MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

800V CoolMOS™ CE Power Transistor
IPx80R1K4CE

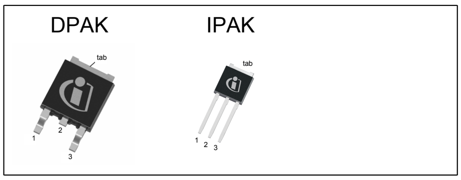
Data Sheet

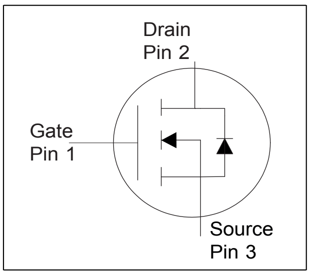
Rev. 2.1
Final

Power Management & Multimarket

1 Description

CoolMOS™ CE is a revolutionary technology for high voltage power MOSFETs. The high voltage capability combines safety with performance and ruggedness to allow stable designs at highest efficiency level. CoolMOS™ 800V CE comes with a selected package choice offering the benefit of reduced system costs and higher power density designs.





Features [1)]

• High voltage technology
• Extreme dv/dt rated
• High peak current capability
• Low gate charge
• Low effective capacitances
• Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)
• Pb-free lead plating; RoHS compliant; available with halogen free and non-halogen free mold compound[1)]

Benefits

• Increased power density solutions due to smaller package
• System cost / size savings due to reduced cooling requirements
• Higher system reliability due to low operating temperatures

Applications

• LED Lighting for retrofit applications in QR Flyback topology

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j=25°C}$	800	V
$R_{DS(on),max}$	1.4	Ω
$Q_{g,typ}$	23	nC
$I_{D,pulse}$	12	A
$V_{GS(th),typ}$	3	V
$C_{O(tr),typ}$	51	pF

Type / Ordering Code	Package	Marking	Related Links
IPD80R1K4CE	PG-TO 252	8R1K4CE	see Appendix A
IPU80R1K4CE	PG-TO 251		

[1)] Halogen free version is available with OPN: IPD80R1K4CEAT

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	- -	- -	3.9 2.3	A	T_C = 25°C T_C = 100°C
Pulsed drain current [2]	$I_{D,pulse}$	-	-	12	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	170	mJ	I_D =1.2A; V_{DD} = 50V
Avalanche energy, repetitive	E_{AR}	-	-	0.14	mJ	I_D =1.2A; V_{DD} = 50V
Avalanche current, repetitive	I_{AR}	-	-	1.2	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS} =0...640V
Gate source voltage	V_{GS}	-20 -30	- -	20 30	V	static; AC (f>1 Hz)
Power dissipation (non FullPAK) TO-252, TO-251	P_{tot}	-	-	63	W	T_C = 25°C
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°C	-
Continuous diode forward current	I_S	-	-	3.9	A	T_C = 25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	12	A	T_C = 25°C
Reverse diode dv/dt [3]	dv/dt	-	-	4	V/ns	V_{DS} =0...400V, $I_{SD} \leq I_S$, T_j=25°C
Maximum diode commutation speed	di_f/dt	-	-	400	A/µs	V_{DS} =0...400V, $I_{SD} \leq I_S$, T_j=25°C

3 Thermal characteristics

Table 3 Thermal characteristics DPAK, IPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	2	°C/W	-
Thermal resistance, junction - ambient [4]	R_{thJA}	- -	- 35	62 -	°C/W	SMD version, device on PCB, minimal footprint SMD version, device on PCB, 6cm² cooling area[4]
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}	-	-	260	°C	reflow MSL 1

[1] Limited by $T_{j\,max}$.
[2] Pulse width t_p limited by $T_{j,max}$
[3] Identical low side and high side switch with identical R_G
[4] 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

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	800	-	-	V	V_{GS}=0V, I_D=0.25mA
Gate threshold voltage	$V_{(GS)th}$	2.1	3	3.9	V	V_{DS}=V_{GS}, I_D=0.24mA
Zero gate voltage drain current	I_{DSS}	- -	- 50	10 -	µA	V_{DS}=800V, V_{GS}=0V, T_j=25°C V_{DS}=800V, 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	$R_{DS(on)}$	- -	1.2 3.2	1.4 -	Ω	V_{GS}=10V, I_D=2.3A, T_j=25°C V_{GS}=10V, I_D=2.3A, T_j=150°C
Gate resistance	R_G	-	1.2	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	570	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	25	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related [1]	$C_{o(er)}$	-	19	-	pF	V_{GS}=0V, V_{DS}=0...480V
Effective output capacitance, time related [2]	$C_{o(tr)}$	-	51	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...480V
Turn-on delay time	$t_{d(on)}$	-	25	-	ns	V_{DD}=400V, V_{GS}=0/10V, I_D=3.9A, R_G=22Ω
Rise time	t_r	-	15	-	ns	V_{DD}=400V, V_{GS}=0/10V, I_D=3.9A, R_G=22Ω
Turn-off delay time	$t_{d(off)}$	-	72	-	ns	V_{DD}=400V, V_{GS}=0/10V, I_D=3.9A, R_G=22Ω
Fall time	t_f	-	12	-	ns	V_{DD}=400V, V_{GS}=10 V, I_D=3.9A, R_G=22Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	3	-	nC	V_{DD}=640V, I_D=3.9A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	12	-	nC	V_{DD}=640V, I_D=3.9A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	23	-	nC	V_{DD}=640V, I_D=3.9A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.5	-	V	V_{DD}=640V, I_D=3.9A, V_{GS}=0 to 10V

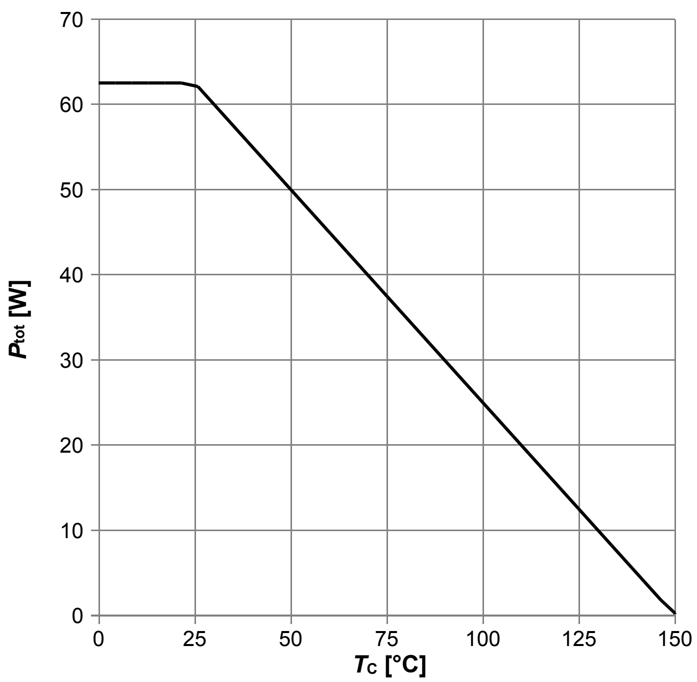
[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1	1.2	V	V_{GS}=0V, I_F=3.9A, T_j=25°C
Reverse recovery time	t_{rr}	-	520	-	ns	V_R=400V, I_F=3.9A, di_F/dt=100A/µs
Reverse recovery charge	Q_{rr}	-	4	-	µC	V_R=400V, I_F=3.9A, di_F/dt=100A/µs
Peak reverse recovery current	I_{rrm}	-	12	-	A	V_R=400V, I_F=3.9A, di_F/dt=100A/µs

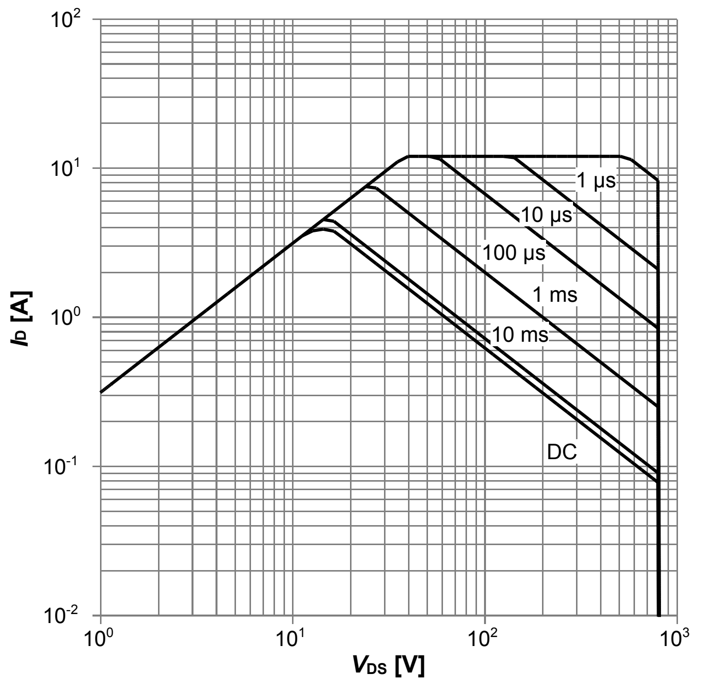
5 Electrical characteristics diagrams

Diagram 1: Power dissipation



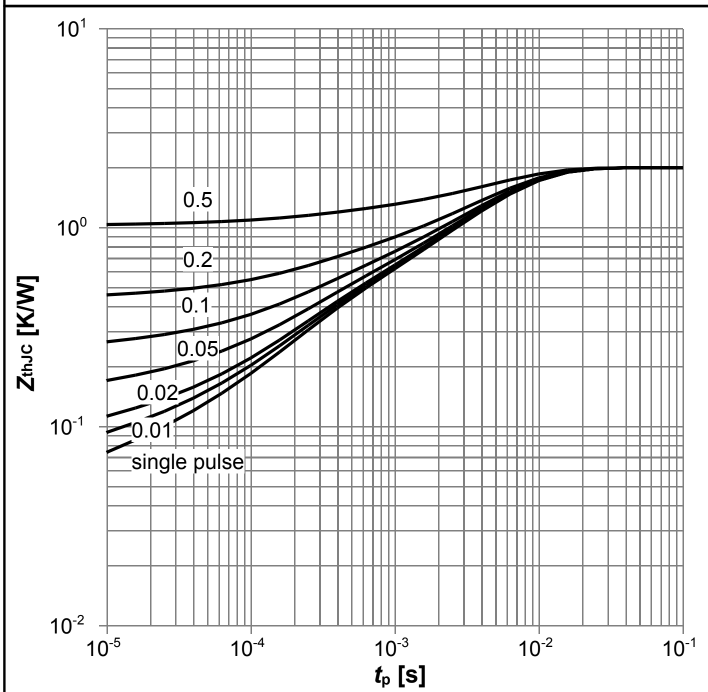
P_{tot}=f(T_C)

Diagram 2: Safe operating area



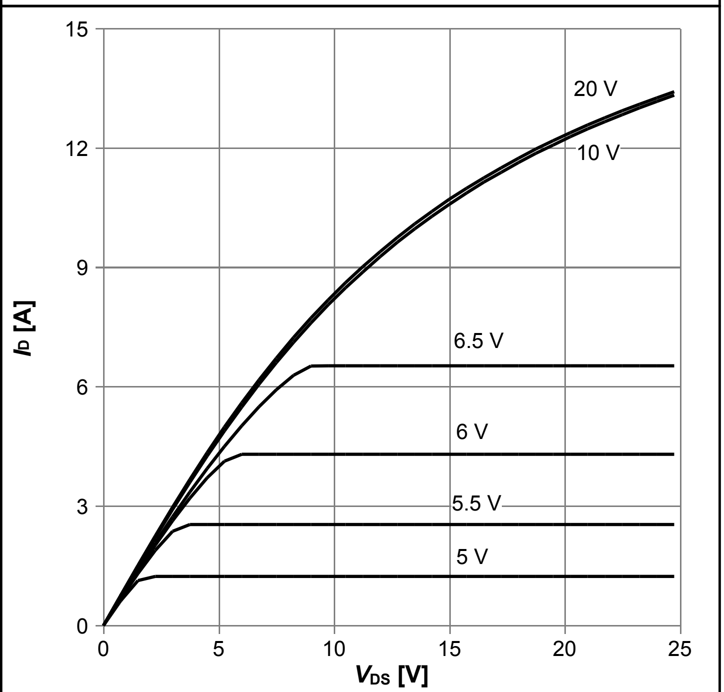
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 3: Max. transient thermal impedance



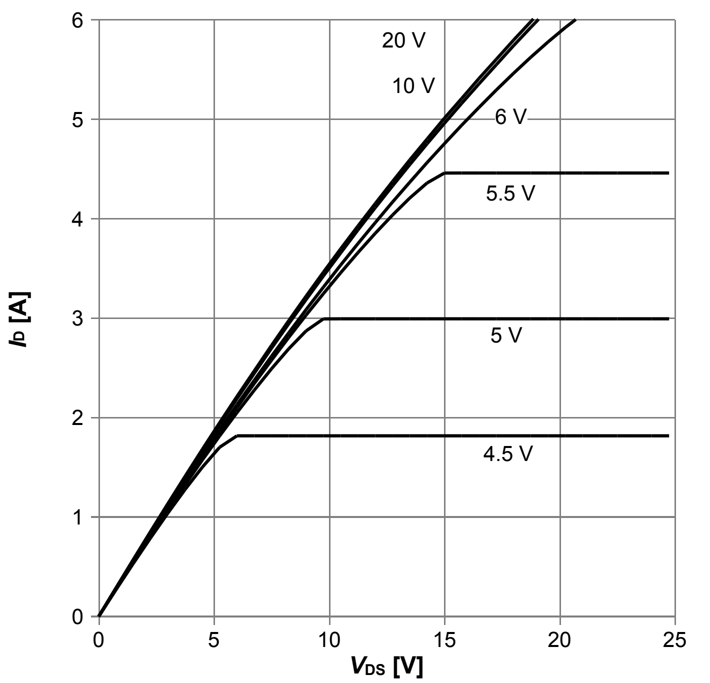
Z_{thJC}=f(t_P); parameter: D=t_p/T

Diagram 4: Typ. output characteristics



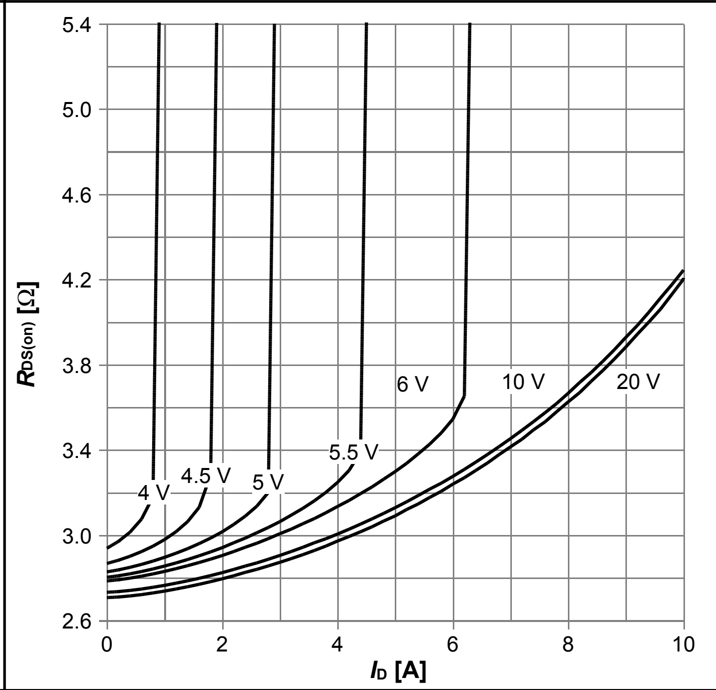
I_D=f(V_{DS}); T_j=25 °C; t_p=10 µs; parameter: V_{GS}

Diagram 5: Typ. output characteristics



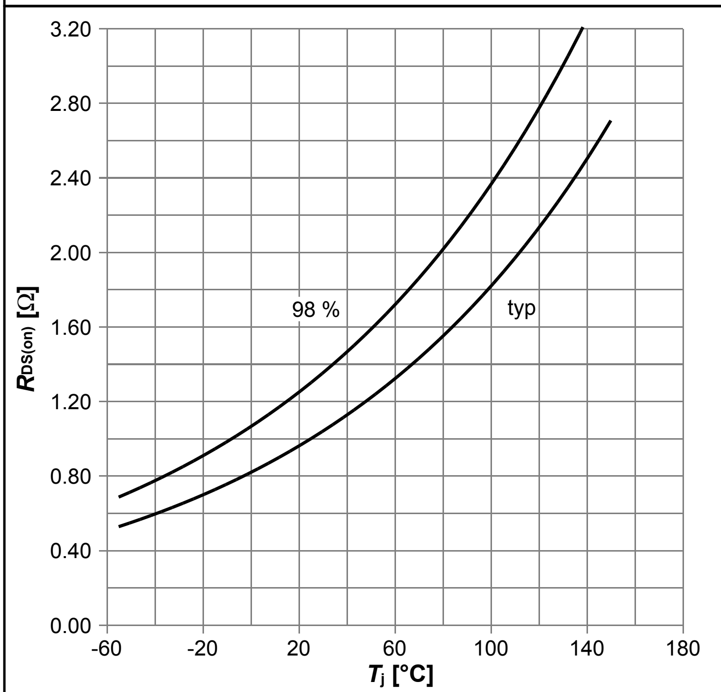
I_D=f(V_{DS}); T_j=150 °C; t_p=10 µs; parameter: V_{GS}

Diagram 6: Typ. drain-source on-state resistance



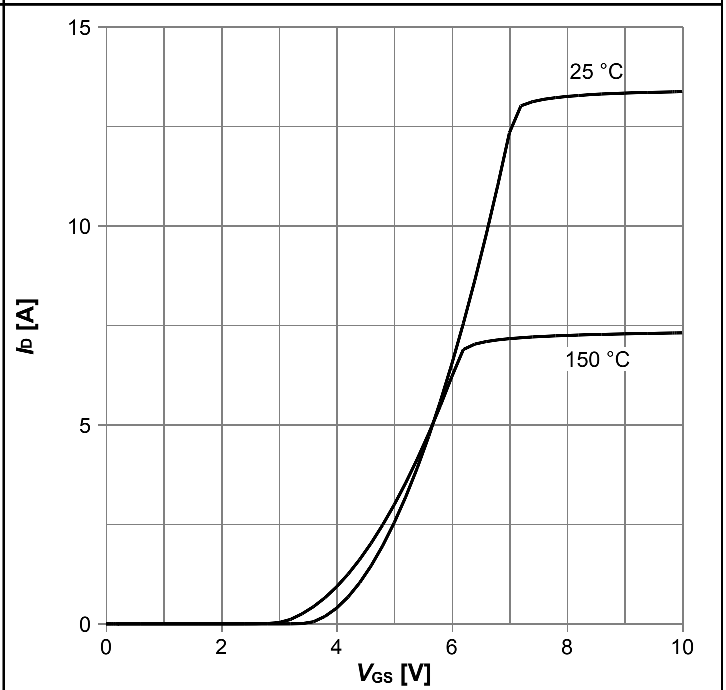
$R_{DS(on)}$=f(I_D); T_j=150 °C; parameter: V_{GS}

Diagram 7: Drain-source on-state resistance



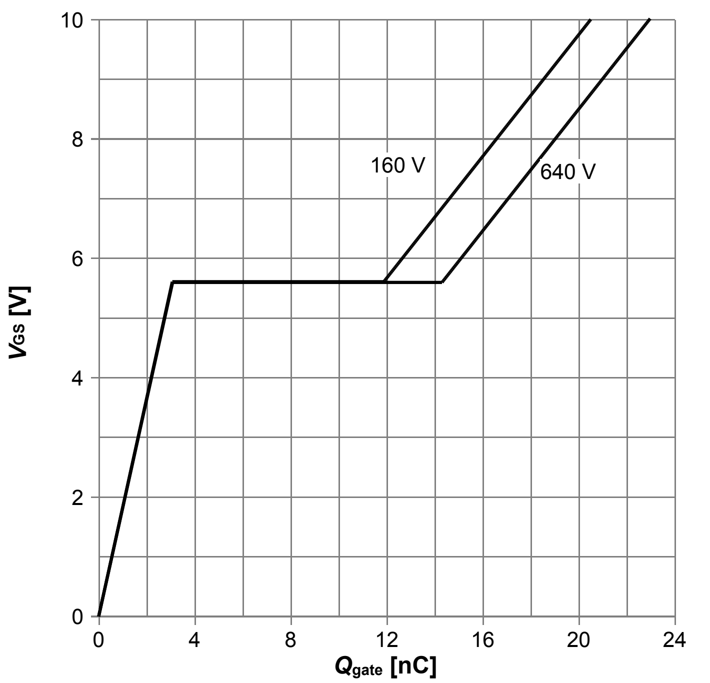
$R_{DS(on)}$=f(T_j); I_D=2.3 A; V_{GS}=10 V

Diagram 8: Typ. transfer characteristics



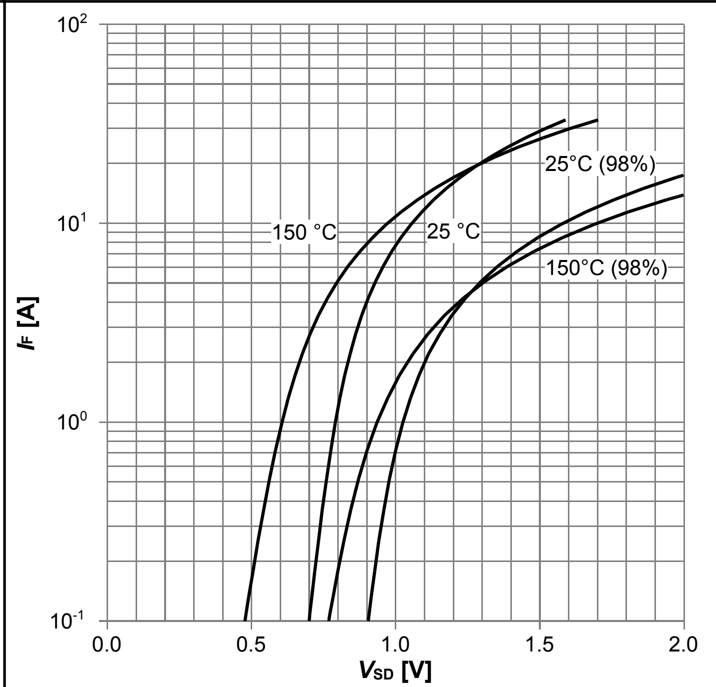
I_D=f(V_{GS}); |V_{DS}|>2|I_D|$R_{DS(on)max}$; t_p=10 µs; parameter: T_j

Diagram 9: Typ. gate charge



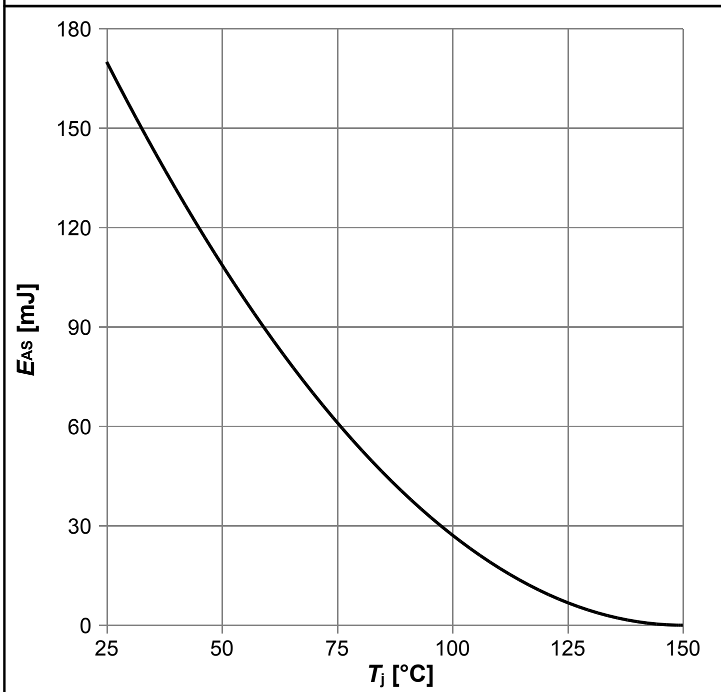
V_{GS}=f(Q_{gate}); I_D=3.9 A pulsed; parameter: V_{DD}

Diagram 10: Forward characteristics of reverse diode



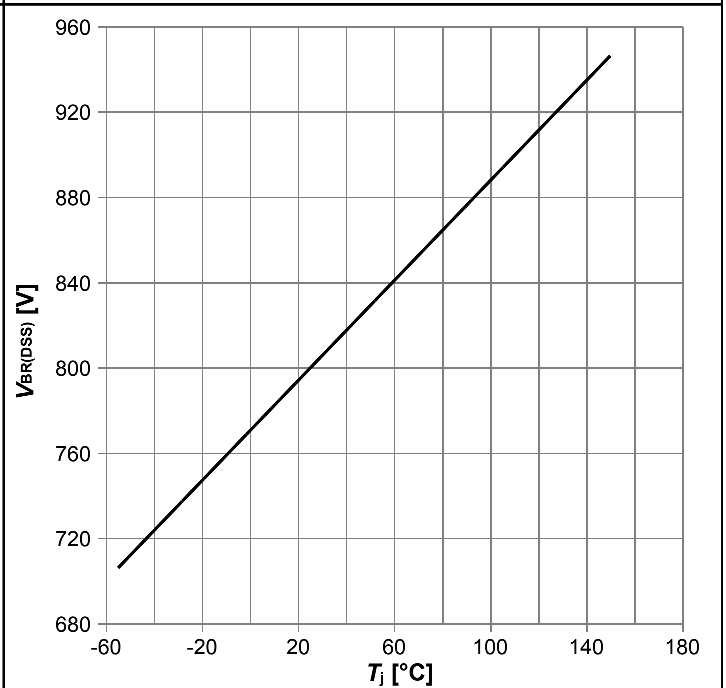
I_F=f(V_{SD}); t_p=10 µs; parameter: T_j

Diagram 11: Avalanche energy

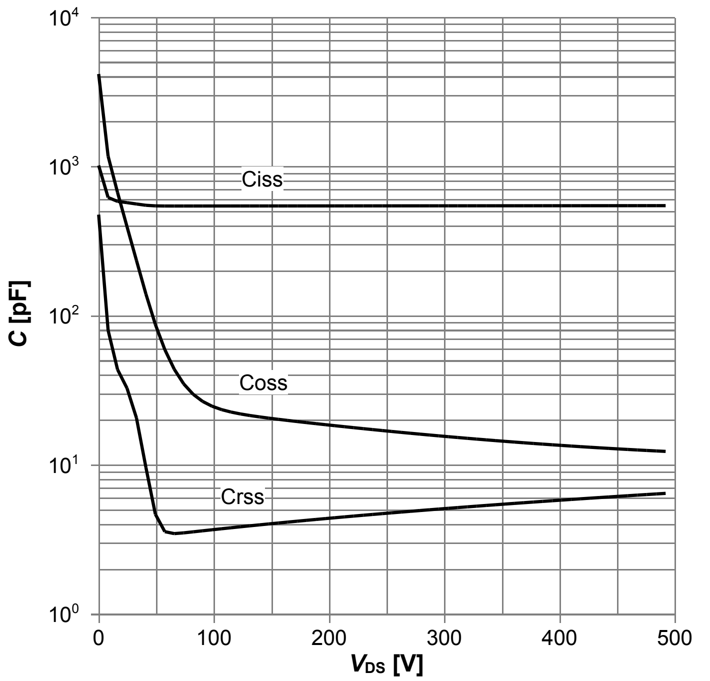
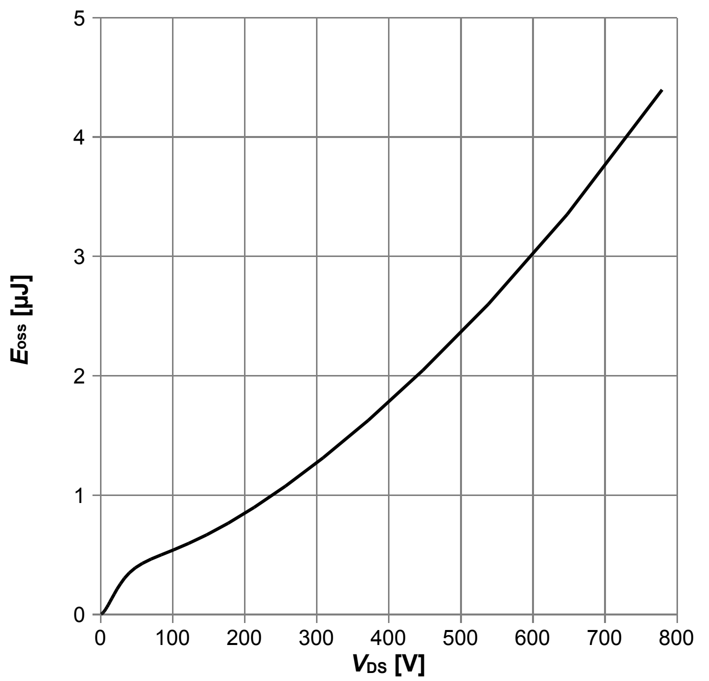


E_{AS}=f(T_j); I_D=1.2 A; V_{DD}=50 V

Diagram 12: Drain-source breakdown voltage



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

Diagram 13: Typ. capacitances	Diagram 14: Typ. Coss stored energy
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	E_{oss}=f(V_{DS})

6 Test Circuits

Table 8 Diode characteristics

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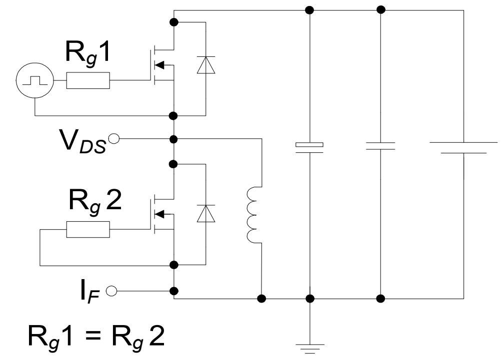
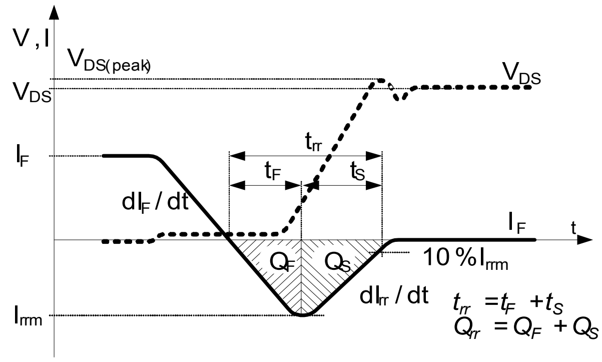
<tr><th>Test circuit for diode characteristics</th><th>Diode recovery waveform</th></tr>
<tr><td>
</td><td>
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Table 9 Switching times

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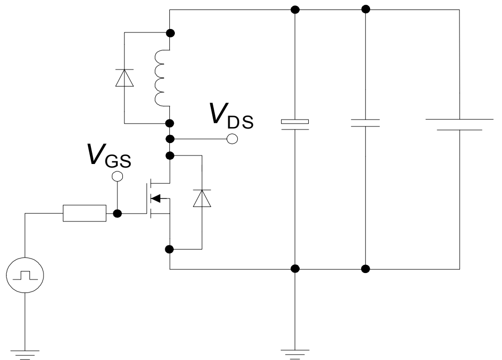
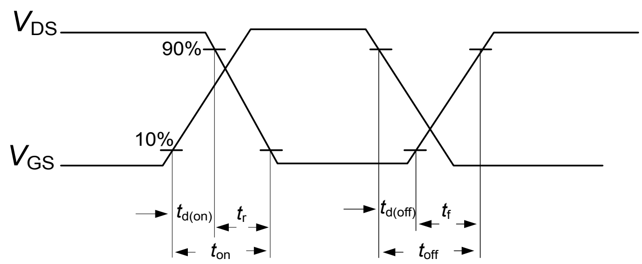
<tr><th>Switching times test circuit for inductive load</th><th>Switching times waveform</th></tr>
<tr><td>
</td><td>
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Table 10 Unclamped inductive load

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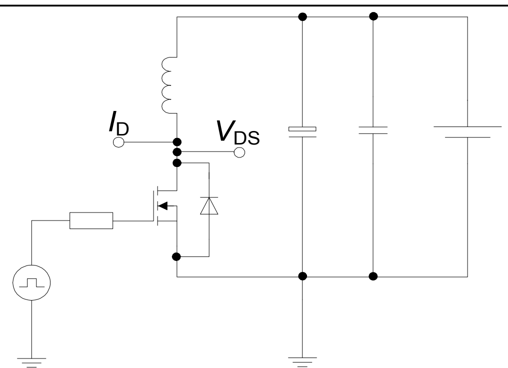
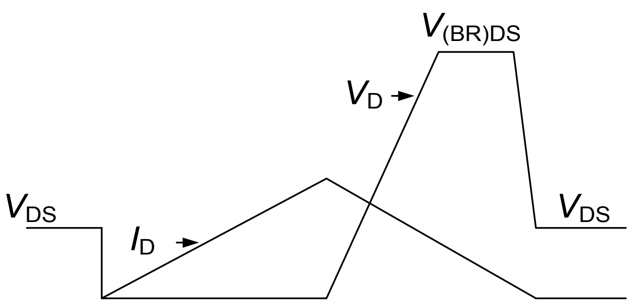
<tr><th>Unclamped inductive load test circuit</th><th>Unclamped inductive waveform</th></tr>
<tr><td>
</td><td>
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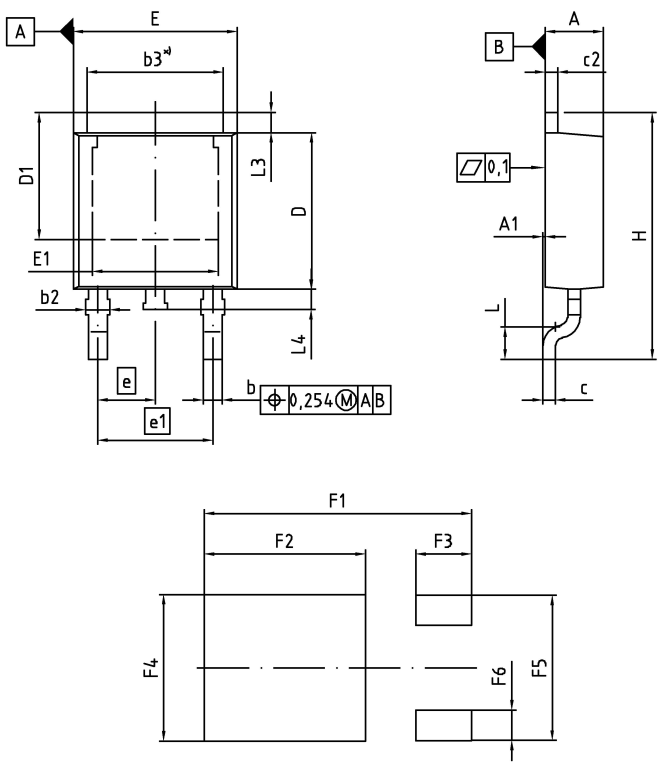
7 Package Outlines

TO252-3 (DPAK)



*) mold flash not included

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	

DOCUMENT NO.
Z8B00003328

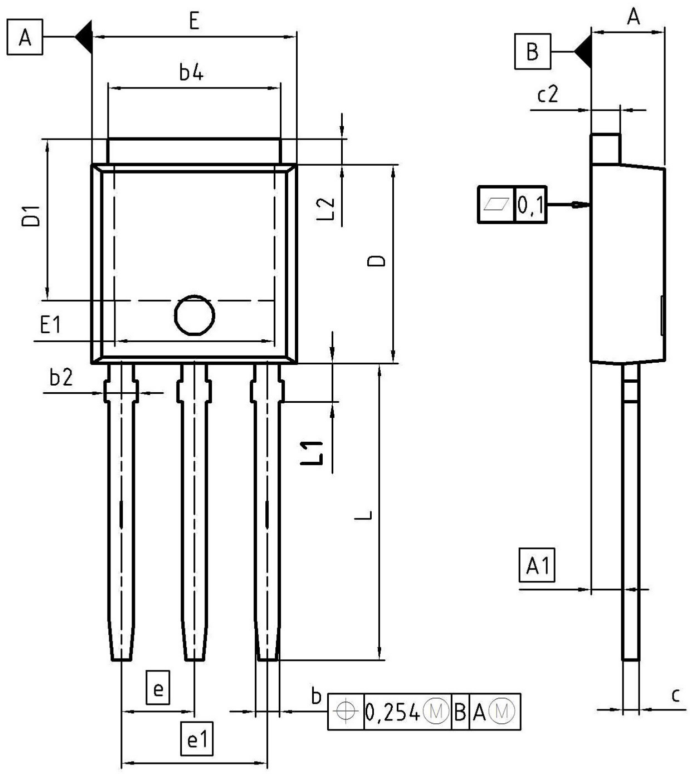
SCALE
0 2.0 4mm

EUROPEAN PROJECTION

ISSUE DATE
16-02-2011

REVISION
04

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



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.90	1.14	0.035	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	0.60	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	5.04	5.77	0.198	0.227
E	6.35	6.73	0.250	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
L	8.89	9.65	0.350	0.380
L1	1.90	2.29	0.075	0.090
L2	0.89	1.37	0.035	0.054

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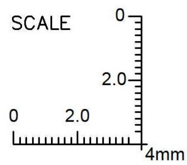

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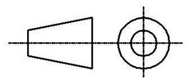

ISSUE DATE
19-03-2008

REVISION
03

Figure 2 Outline PG-TO 251, 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

IPD80R1K4CE, IPU80R1K4CE

Revision: 2013-07-18, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2013-06-24	Release of final version
2.1	2013-07-18	updtae to halogen free mold compound

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Edition 2011-08-01
Published by
Infineon Technologies AG
81726 München, Germany

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