

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C7

650V CoolMOS™ C7 Power Transistor
IPZ65R065C7

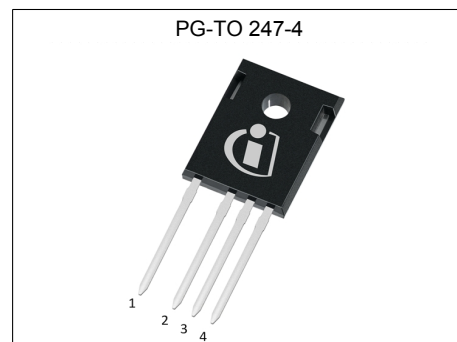
Data Sheet

Rev. 2.1
Final

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™ C7 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The product portfolio provides all benefits of fast switching superjunction MOSFETs offering better efficiency, reduced gate charge, easy implementation and outstanding reliability.



Features

- Increased MOSFET dv/dt ruggedness
- Better efficiency due to best in class FOM $R_{DS(on)} \cdot E_{oss}$ and $R_{DS(on)} \cdot Q_g$
- Best in class $R_{DS(on)}$ /package
- Easy to use/drive due to **driver source pin** for better control of the gate.
- Pb-free plating, halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)

Benefits

- Enabling higher system efficiency
- Enabling higher frequency / increased power density solutions
- System cost / size savings due to reduced cooling requirements
- Higher system reliability due to lower operating temperatures

Applications

PFC stages and hard switching PWM stages for e.g. Computing, Server, Telecom, UPS and Solar.

Please note: The source and sense source pins are not exchangeable. Their exchange might lead to malfunction.

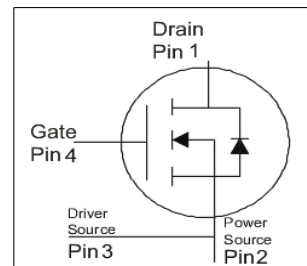


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	65	mΩ
$Q_{g,typ}$	64	nC
$I_{D,pulse}$	145	A
$E_{oss}@400V$	8	μJ
Body diode di/dt	60	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPZ65R065C7	PG-TO 247-4	65C7065	see Appendix A

Table of Contents

Description	2
Maximum ratings	4
Thermal characteristics	5
Electrical characteristics	6
Electrical characteristics diagrams	8
Test Circuits	12
Package Outlines	13
Appendix A	14
Revision History	15
Disclaimer	15

2 Maximum ratings

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	33 21	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	145	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	171	mJ	$I_D=10.2\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.85	mJ	$I_D=10.2\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche current, single pulse	I_{AS}	-	-	10.2	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	100	V/ns	$V_{DS}=0\dots400\text{V}$
Gate source voltage (static)	V_{GS}	-20	-	20	V	static;
Gate source voltage (dynamic)	V_{GS}	-30	-	30	V	AC ($f>1\text{ Hz}$)
Power dissipation	P_{tot}	-	-	171	W	$T_C=25^\circ\text{C}$
Storage temperature	T_{stg}	-55	-	150	$^\circ\text{C}$	-
Operating junction temperature	T_j	-55	-	150	$^\circ\text{C}$	-
Mounting torque	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	33	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	145	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	1.5	V/ns	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 8
Maximum diode commutation speed	di/dt	-	-	60	A/ μs	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 8
Insulation withstand voltage	V_{ISO}	-	-	n.a.	V	V_{rms} , $T_C=25^\circ\text{C}$, $t=1\text{min}$

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

3 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.73	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	-	°C/W	n.a.
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

4 Electrical characteristics

at $T_j=25^\circ\text{C}$, 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	3.5	4	V	$V_{DS}=V_{GS}$, $I_D=0.85mA$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=650$, $V_{GS}=0V$, $T_j=25^\circ\text{C}$ $V_{DS}=650$, $V_{GS}=0V$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20V$, $V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.058 0.138	0.065 -	Ω	$V_{GS}=10V$, $I_D=17.1A$, $T_j=25^\circ\text{C}$ $V_{GS}=10V$, $I_D=17.1A$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	0.85	-	Ω	$f=1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	3020	-	pF	$V_{GS}=0V$, $V_{DS}=400V$, $f=250kHz$
Output capacitance	C_{oss}	-	48	-	pF	$V_{GS}=0V$, $V_{DS}=400V$, $f=250kHz$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	100	-	pF	$V_{GS}=0V$, $V_{DS}=0...400V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	1110	-	pF	$I_D=\text{constant}$, $V_{GS}=0V$, $V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	16	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=17.1A$, $R_G=5.3\Omega$; see table 9
Rise time	t_r	-	7	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=17.1A$, $R_G=5.3\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	72	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=17.1A$, $R_G=5.3\Omega$; see table 9
Fall time	t_f	-	7	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=17.1A$, $R_G=5.3\Omega$; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	16	-	nC	$V_{DD}=400V$, $I_D=17.1A$, $V_{GS}=0$ to $10V$
Gate to drain charge	Q_{gd}	-	21	-	nC	$V_{DD}=400V$, $I_D=17.1A$, $V_{GS}=0$ to $10V$
Gate charge total	Q_g	-	64	-	nC	$V_{DD}=400V$, $I_D=17.1A$, $V_{GS}=0$ to $10V$
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	$V_{DD}=400V$, $I_D=17.1A$, $V_{GS}=0$ to $10V$

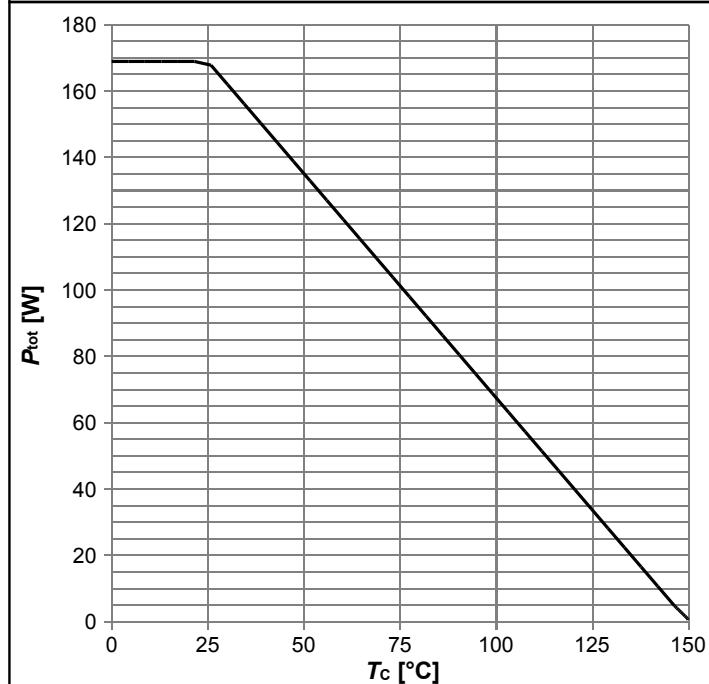
¹⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V

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

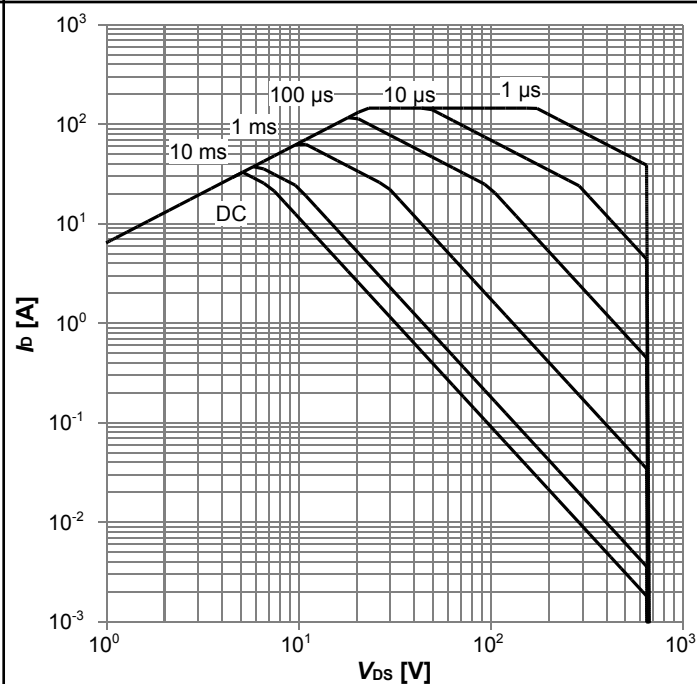
Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	$V_{GS}=0V$, $I_F=17.1A$, $T_j=25^{\circ}C$
Reverse recovery time	t_{rr}	-	800	-	ns	$V_R=400V$, $I_F=33A$, $di_F/dt=60A/\mu s$; see table 8
Reverse recovery charge	Q_{rr}	-	10	-	μC	$V_R=400V$, $I_F=33A$, $di_F/dt=60A/\mu s$; see table 8
Peak reverse recovery current	I_{rrm}	-	30	-	A	$V_R=400V$, $I_F=33A$, $di_F/dt=60A/\mu s$; see table 8

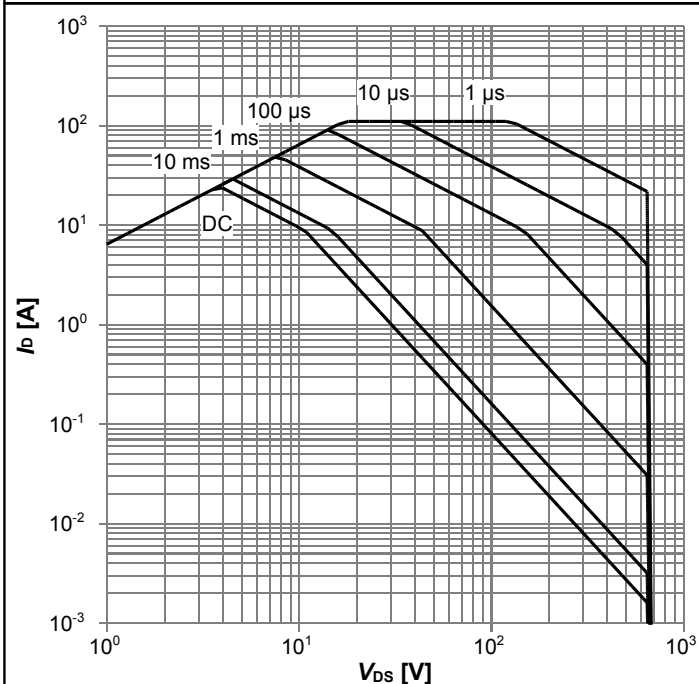
5 Electrical characteristics diagrams

Diagram 1: Power dissipation


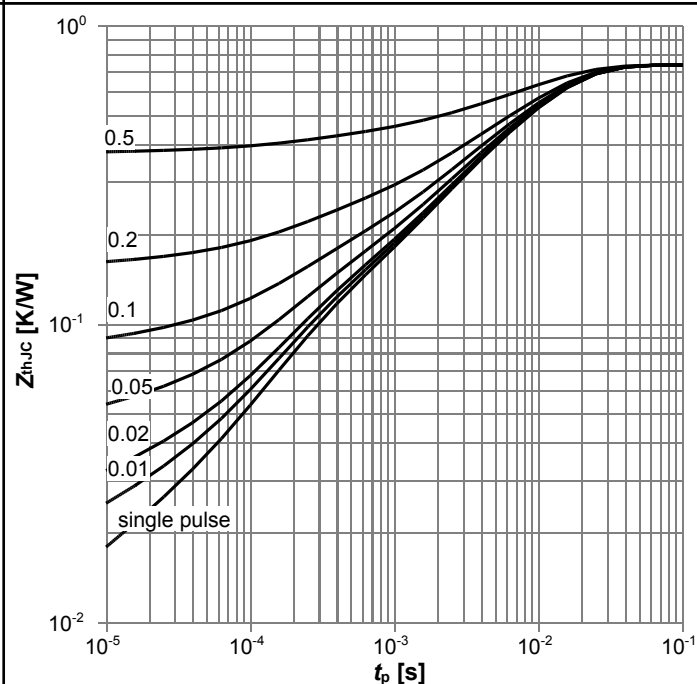
$$P_{tot}=f(T_c)$$

Diagram 2: Safe operating area


$$I_D=f(V_{DS}); T_c=25\text{ °C}; D=0; \text{parameter: } t_p$$

Diagram 3: Safe operating area


$$I_D=f(V_{DS}); T_c=80\text{ °C}; D=0; \text{parameter: } t_p$$

Diagram 4: Max. transient thermal impedance


$$Z_{thJC}=f(t_p); \text{parameter: } D=t_p/T$$

Diagram 5: Typ. output characteristics

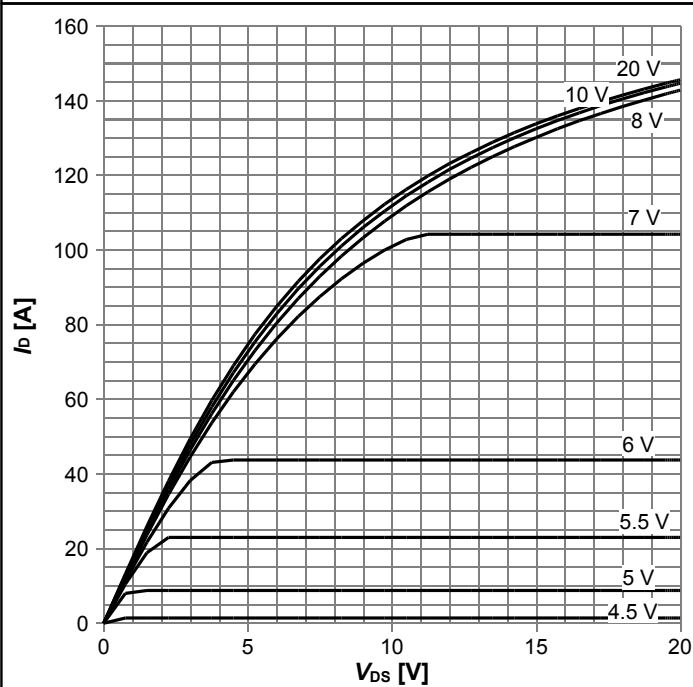

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 6: Typ. output characteristics

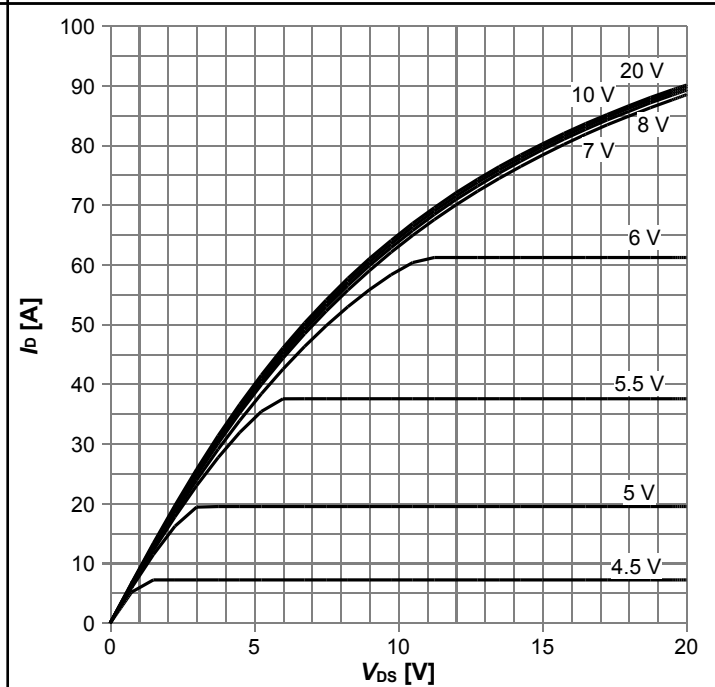

 $I_D = f(V_{DS}); T_J = 125^\circ\text{C}; \text{parameter: } V_{GS}$

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

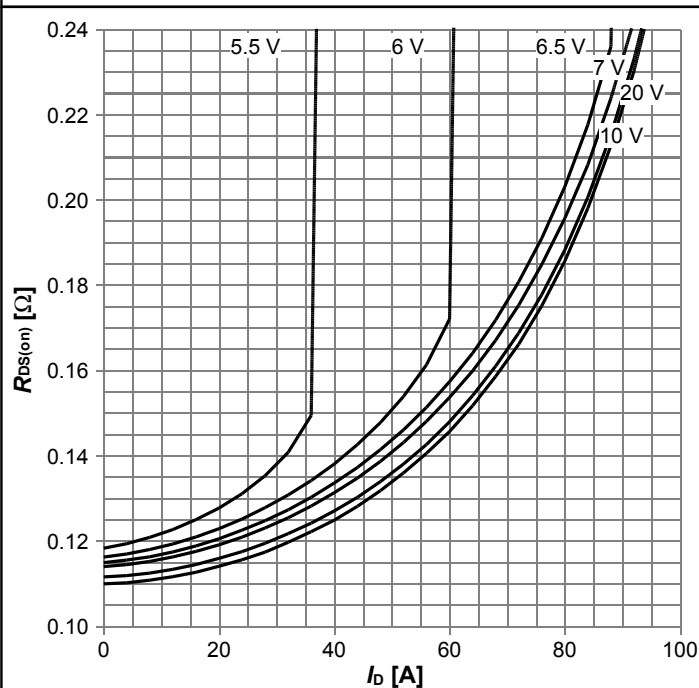

 $R_{DS(on)} = f(I_D); T_J = 125^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 8: Drain-source on-state resistance

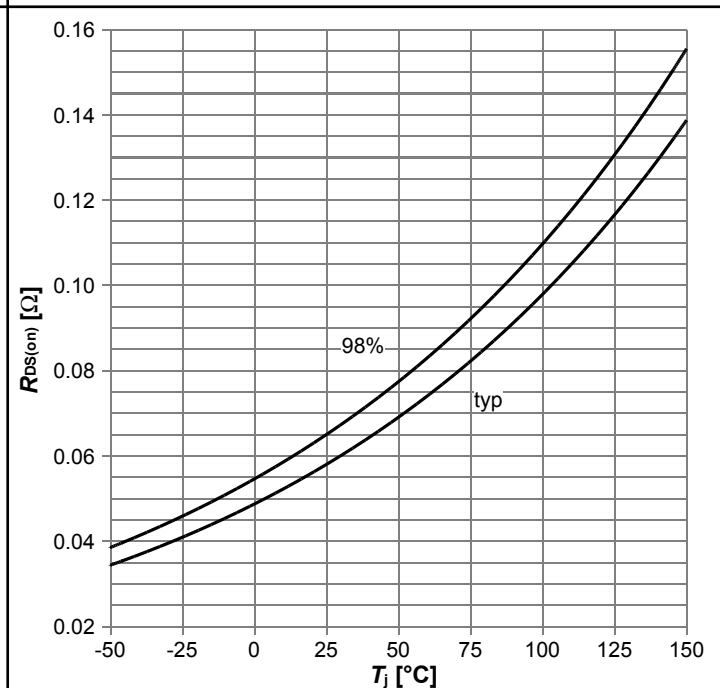

 $R_{DS(on)} = f(T_J); I_D = 17.1\text{ A}; V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics

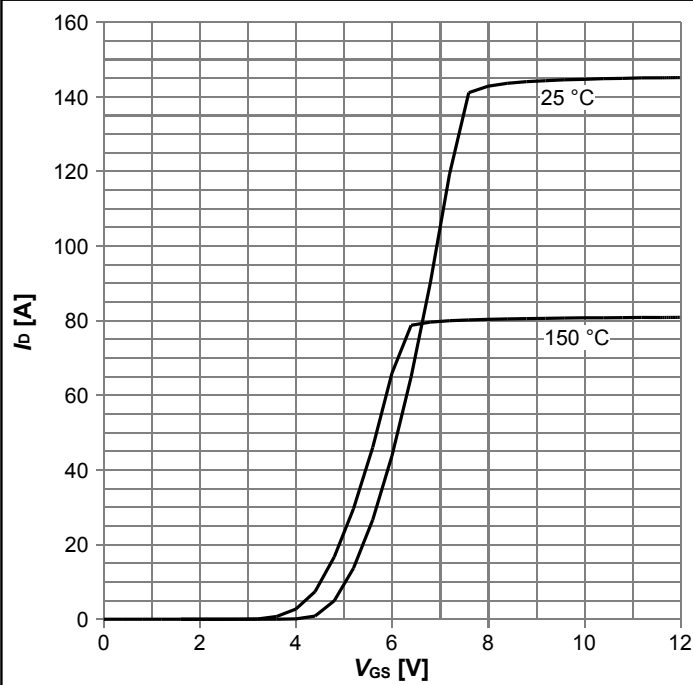

 $I_D = f(V_{GS})$; $V_{DS} = 20V$; parameter: T_j

Diagram 10: Typ. gate charge

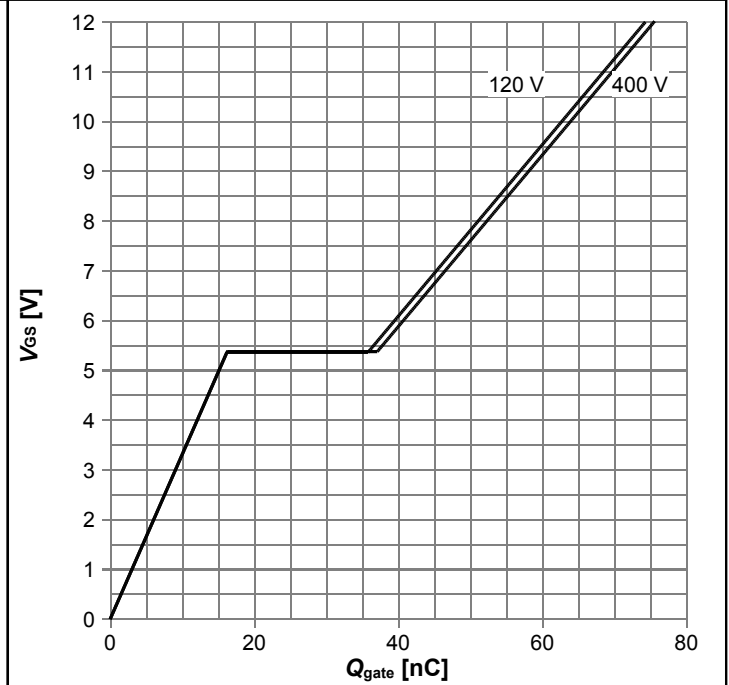

 $V_{GS} = f(Q_{gate})$; $I_D = 17.1$ A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode

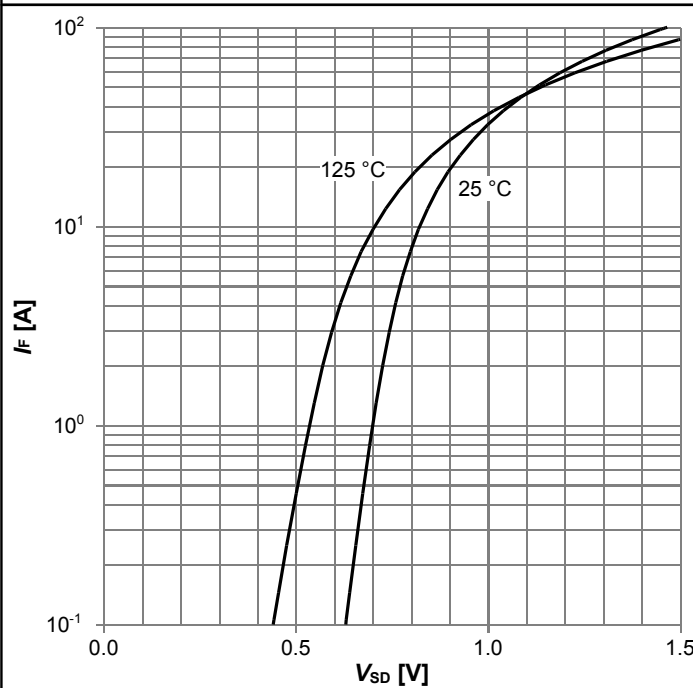

 $I_F = f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy

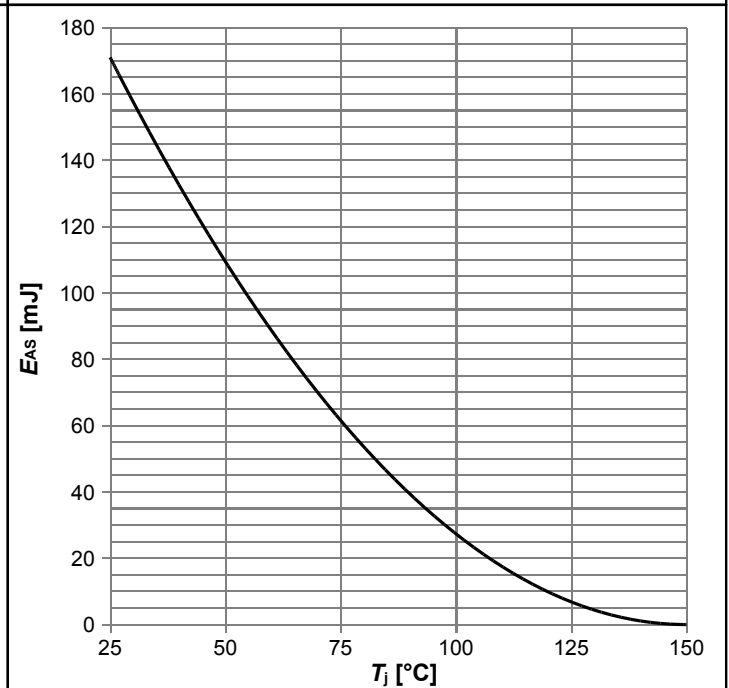
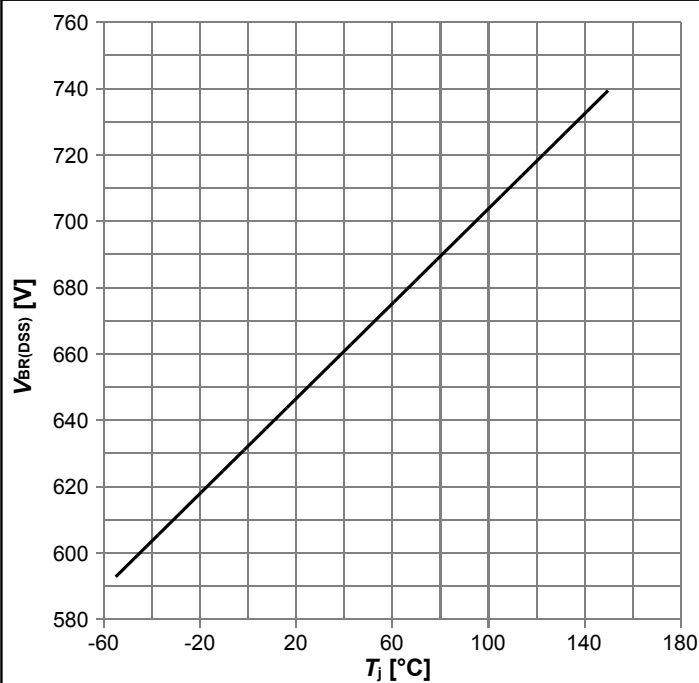
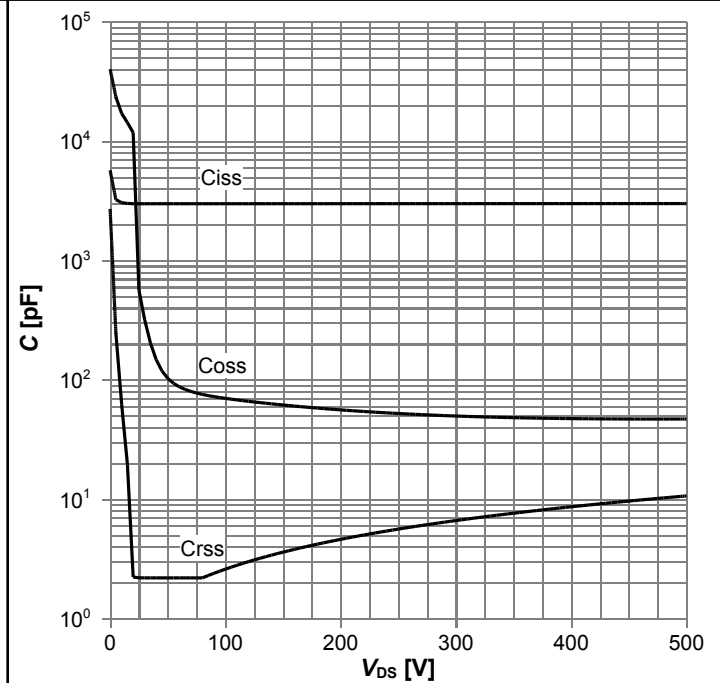

 $E_{AS} = f(T_j)$; $I_D = 10.2$ A; $V_{DD} = 50$ V

Diagram 13: Drain-source breakdown voltage



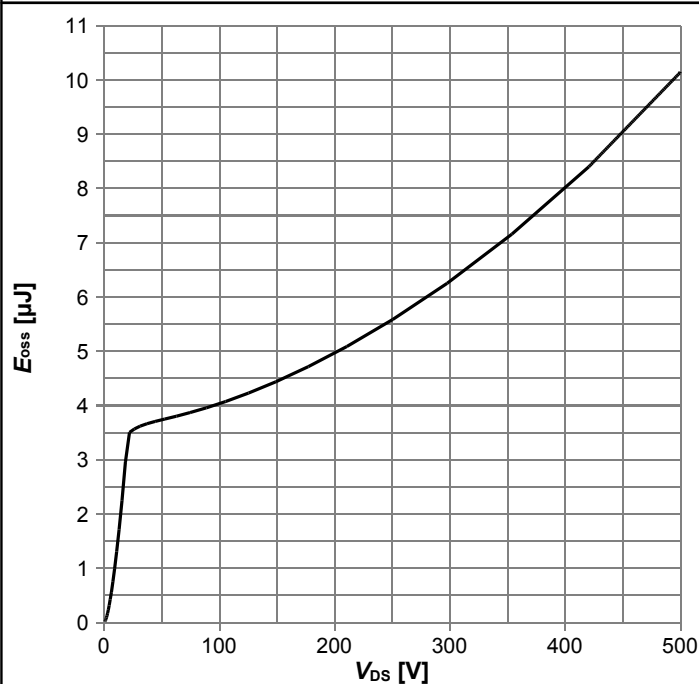
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$

Diagram 14: Typ. capacitances



$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 250 \text{ kHz}$$

Diagram 15: Typ. Coss stored energy



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

6 Test Circuits

Table 8 Diode characteristics

Test circuit for diode characteristics $R_{g1} = R_{g2}$	Diode recovery waveform $t_{rr} = t_F + t_s$ $Q_{rr} = Q_F + Q_S$
---	--

Table 9 switching times (ss)

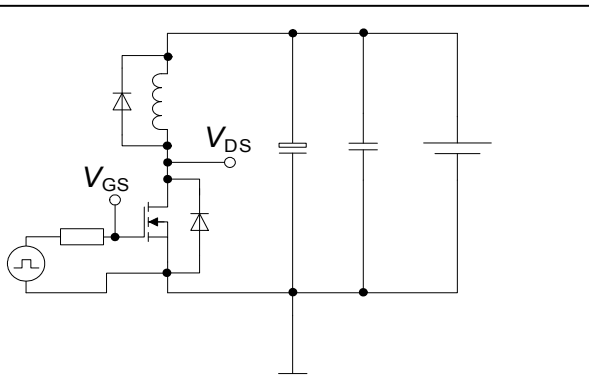
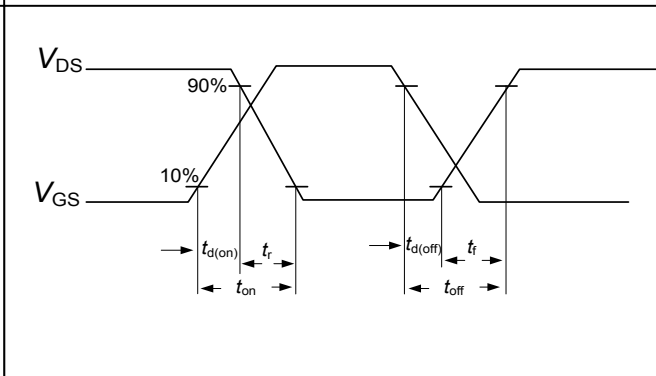
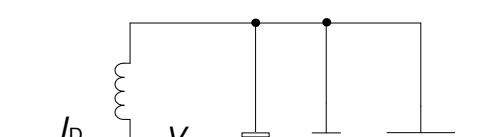
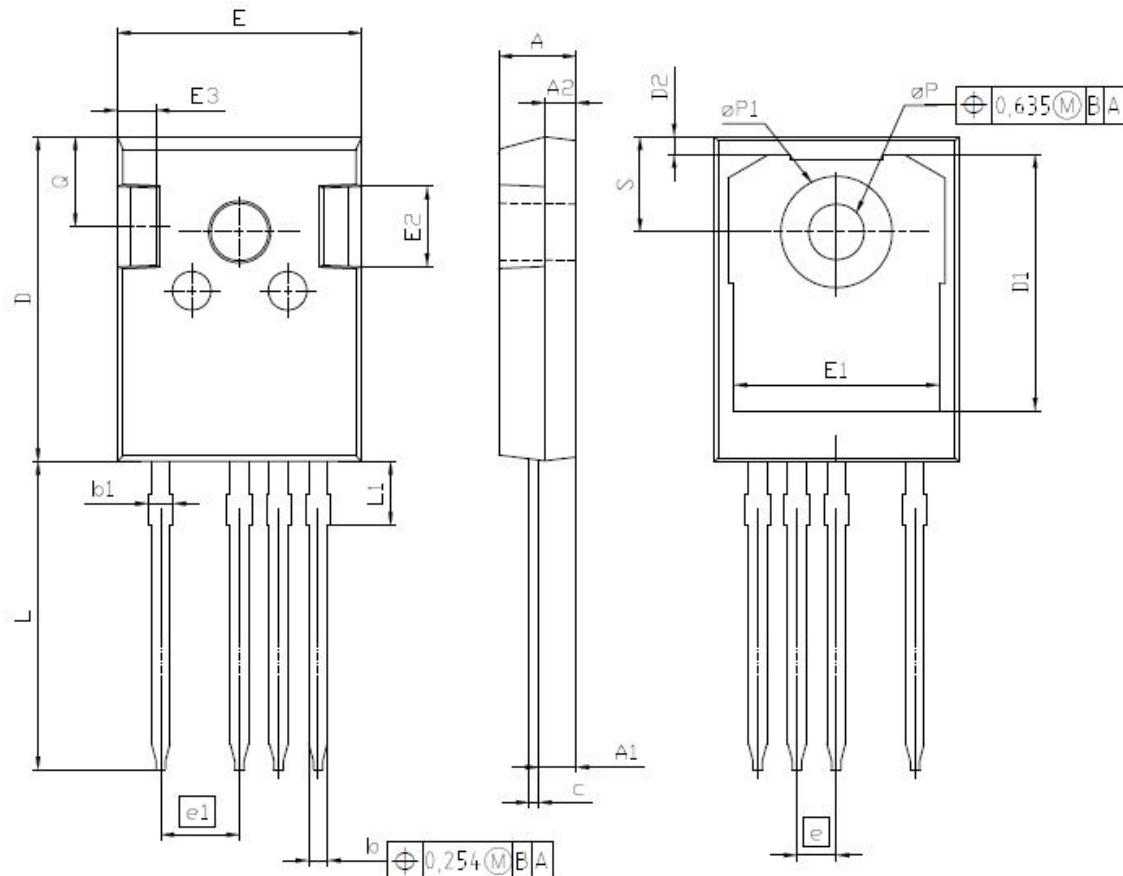
Switching times test circuit for inductive load	Switching times waveform
 The circuit diagram illustrates a MOSFET switching an inductive load. A pulse generator provides a gate voltage V_{GS} through a resistor. The MOSFET's drain is connected to a DC source V_{DS} and an inductive load (inductor and diode). The source is grounded. The inductor and diode are in series with the MOSFET's drain. The diode is connected to ground. The MOSFET's gate is connected to the pulse generator through a resistor. The MOSFET's source is grounded. The inductor and diode are connected between the MOSFET's drain and the DC source V_{DS}. The voltage V_{DS} is measured across the MOSFET's drain and source. The voltage V_{GS} is measured across the gate and source.	 The timing diagram shows the switching waveforms for V_{DS} and V_{GS}. The MOSFET is driven by a pulse. The V_{GS} waveform shows a rise time t_r and a fall time t_f. The V_{DS} waveform shows a delay time $t_{d(on)}$ before the voltage begins to rise, a rise time t_r to 90%, a plateau time t_{on} at 90%, a fall time t_f to 10%, a delay time $t_{d(off)}$ after the gate voltage falls, a fall time t_f to 10%, and a total off-time t_{off} from the end of the plateau to the end of the fall. The 90% and 10% levels are marked on the V_{DS} waveform.

Table 10 Unclamped inductive load (ss)

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	2.29	2.54	0.090	0.100
A2	1.90	2.16	0.075	0.085
b	1.07	1.33	0.042	0.052
b1	1.10	1.70	0.043	0.067
c	0.50	0.70	0.020	0.028
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	2.54 (BSC)		0.100 (BSC)	
e1	5.08		0.200	
N	4		4	
L	19.72	20.32	0.776	0.800
L1	4.02	4.40	0.158	0.173
øP	3.50	3.70	0.138	0.146
øP1	7.00	7.40	0.276	0.291
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

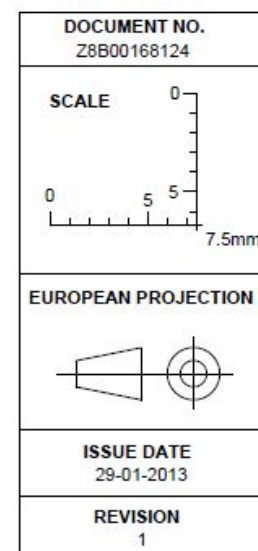


Figure 1 Outline PG-TO 247-4, dimensions in mm/inches

8 Appendix A

Table 11 Related Links

- IFX CoolMOS™ C7 Webpage: www.infineon.com
- IFX CoolMOS™ C7 application note: www.infineon.com
- IFX CoolMOS™ C7 simulation model: www.infineon.com
- IFX Design tools: www.infineon.com

Revision History

IPZ65R065C7

Revision: 2013-10-18, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2013-10-11	Release of final version
2.1	2013-10-18	final datasheet

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

Edition 2011-08-01**Published by****Infineon Technologies AG****81726 München, Germany****© 2011 Infineon Technologies AG****All Rights Reserved.**

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

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.