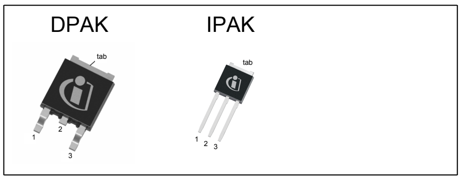
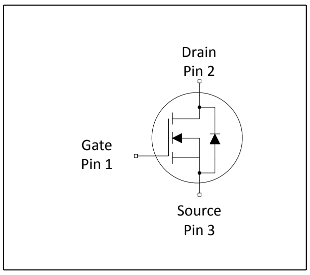
MOSFET

500V CoolMOS™ CE Power Transistor

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE is a price-performance optimized platform enabling to target cost sensitive applications in Consumer and Lighting markets by still meeting highest efficiency standards. The new series provides all benefits of a fast switching Superjunction MOSFET while not sacrificing ease of use and offering the best cost down performance ratio available on the market.





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 standard grade applications

Applications

PFC stages, hard switching PWM stages and resonant switching stages for e.g. PC Silverbox, Adapter, LCD & PDP TV and indoor lighting.

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

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	550	V
$R_{DS(on),max}$	1.4	Ω
I_D	4.8	A
$Q_{g.typ}$	8.2	nC
$I_{D,pulse}$	8.8	A
E_{oss}@400V	0.79	µJ

Type / Ordering Code	Package	Marking	Related Links
IPD50R1K4CE	PG-TO 252	50S1K4CE	see Appendix A
IPU50R1K4CE	PG-TO 251		

Table of Contents

Description . . . 1
Maximum ratings . . . 3
Thermal characteristics . . . 3
Electrical characteristics . . . 4
Electrical characteristics diagrams . . . 6
Test Circuits . . . 10
Package Outlines . . . 11
Appendix A . . . 13
Revision History . . . 14
Trademarks . . . 14
Disclaimer . . . 14

1 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	- -	- -	4.8 3.1	A	T_C = 25°C T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	8.8	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	49	mJ	I_D =1.1A; V_{DD} = 50V
Avalanche energy, repetitive	E_{AR}	-	-	0.07	mJ	I_D =1.1A; V_{DD} = 50V
Avalanche current, repetitive	I_{AR}	-	-	1.1	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS} =0...400V
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}	-	-	42	W	T_C=25°C
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°C	-
Continuous diode forward current	I_S	-	-	3.4	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	8.8	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, t_{cond}<2µs
Maximum diode commutation speed[3]	di_f/dt	-	-	500	A/µs	V_{DS} =0...400V, I_{SD}<=I_S, T_j=25°C, t_{cond}<2µs

2 Thermal characteristics

Table 3 Thermal characteristics DPAK, IPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	2.95	°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 $T_{j\,max}$. Maximum duty cycle D=0.5
[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] 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.

3 Electrical characteristics

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	500	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.50	3	3.50	V	V_{DS}=V_{GS}, I_D=0.07mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=500V, V_{GS}=0V, T_j=25°C V_{DS}=500V, 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	$R_{DS(on)}$	- -	1.26 3.28	1.40 -	Ω	V_{GS}=13V, I_D=0.9A, T_j=25°C V_{GS}=13V, I_D=0.9A, T_j=150°C
Gate resistance	R_G	-	7	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	178	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	11	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	10	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	36	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	6.5	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=1.1A, R_G=5.3Ω
Rise time	t_r	-	6	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=1.1A, R_G=5.3Ω
Turn-off delay time	$t_{d(off)}$	-	23	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=1.1A, R_G=5.3Ω
Fall time	t_f	-	30	-	ns	V_{DD}=400V, V_{GS}=13 V, I_D=1.1A, R_G=5.3Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	1	-	nC	V_{DD}=400V, I_D=1.1A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	4.6	-	nC	V_{DD}=400V, I_D=1.1A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	8.2	-	nC	V_{DD}=400V, I_D=1.1A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	V_{DD}=400V, I_D=1.1A, V_{GS}=0 to 10V

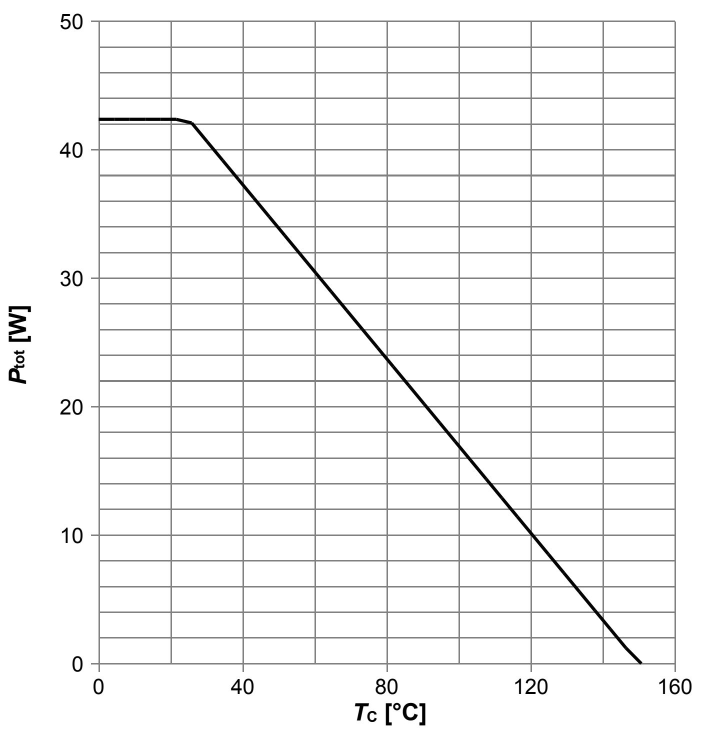
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.83	-	V	V_{GS}=0V, I_F=1.1A, T_f=25°C
Reverse recovery time	t_{rr}	-	120	-	ns	V_R=400V, I_F=1.1A, di_F/dt=100A/µs
Reverse recovery charge	Q_{rr}	-	0.5	-	µC	V_R=400V, I_F=1.1A, di_F/dt=100A/µs
Peak reverse recovery current	I_{rrm}	-	6.8	-	A	V_R=400V, I_F=1.1A, di_F/dt=100A/µs

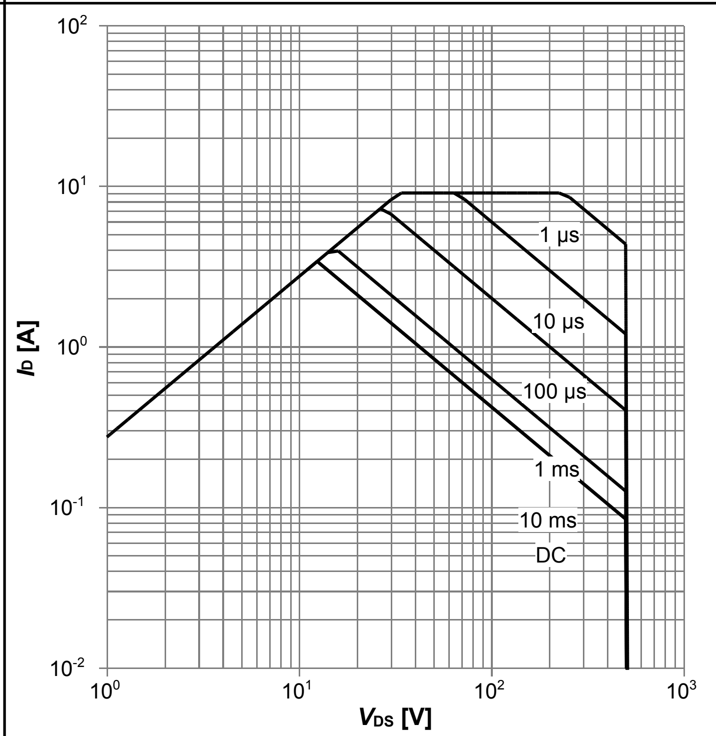
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



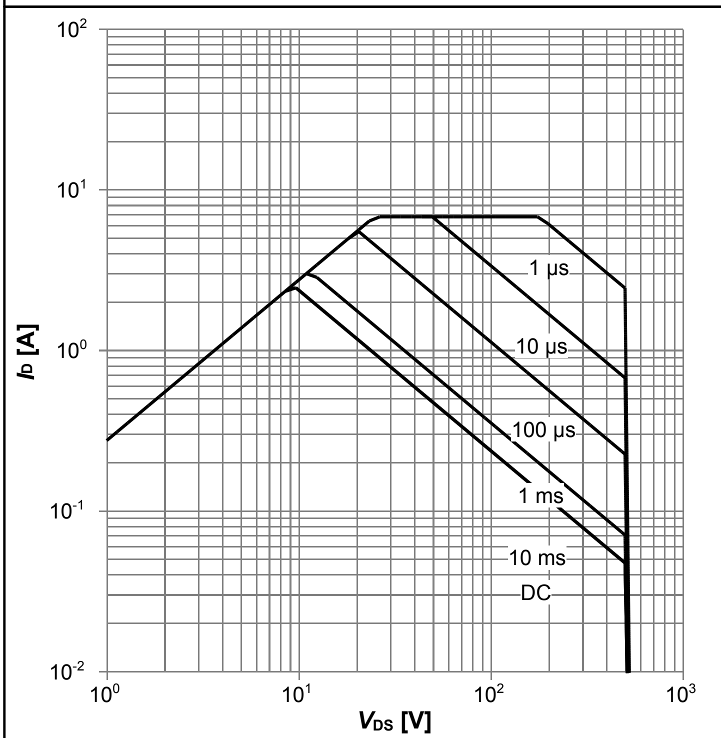
P_{tot}=f(T_C)

Diagram 2: Safe operating area



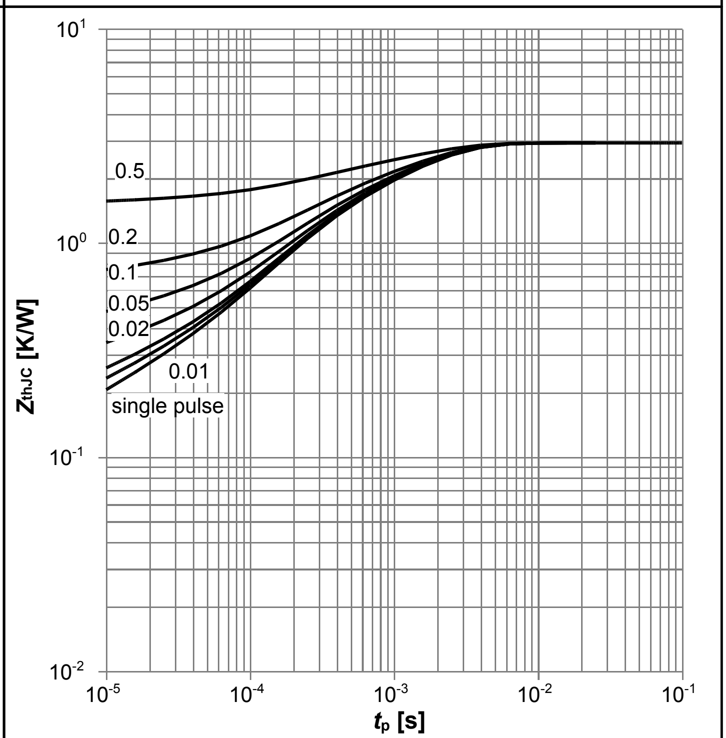
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



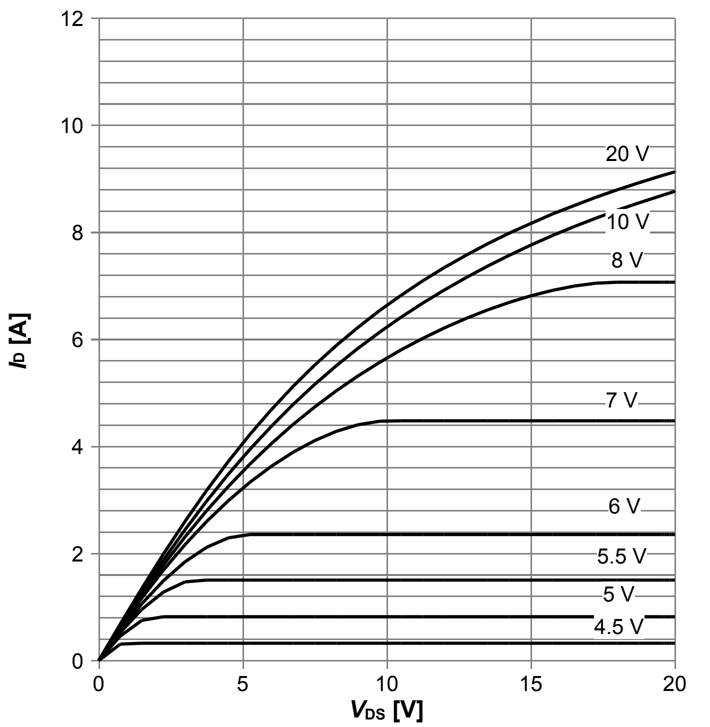
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



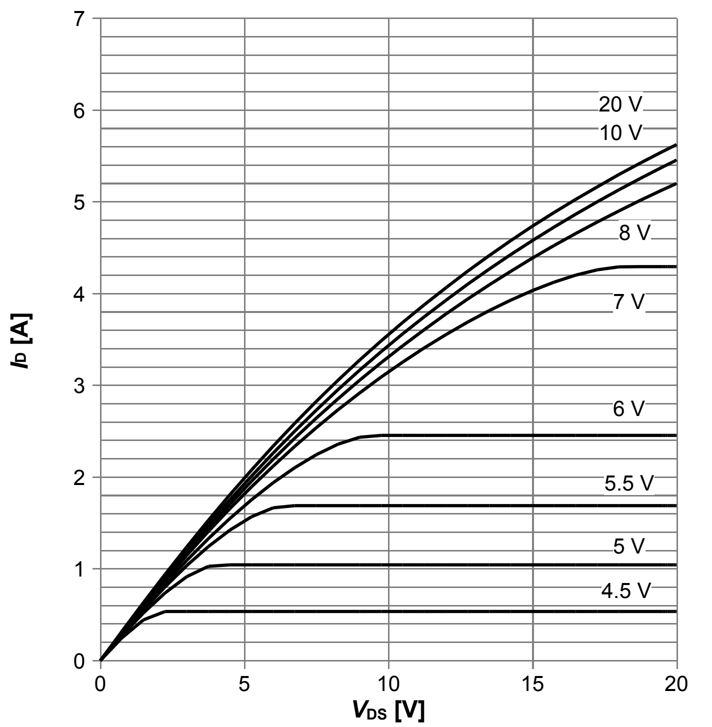
Z_{thJC} =f(t_P); parameter: D=t_p/T

Diagram 5: Typ. output characteristics Tj=25°C



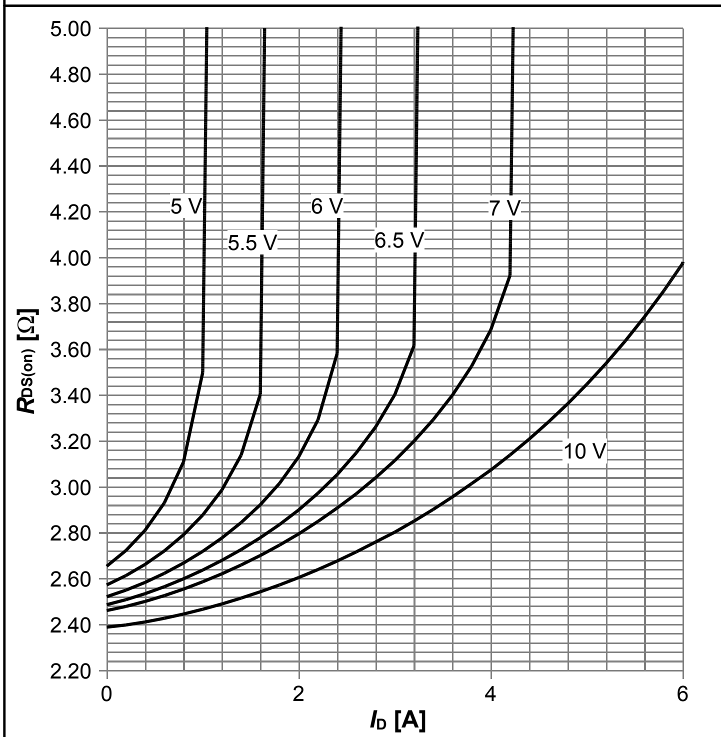
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics Tj=125°C



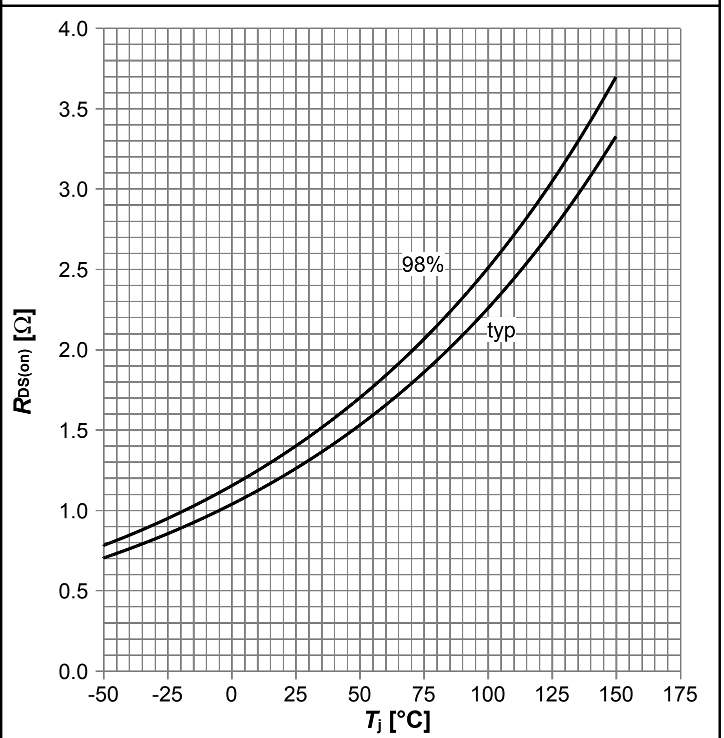
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

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



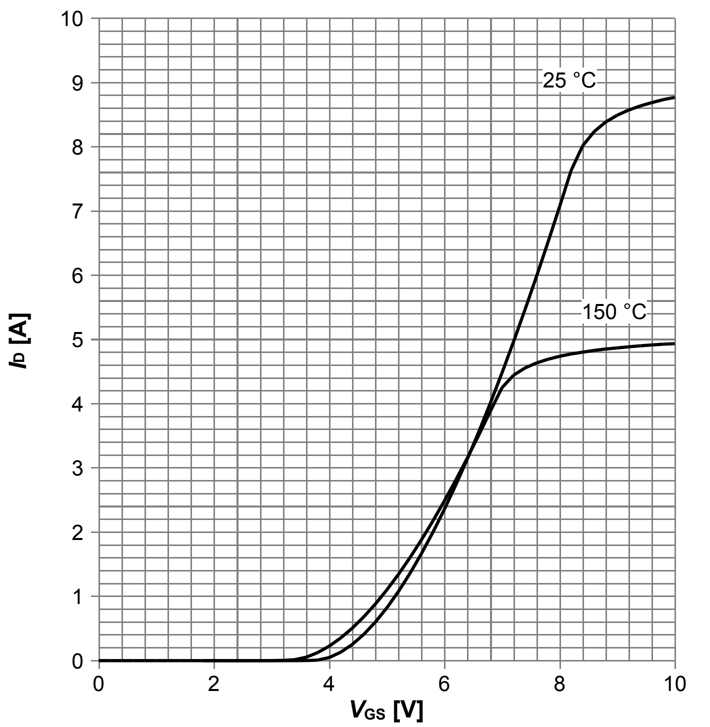
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



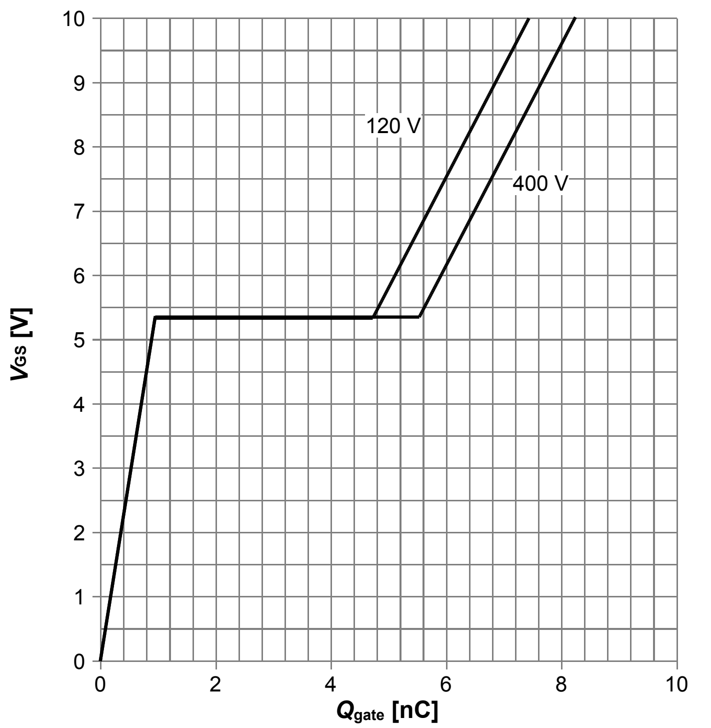
$R_{DS(on)}$=f(T_j); I_D=0.9 A; V_{GS}=13 V

Diagram 9: Typ. transfer characteristics



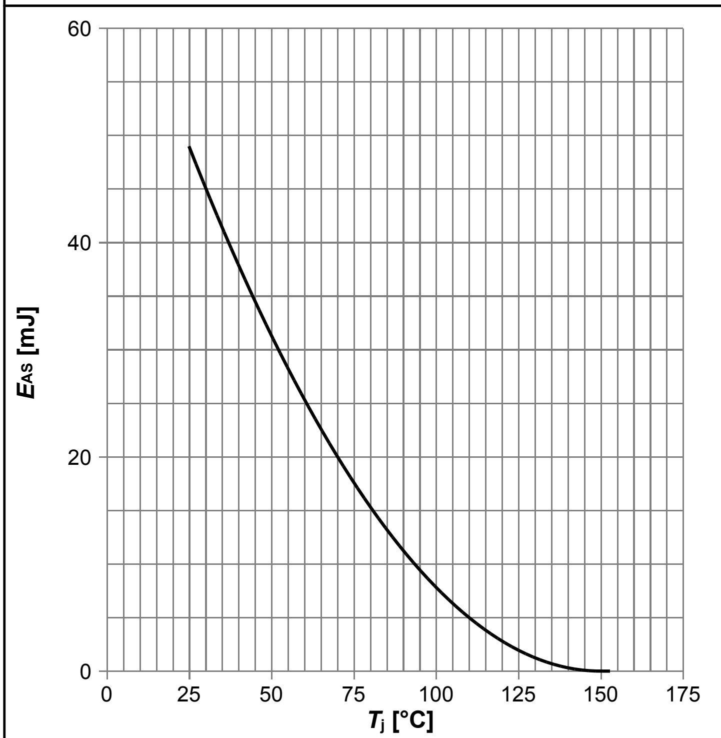
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



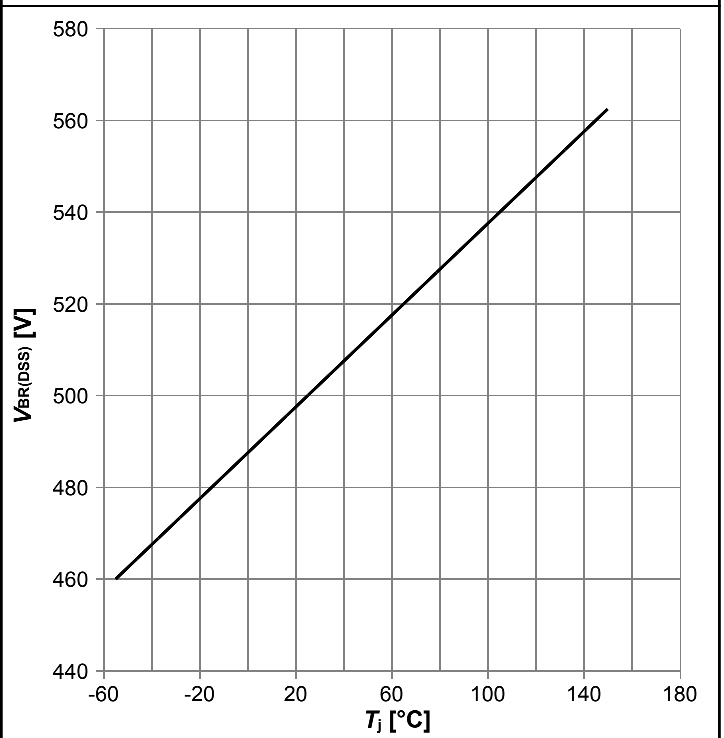
V_{GS}=f(Q_{gate}); I_D=1.1 A pulsed; parameter: V_{DD}

Diagram 11: Avalanche energy



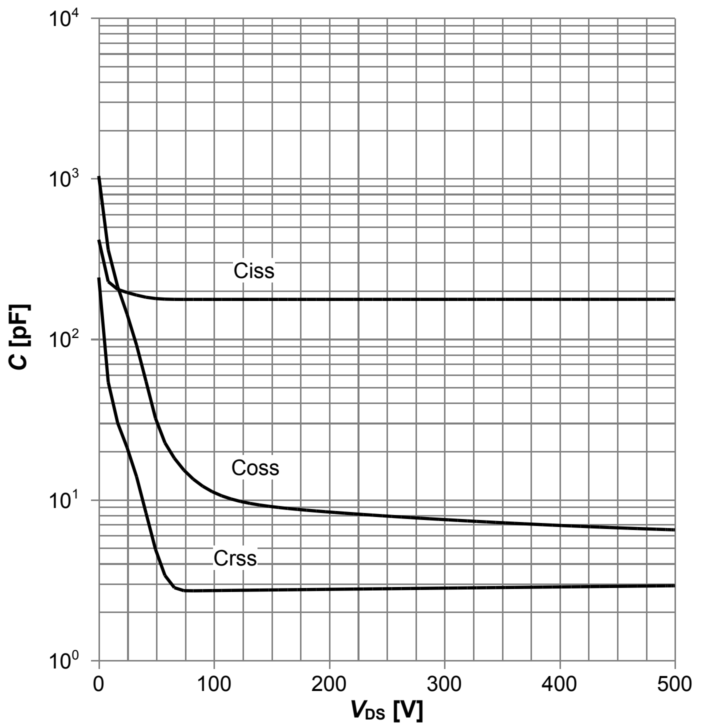
E_{AS}=f(T_j); I_D=1.1 A; V_{DD}=50 V

Diagram 12: Drain-source breakdown voltage



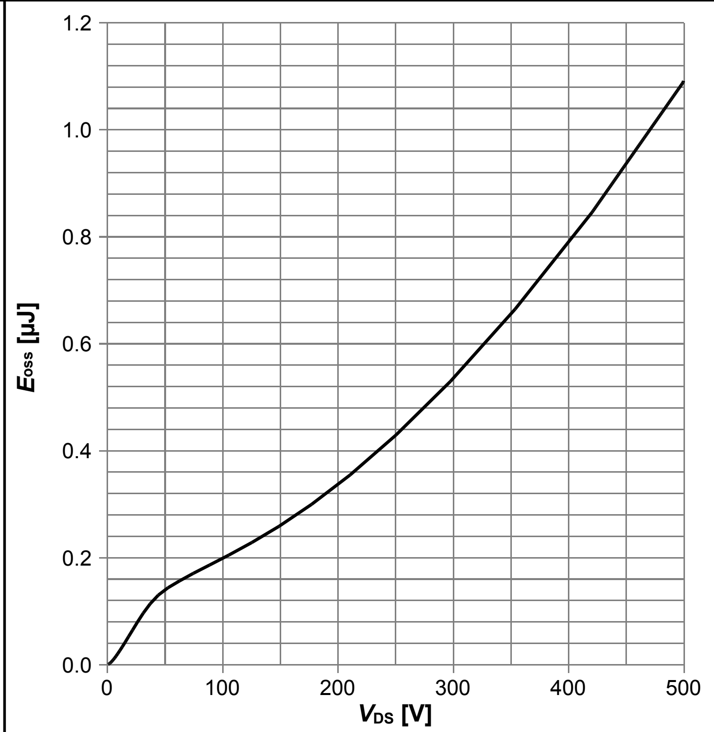
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Diagram 13: Typ. capacitances



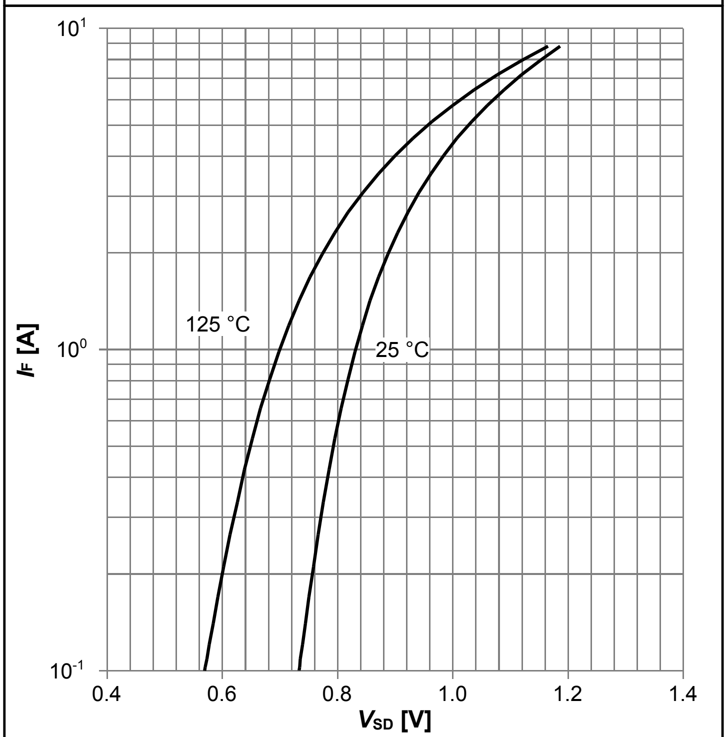
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

Diagram 14: Typ. Coss stored energy



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

Diagram 15: Forward characteristics of reverse diode



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

5 Test Circuits

Table 8 Diode characteristics

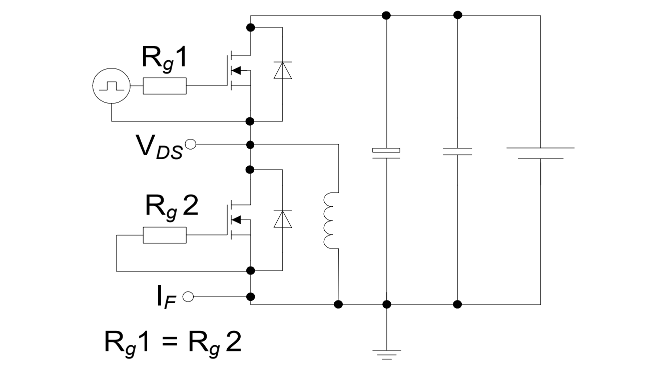
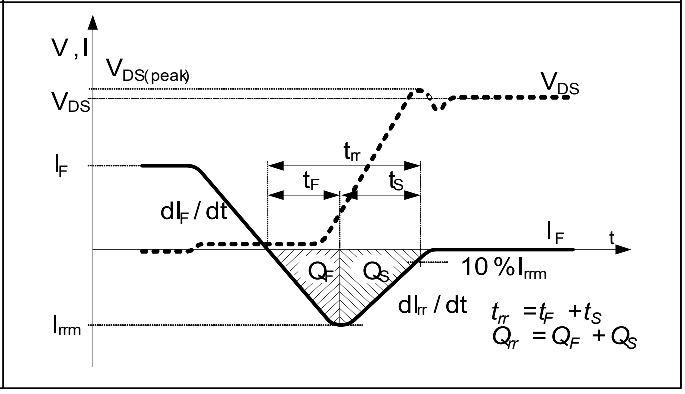
<table>
<tr><th>Test circuit for diode characteristics</th><th>Diode recovery waveform</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Table 9 Switching times

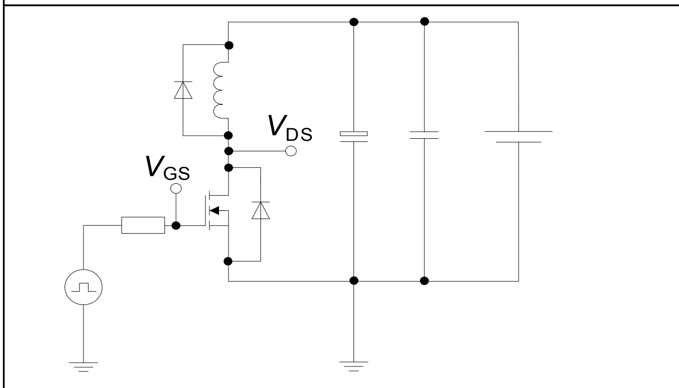
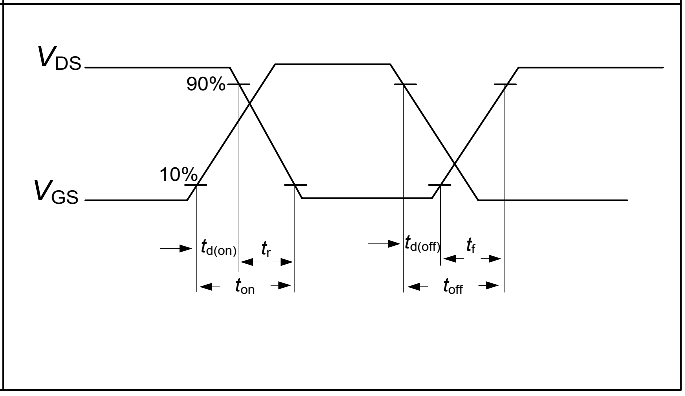
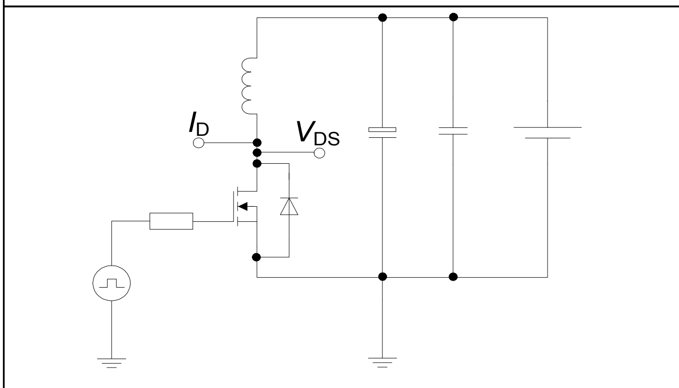
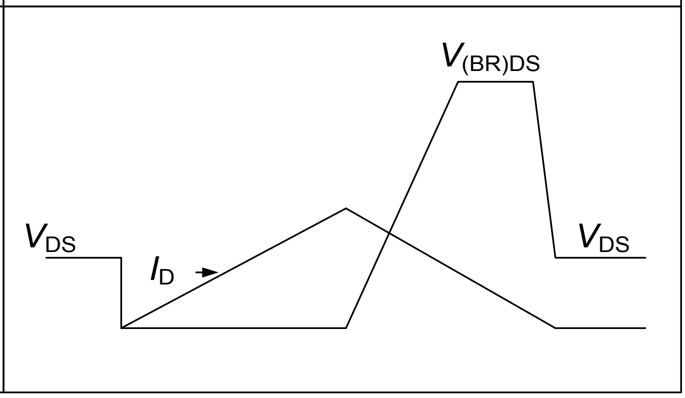
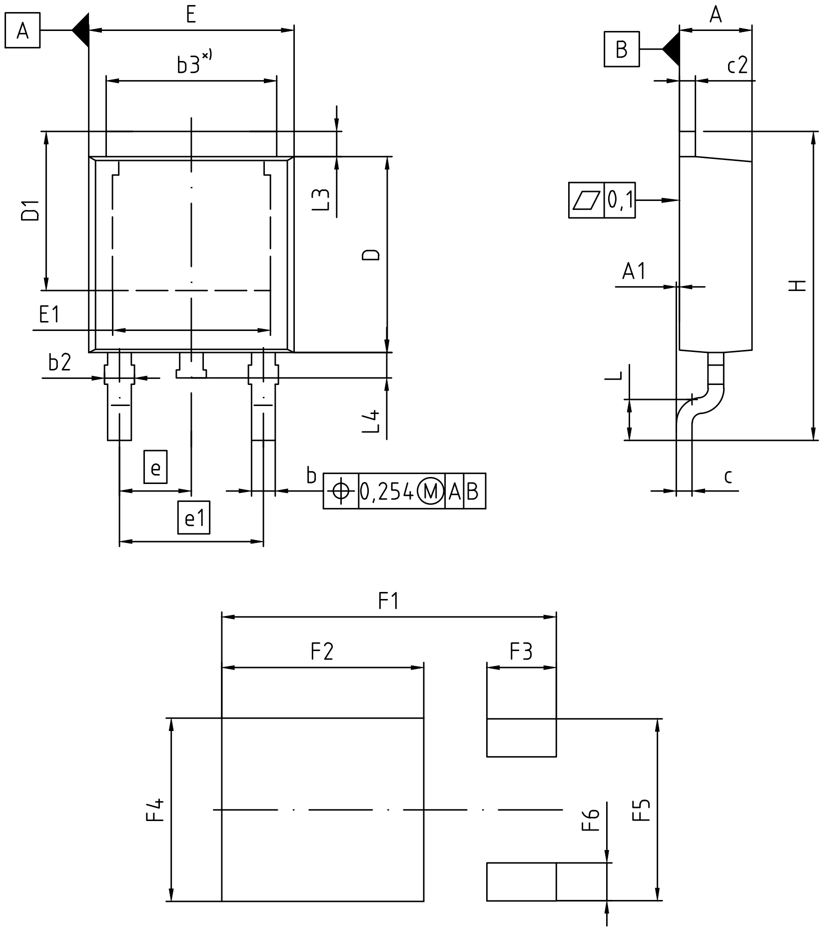
<table>
<tr><th>Switching times test circuit for inductive load</th><th>Switching times waveform</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Table 10 Unclamped inductive load

<table>
<tr><th>Unclamped inductive load test circuit</th><th>Unclamped inductive waveform</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

6 Package Outlines

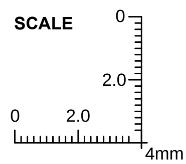


*) mold flash not included

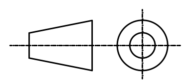
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.60	0.185	0.220
e	2.29 (BSC)		0.090 (BSC)	
e1	4.57 (BSC)		0.180 (BSC)	
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



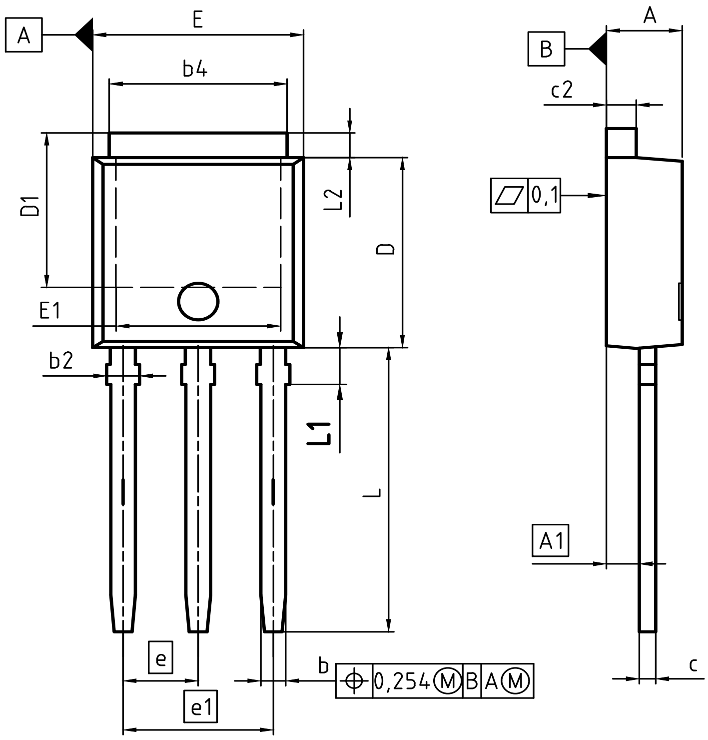
EUROPEAN PROJECTION



ISSUE DATE
01-09-2015

REVISION
05

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	0.85	2.29	0.033	0.090
L2	0.89	1.37	0.035	0.054

DOCUMENT NO.
Z8B00003330

SCALE 0 2.0 4mm

EUROPEAN PROJECTION

ISSUE DATE
31-08-2015

REVISION
04

Figure 2 Outline PG-TO 251, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

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

Revision History

IPD50R1K4CE, IPU50R1K4CE

Revision: 2016-06-13, Rev. 2.4

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-09-13	Release of final version
2.1	2012-12-05	release of final datasheet
2.2	2013-07-16	update to Halogen free mold compound
2.3	2015-11-17	Updated to standard grade qualified & updated package drawing
2.4	2016-06-13	Updated ID ratings, Zth, SOA and Pd curves

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

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.