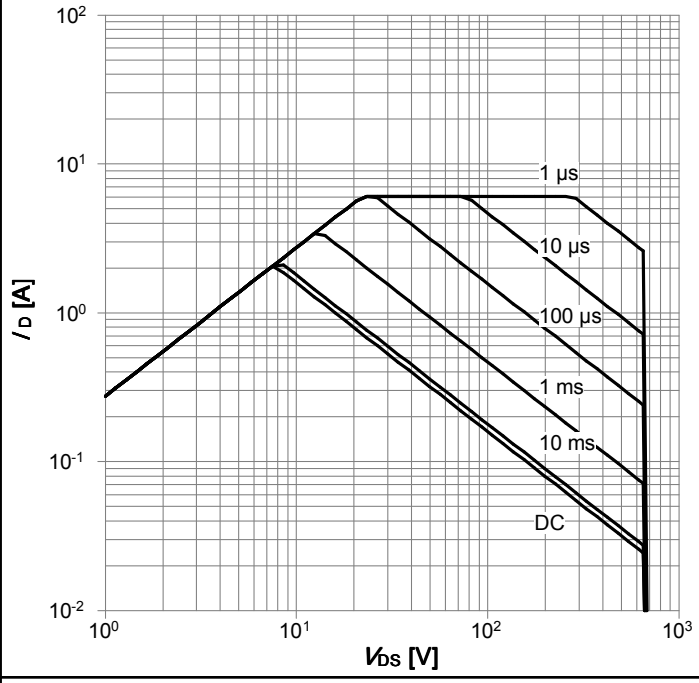
Safe operating area	Safe operating area
	
I_D=f(V_{DS}); T_C=25 °C; D=0; V_{GS}>7.5V; parameter: t_p	I_D=f(V_{DS}); T_C=80 °C; D=0; V_{GS}>7.5V; parameter: t_p

Table 10

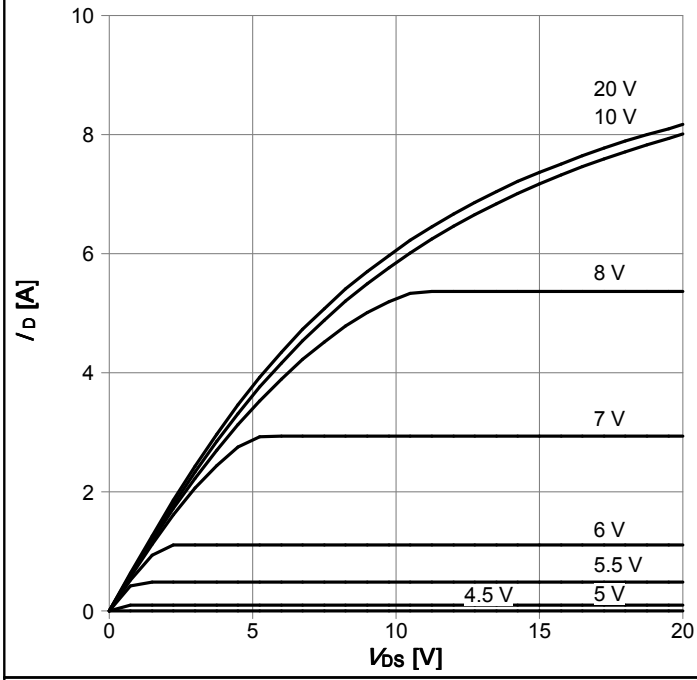
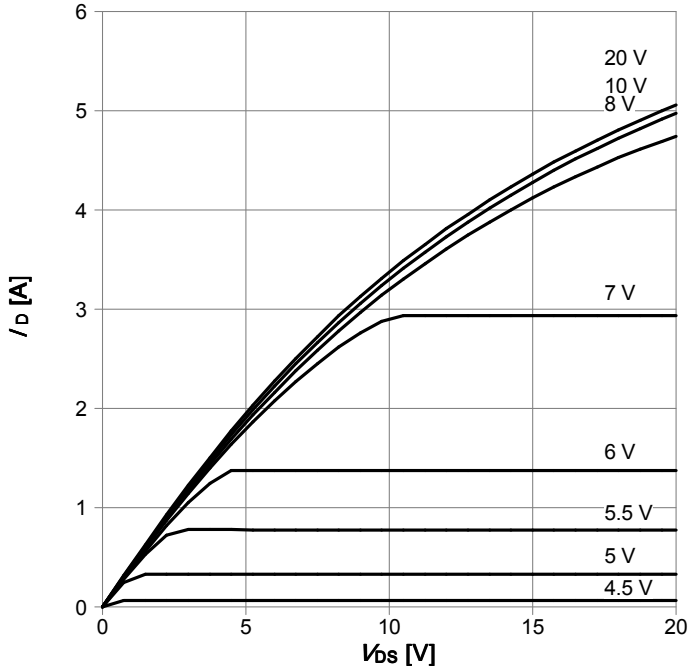
Typ. output characteristics	Typ. output characteristics
	
$I_D=f(V_{DS})$; T_j=25 °C; parameter: V_{GS}	$I_D=f(V_{DS})$; T_j=125 °C; parameter: V_{GS}

Table 11

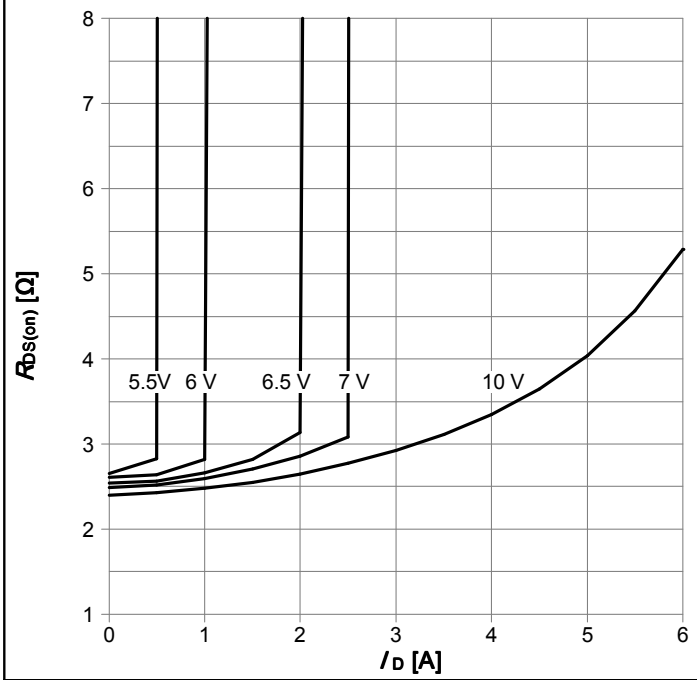
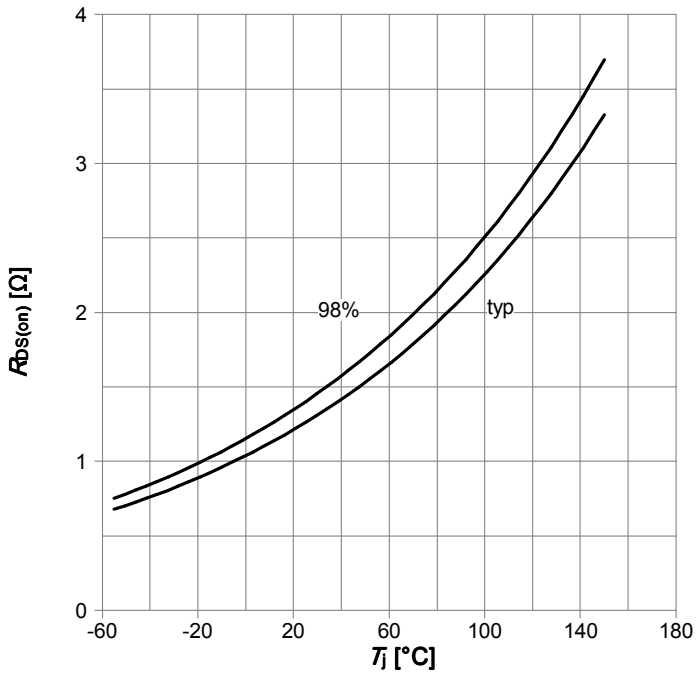
Typ. drain-source on-state resistance	Drain-source on-state resistance
	
$R_{DS(on)}=f(I_D)$; T_j=125 °C; parameter: V_{GS}	$R_{DS(on)}=f(T_j)$; I_D=1.0 A; V_{GS}=10 V

Table 12

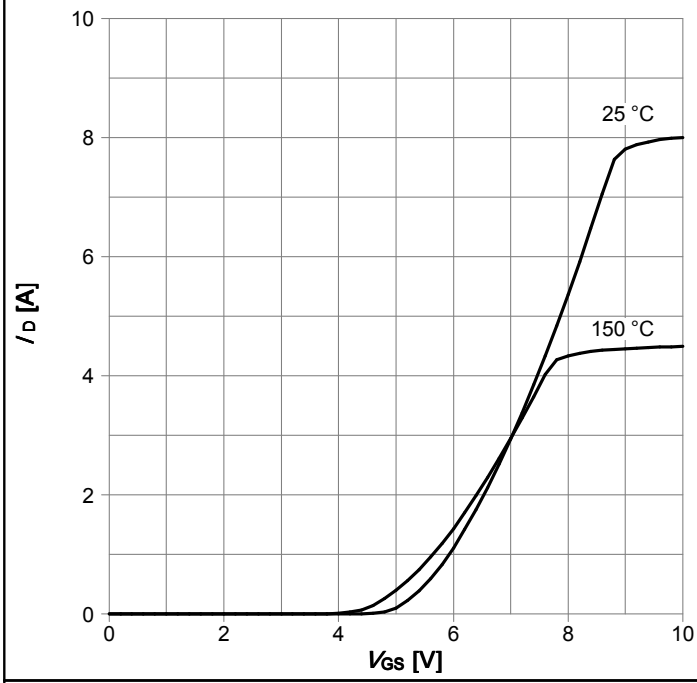
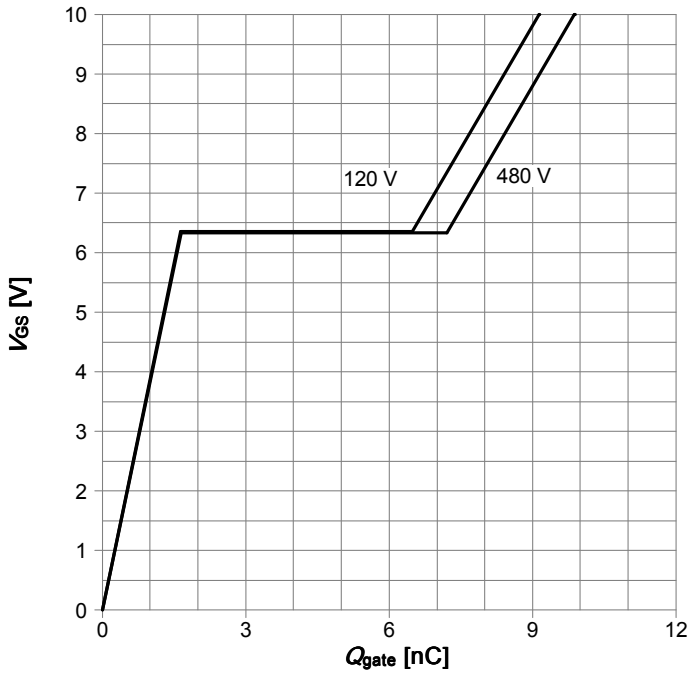
Typ. transfer characteristics	Typ. gate charge
	
I_D=f(V_{GS}); V_{DS} = 20V; parameter: T_j	V_{GS}=f(Q_{gate}); I_D=1.5 A pulsed; parameter: V_{DD}

Table 13

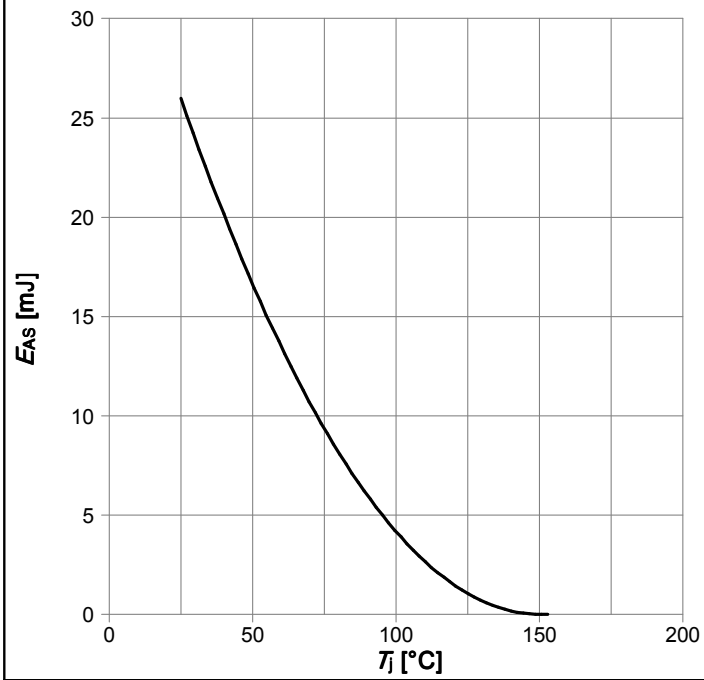
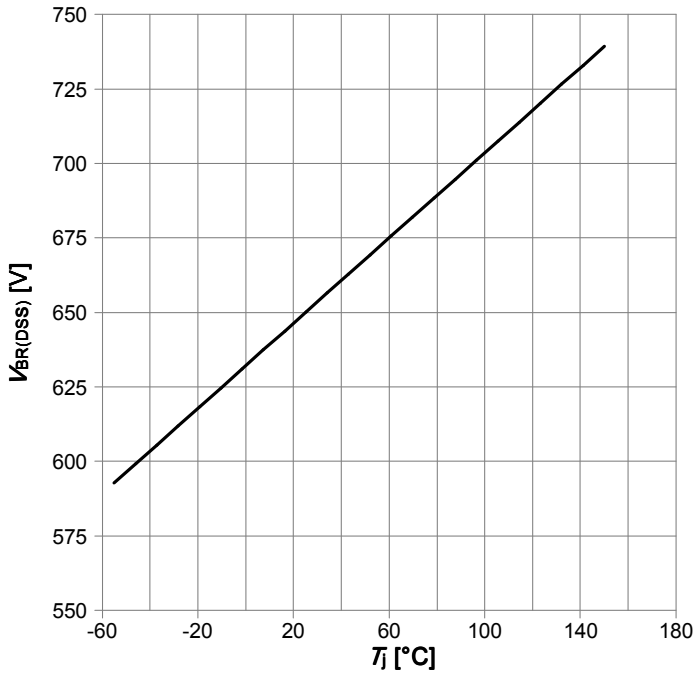
Avalanche energy	Drain-source breakdown voltage
	
E_{AS}=f(T_j); I_D=0.6 A; V_{DD}=50 V	$V_{BR(DSS)}$=f(T_j); I_D=1.0 mA

Table 14

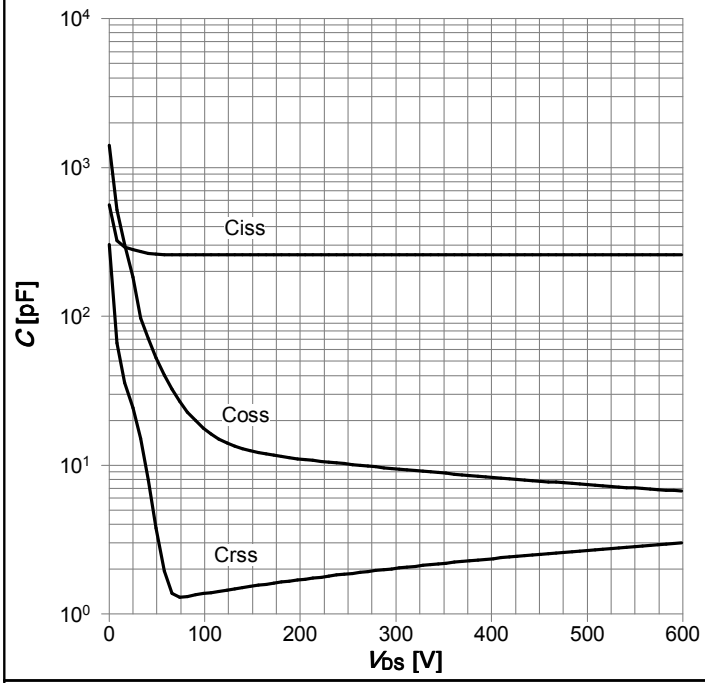
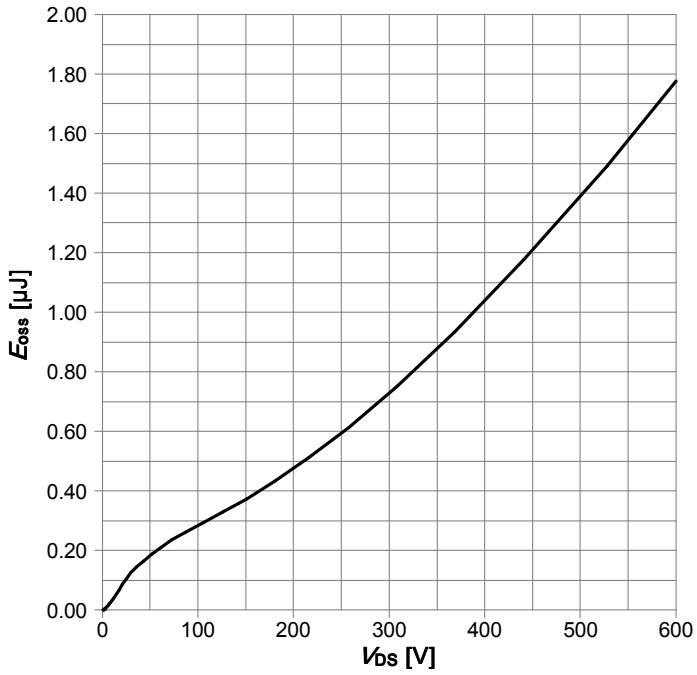
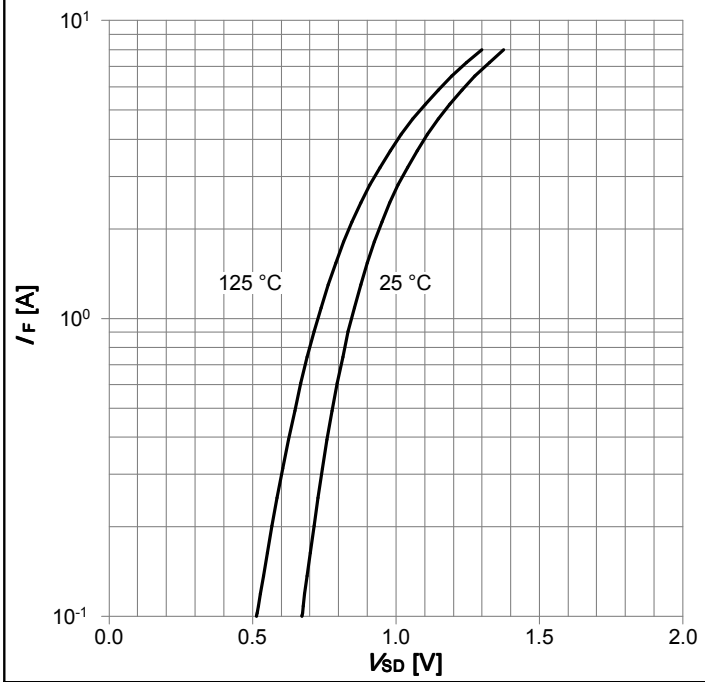
Typ. capacitances	Typ. Coss stored energy
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	E_{oss}=f(V_{DS})

Table 15

Forward characteristics of reverse diode

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

6 Test Circuits

Table 16 Diode characteristics

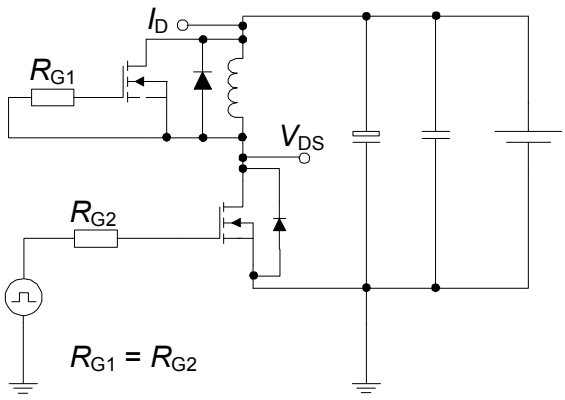
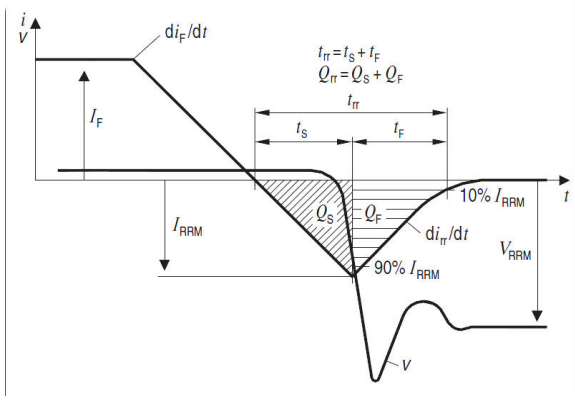
Test circuit for diode characteristics	Diode recovery waveform
	

Table 17 Switching times

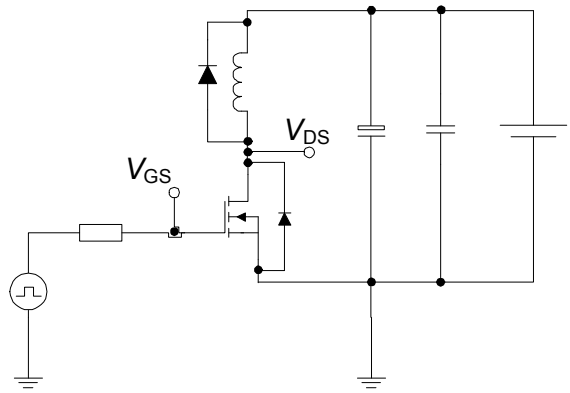
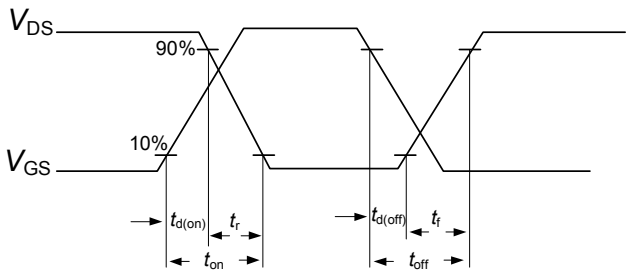
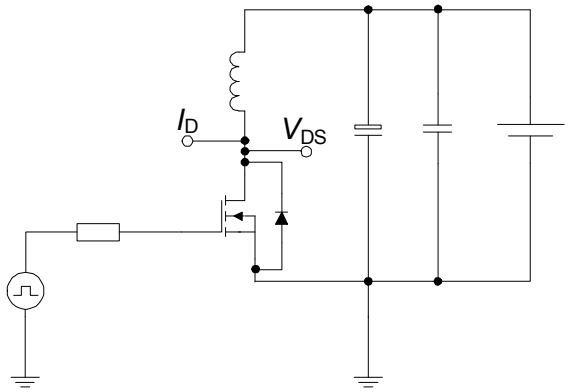
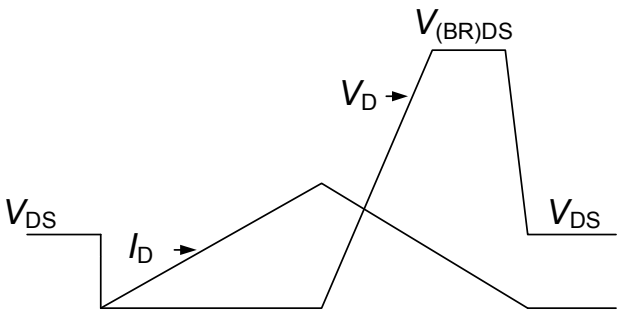
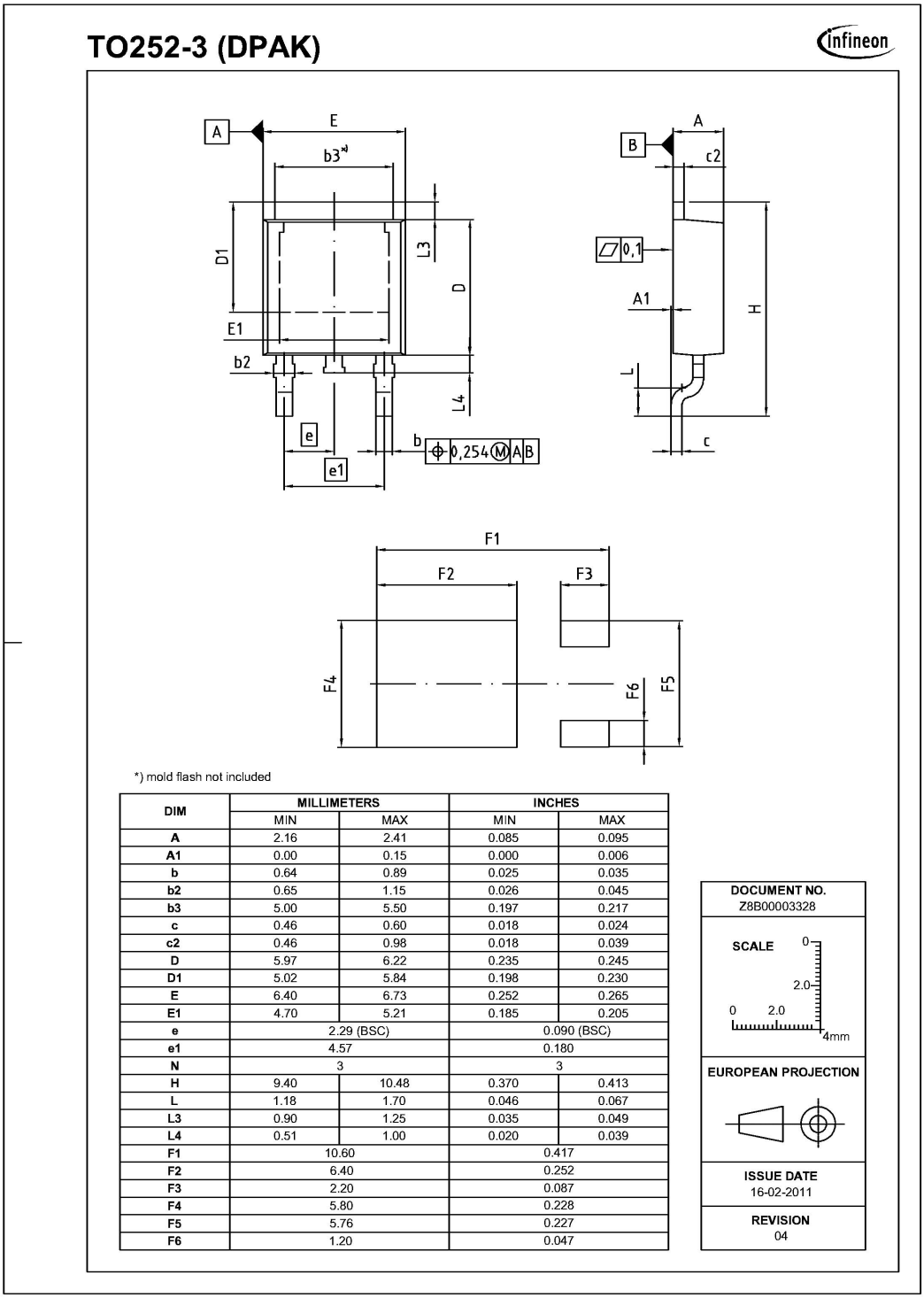
Switching times test circuit for inductive load	Switching times waveform
	

Table 18 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.21	0.185	0.205
e	2.29 (BSC)		0.090 (BSC)	
e1	4.57		0.180	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.70	0.046	0.067
L3	0.90	1.25	0.035	0.049
L4	0.51	1.00	0.020	0.039
F1	10.60		0.417	
F2	6.40		0.252	
F3	2.20		0.087	
F4	5.80		0.228	
F5	5.76		0.227	
F6	1.20		0.047	

Figure 1 Outline PG-TO 252, dimensions in mm/inches

8 Appendix A

Table 19 Related Links

- **IFX Design Tools:**
  http://www.infineon.com/cms/en/product/promopages/designtools/index.html
- **IFX CoolMOS Webpage:**
  http://www.infineon.com/cms/en/product/channel.html?channel=ff80808112ab681d0112ab6a628704d8

Revision History

IPD65R1K4CFD

Revision History: 2013-07-31, Rev. 2.1

Previous Revision: 2.0		
Revision	Date	Subjects (major changes since last revision)
2.0	2012-07-17	Release of final version
2.1	2013-07-31	Update halogen free mold compound status

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