MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

500V CoolMOS™ CE Power Transistor
IPx50R280CE

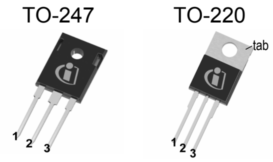
Data Sheet

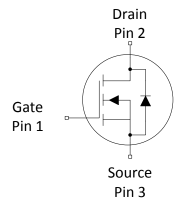
Rev. 2.1
Final

Power Management & 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. CoolMOS™ CE series combines the experience of the leading SJ MOSFET supplier with high class innovation while representing a cost appealing alternative compared to standard MOSFETs in target applications. The resulting devices 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.





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 industrial grade applications according to JEDEC (J-STD20 and JESD22)

Applications

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

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	550	V
$R_{DS(on),max}$	0.28	Ω
$Q_{g.typ}$	32.6	nC
$I_{D,pulse}$	42.9	A
E_{oss}@400V	3.2	µJ
Body diode di/dt	500	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPW50R280CE	PG-TO 247	5R280CE	see Appendix A
IPP50R280CE	PG-TO 220		

Table of Contents

Description 2
Maximum ratings 4
Thermal characteristics 4
Electrical characteristics 5
Electrical characteristics diagrams 7
Test Circuits 11
Package Outlines 12
Appendix A 14
Revision History 15
Disclaimer 15

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	- -	- -	13 8.2	A	T_C = 25°C T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	42.9	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	231	mJ	I_D =5.2A; V_{DD} = 50V
Avalanche energy, repetitive	E_{AR}	-	-	0.35	mJ	I_D =5.2A; V_{DD} = 50V
Avalanche current, repetitive	I_{AR}	-	-	5.2	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-247, TO-220	P_{tot}	-	-	92	W	T_C=25°C
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°C	-
Mounting torque (non FullPAK) TO-247, TO-220	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	11.3	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	42.9	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

3 Thermal characteristics

Table 3 Thermal characteristics (non FullPAK) TO-247, TO-220

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	1.36	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

[1] Limited by $T_{j\,max}$. Maximum duty cycle D=0.75
[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 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=0.35mA
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	$R_{DS(on)}$	- -	0.25 0.66	0.28 -	Ω	V_{GS}=13V, I_D=4.2A, T_j=25°C V_{GS}=13V, I_D=4.2A, T_j=150°C
Gate resistance	R_G	-	3	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	773	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	49	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related[1]	$C_{o(er)}$	-	40	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2]	$C_{o(tr)}$	-	173	-	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=5.2A, R_G=3.4Ω
Rise time	t_r	-	6.4	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=5.2A, R_G=3.4Ω
Turn-off delay time	$t_{d(off)}$	-	40	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=5.2A, R_G=3.4Ω
Fall time	t_f	-	7.6	-	ns	V_{DD}=400V, V_{GS}=13 V, I_D=5.2A, R_G=3.4Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	4.2	-	nC	V_{DD}=400V, I_D=5.2A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	17.1	-	nC	V_{DD}=400V, I_D=5.2A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	32.6	-	nC	V_{DD}=400V, I_D=5.2A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.3	-	V	V_{DD}=400V, I_D=5.2A, V_{GS}=0 to 10V

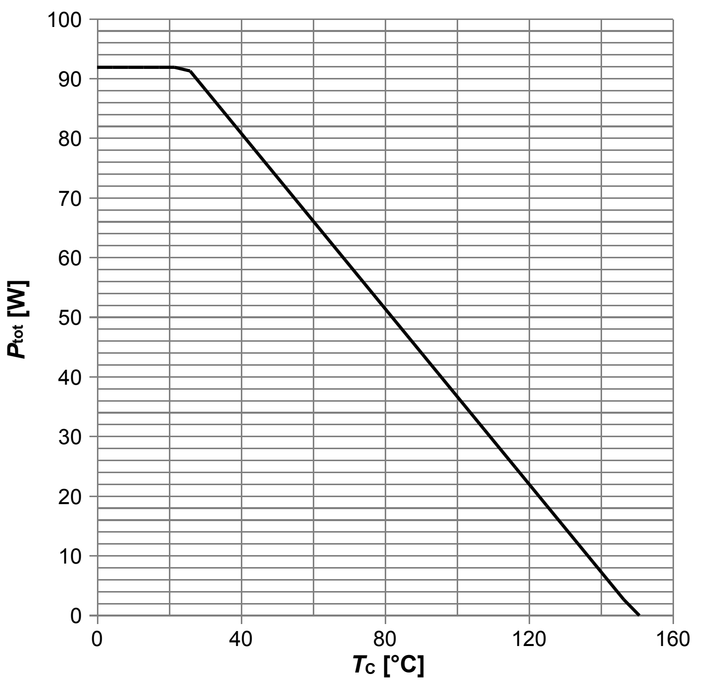
[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.85	-	V	V_{GS}=0V, I_F=5.2A, T_j=25°C
Reverse recovery time	t_{rr}	-	230	-	ns	V_R=400V, I_F=5.2A, di_F/dt=100A/µs
Reverse recovery charge	Q_{rr}	-	2.2	-	µC	V_R=400V, I_F=5.2A, di_F/dt=100A/µs
Peak reverse recovery current	I_{rrm}	-	17.5	-	A	V_R=400V, I_F=5.2A, di_F/dt=100A/µs

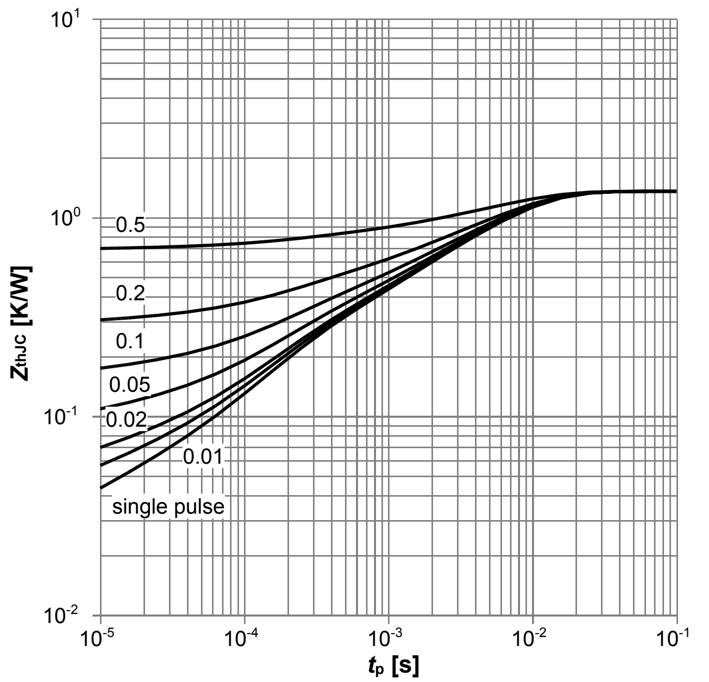
5 Electrical characteristics diagrams

Power dissipation (Non FullPAK)



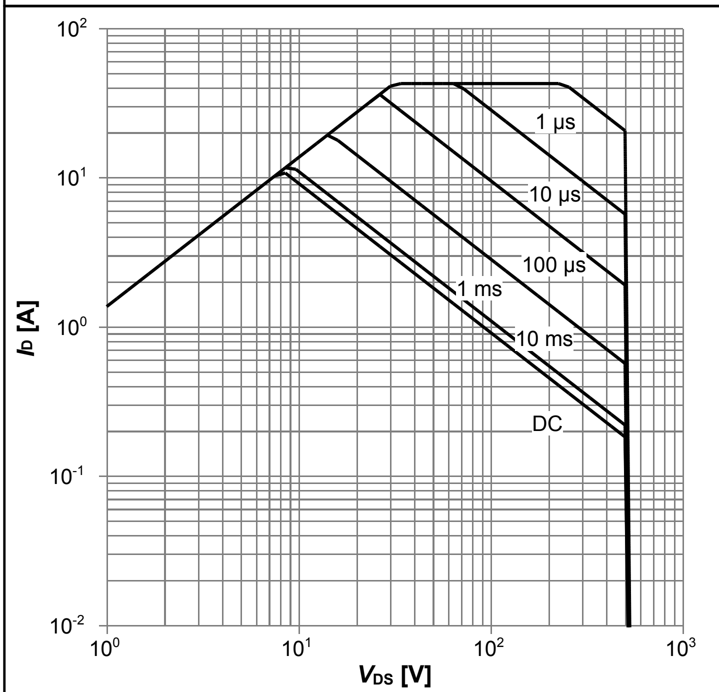
P_{tot}=f(T_C)

Max. transient thermal impedance (Non FullPAK)



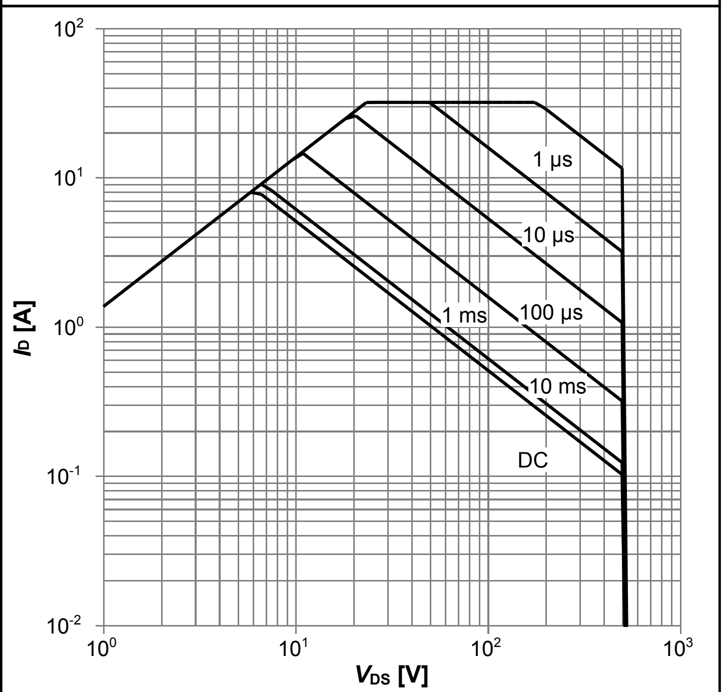
Z_{thJC} =f(t_P); parameter: D=t_p/T

Safe operating area (Non FullPAK) Tj=25°C



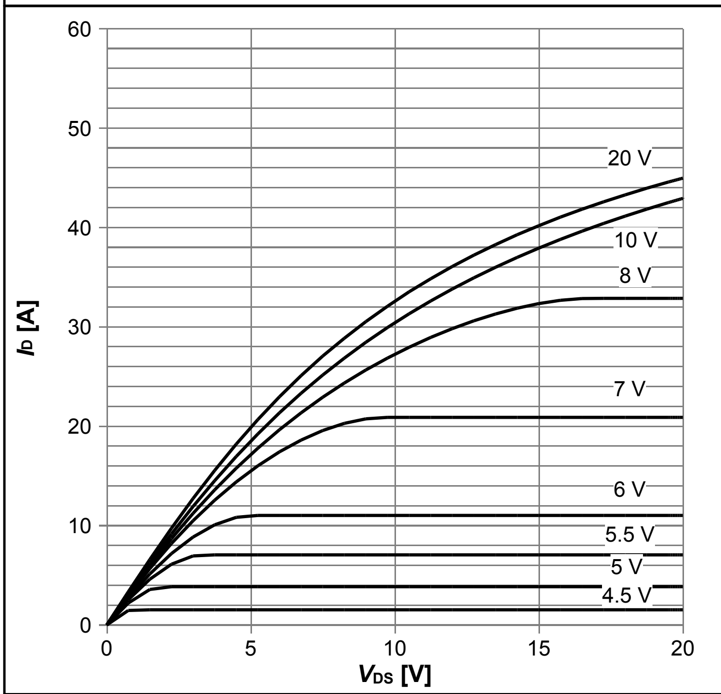
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Safe operating area (Non FullPAK) Tj=80°C



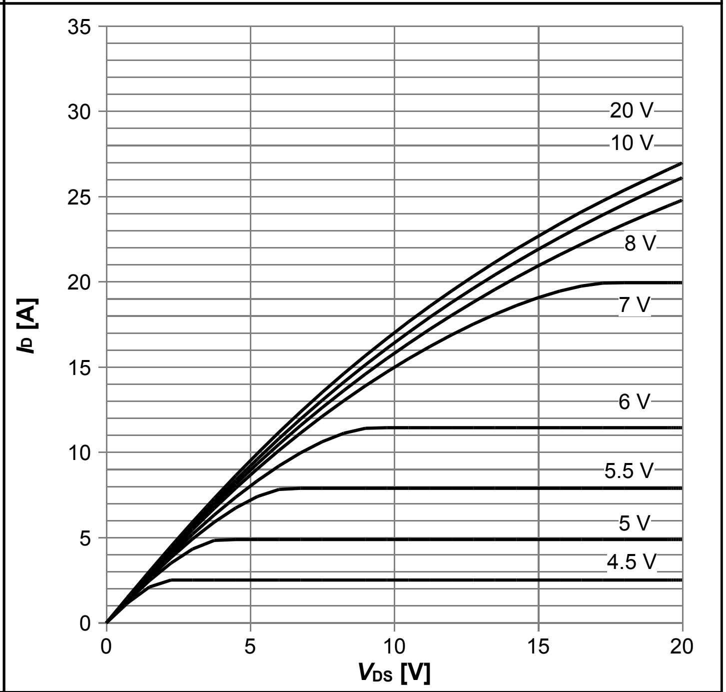
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

Typ. output characteristics Tj=25°C



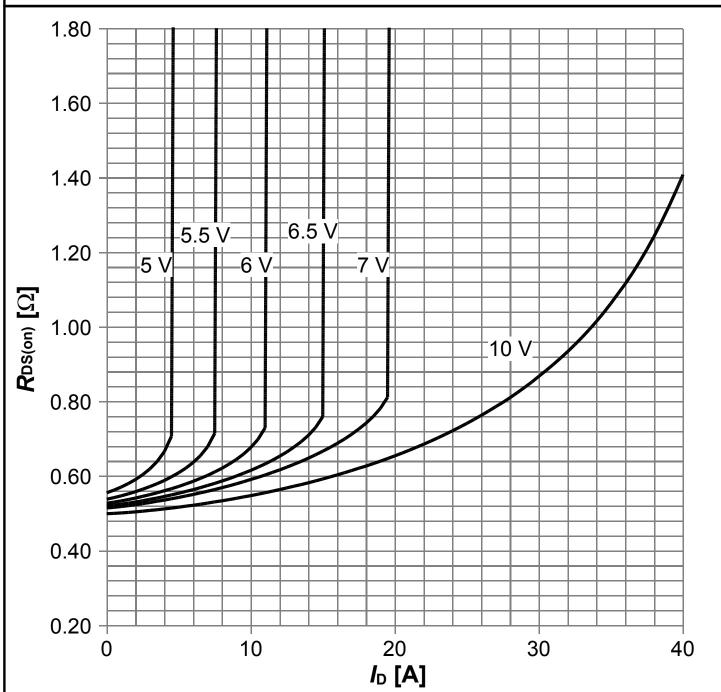
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Typ. output characteristics Tj=125°C



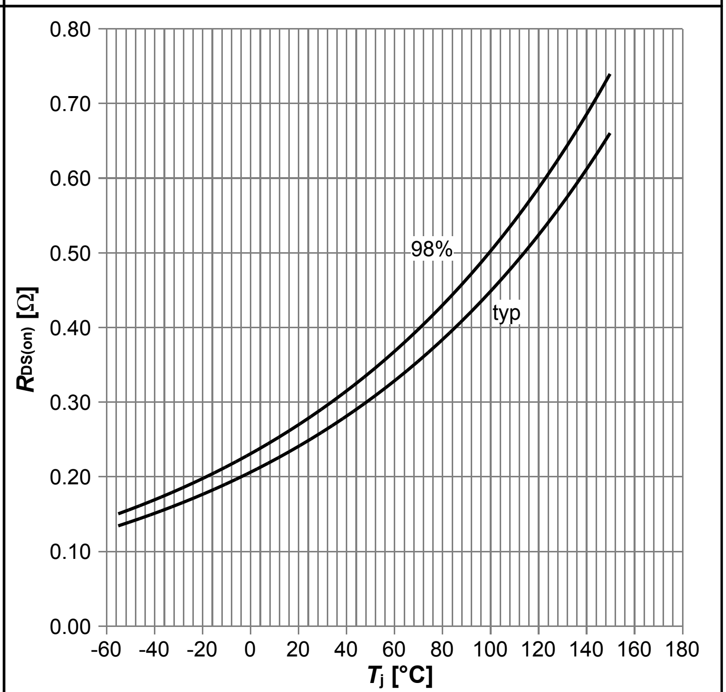
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

Typ. drain-source on-state resistance



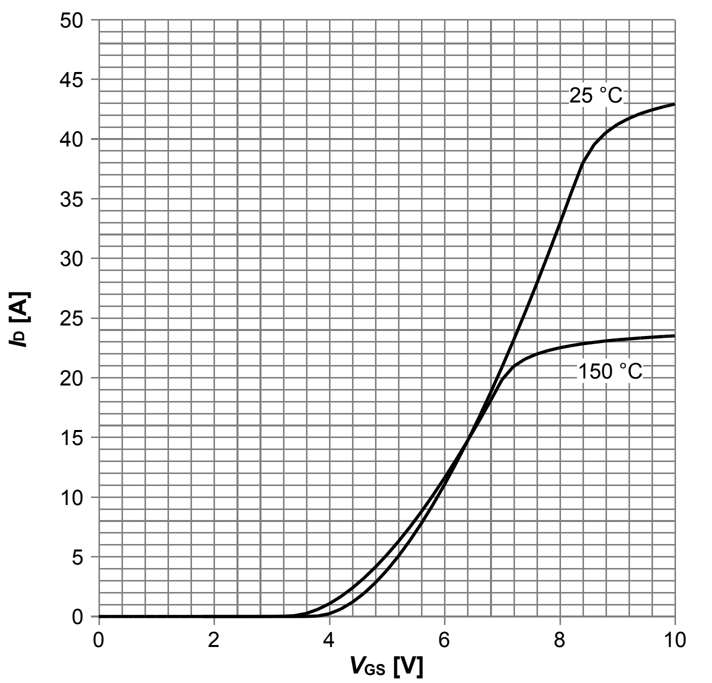
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Drain-source on-state resistance



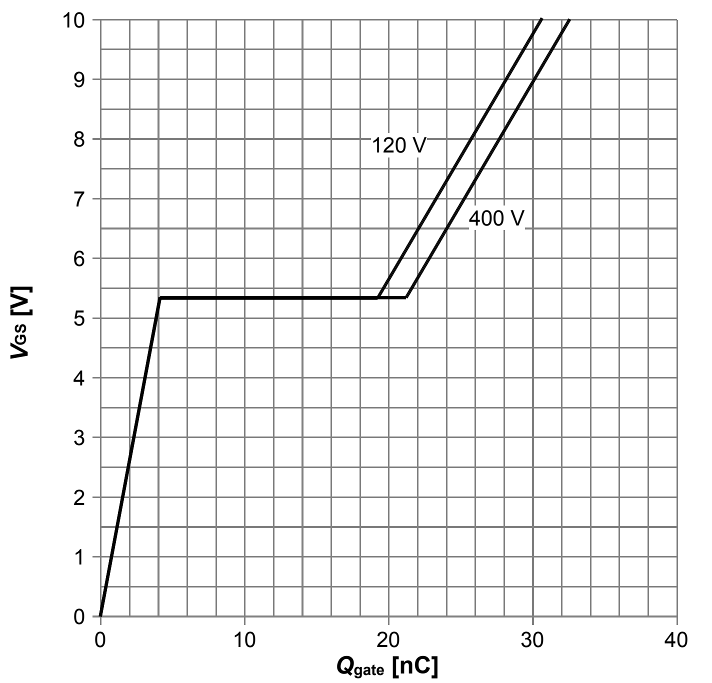
$R_{DS(on)}$=f(T_j); I_D=4.2 A; V_{GS}=13 V

Typ. transfer characteristics



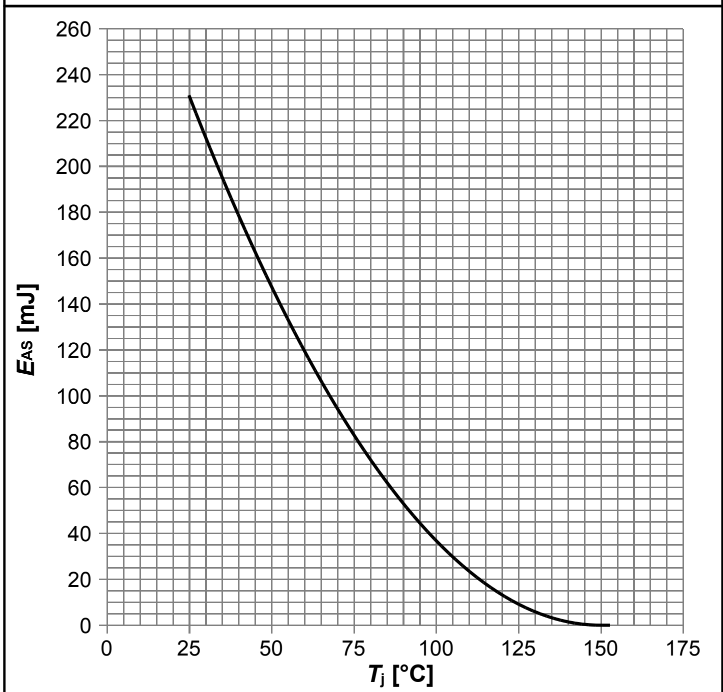
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Typ. gate charge



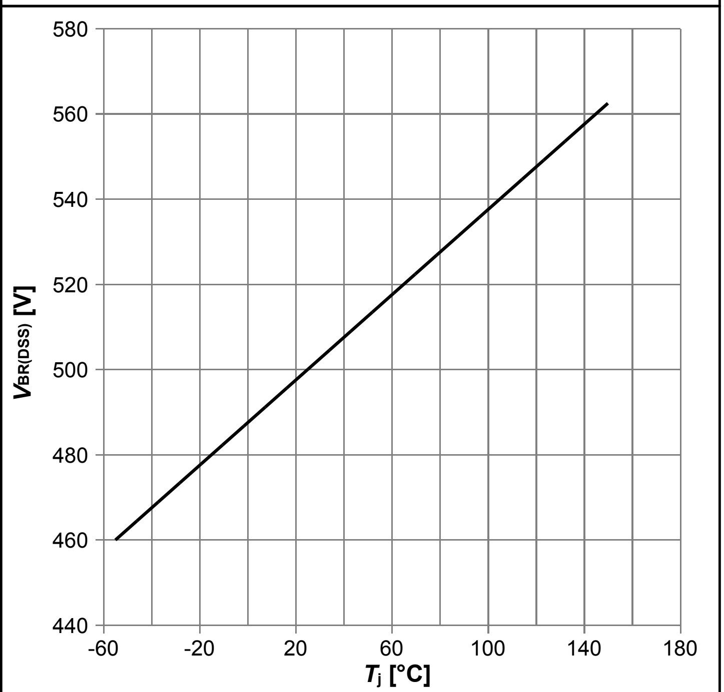
V_{GS}=f(Q_{gate}); I_D=5.2 A pulsed; parameter: V_{DD}

Avalanche energy



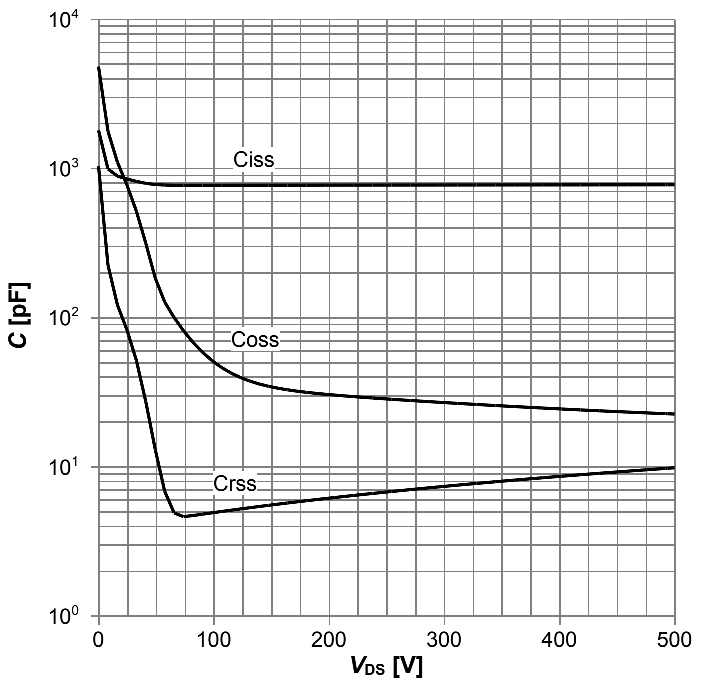
E_{AS}=f(T_j); I_D=5.2 A; V_{DD}=50 V

Drain-source breakdown voltage



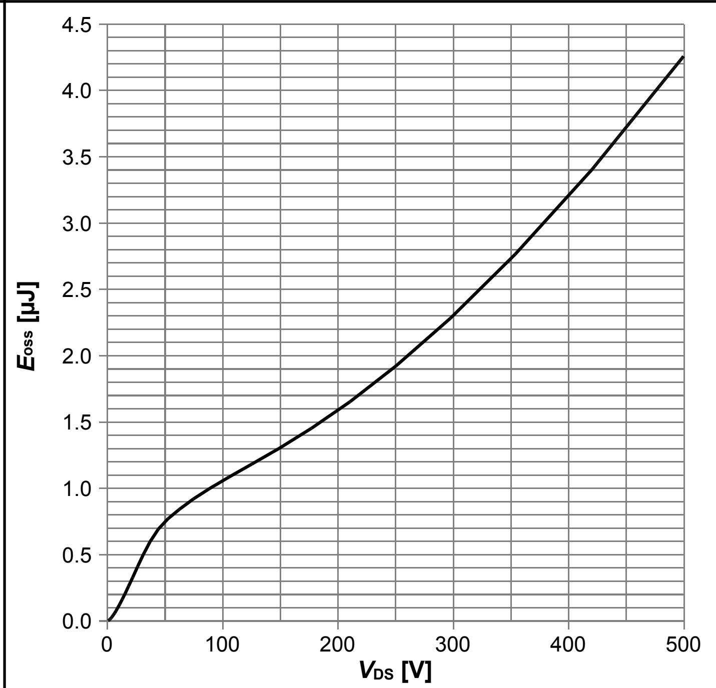
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Typ. capacitances



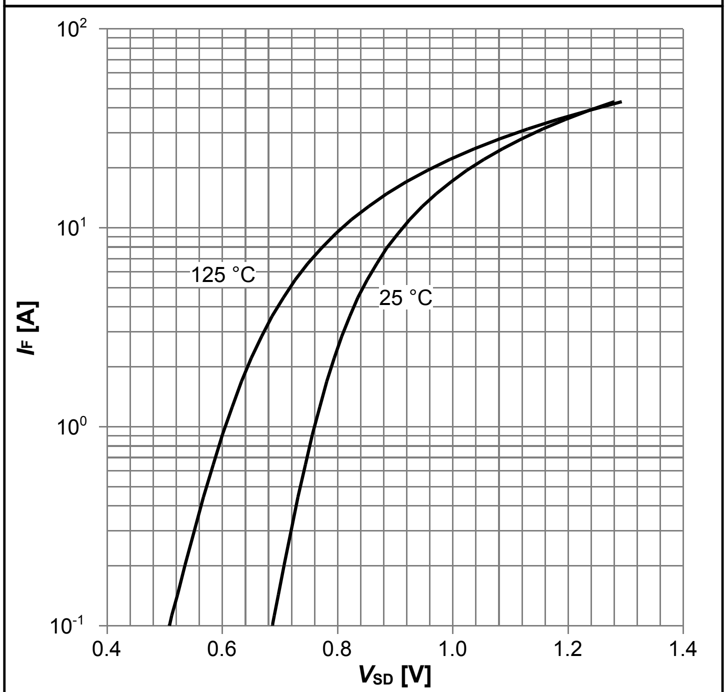
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. Coss stored energy



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

Forward characteristics of reverse diode



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

6 Test Circuits

Table 8 Diode characteristics

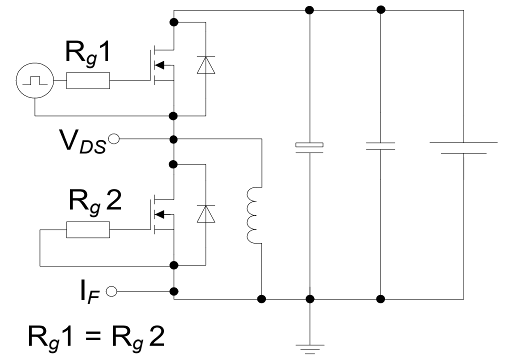
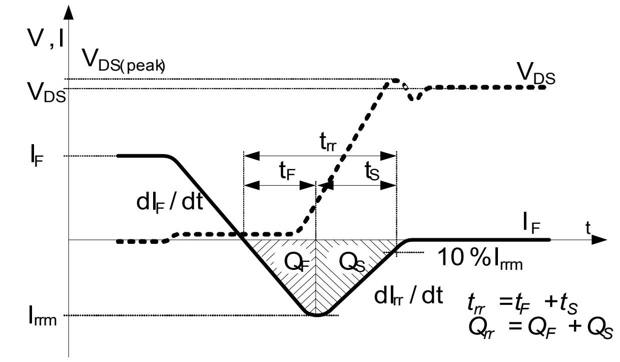
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

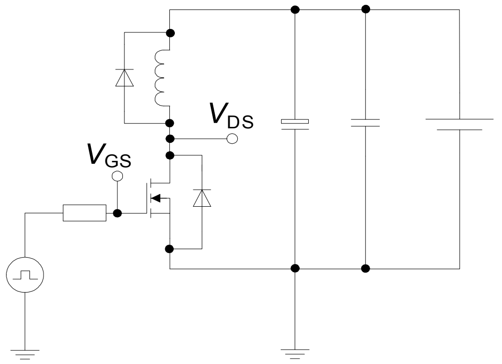
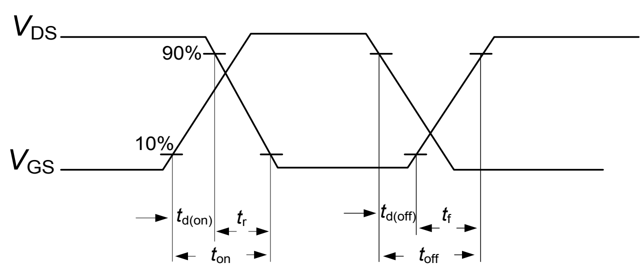
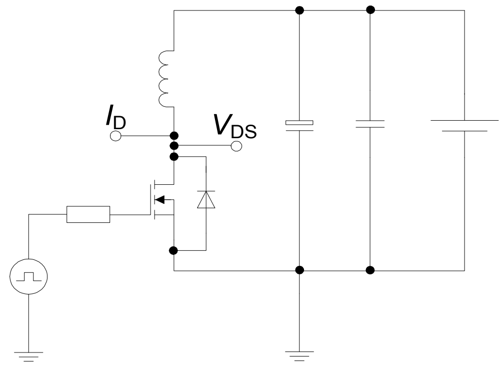
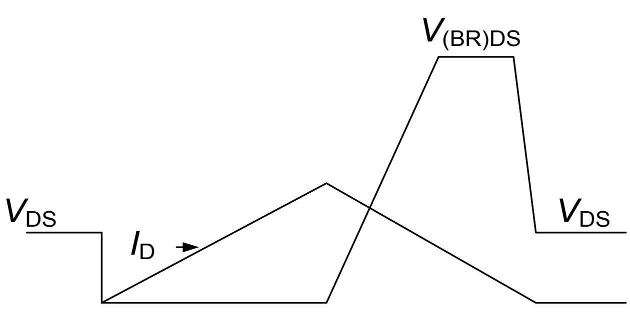
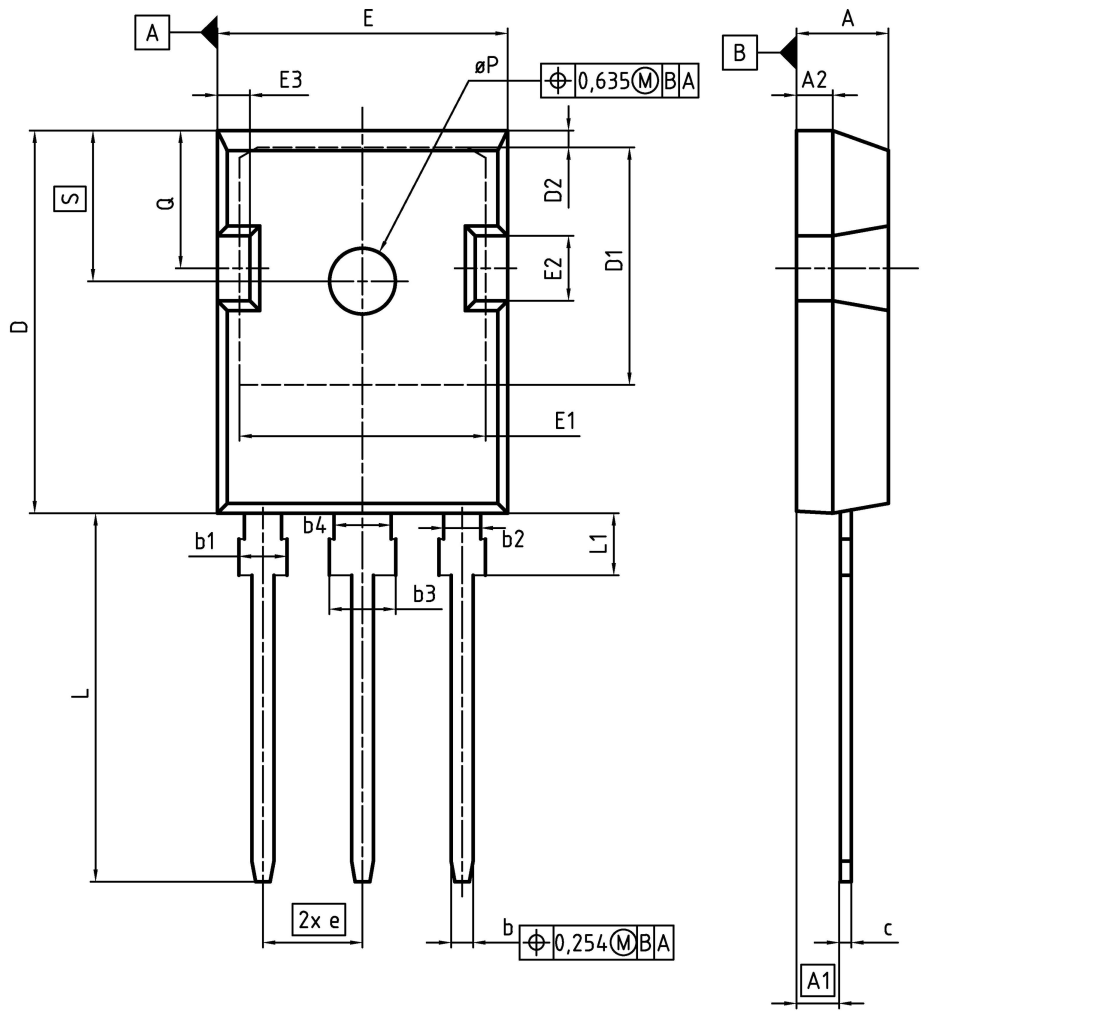
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

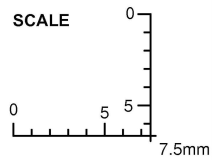
7 Package Outlines



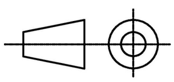
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

DOCUMENT NO.
Z8B00003327

SCALE



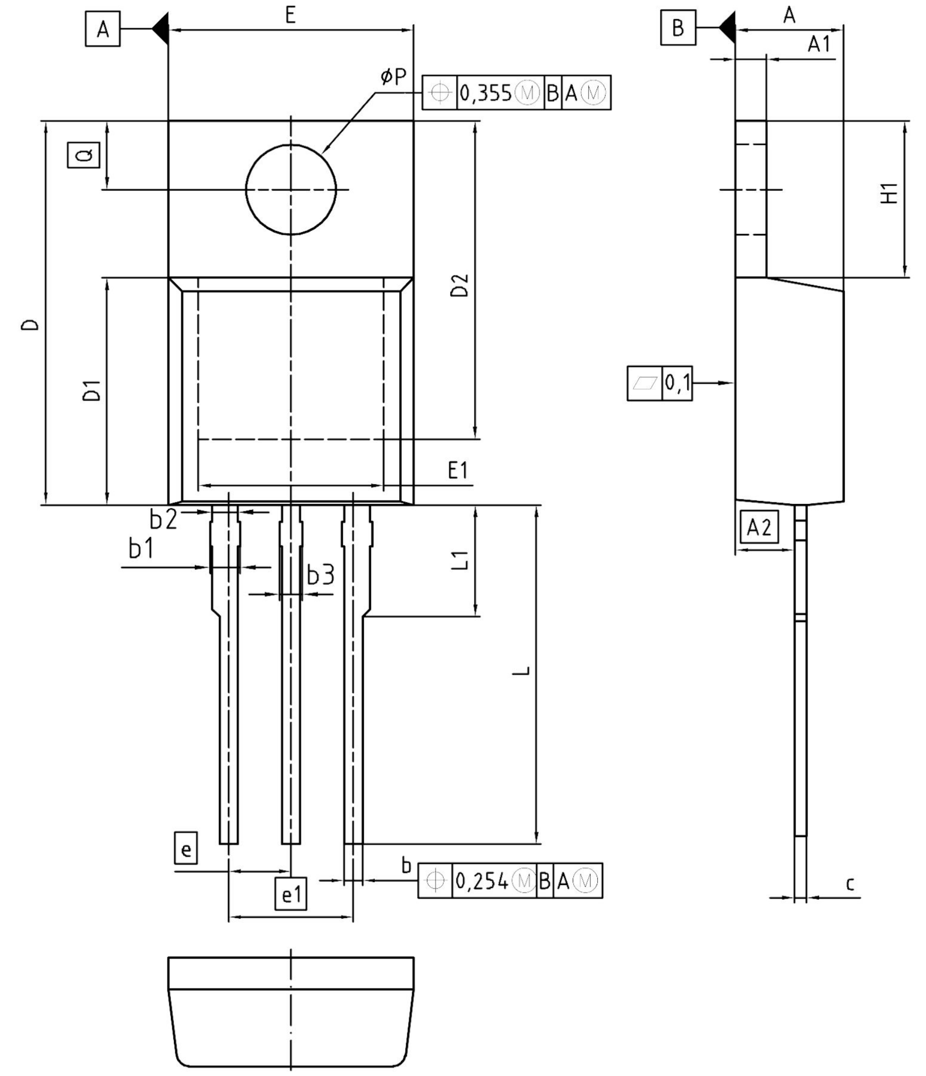
EUROPEAN PROJECTION



ISSUE DATE
09-07-2010

REVISION
05

Figure 1 Outline PG-TO 247, dimensions in mm/inches



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

DOCUMENT NO.
Z8B00003318

SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
30-07-2009

REVISION
06

Figure 2 Outline PG-TO 220, 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

IPW50R280CE, IPP50R280CE

Revision: 2014-06-06, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-06-29	Release of final version
2.1	2014-06-06	Removal of TO-220FP

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.