

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

800V CoolMOS™ CE Power Transistor
IPA80R1K0CE

Data Sheet

Rev. 2.1
Final

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 selected package choice offering the benefit of reduced system costs and higher power density designs.

Features

- High voltage technology
- Extreme dv/dt rated
- High peak current capability
- Low gate charge
- Low effective capacitances
- Pb-free plating, RoHS Compliant, Halogen free mold compound
- Qualified for consumer grade applications

Applications

LED Lighting for retrofit applications in QR Flyback topology

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

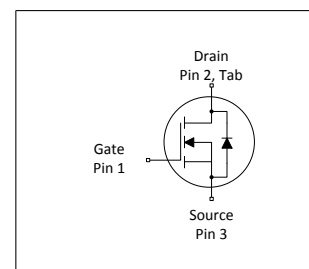


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_J=25^{\circ}C$	800	V
$R_{DS(on),max}$	950	mΩ
$Q_{g,typ}$	31	nC
$I_{D,pulse}$	18	A
$E_{oss}@400V$	2.4	μJ
Body diode di/dt	400	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPA80R1K0CE	PG-TO 220 FullPAK	8R1K0CE	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	-	-	5.7 3.6	A	$T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	18	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	230	mJ	$I_D=1.6\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.20	mJ	$I_D=1.6\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche current, repetitive	I_{AR}	-	-	1.60	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	$V_{DS}=0\dots640\text{V}$
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}	-	-	32	W	$T_C=25^\circ\text{C}$
Storage temperature	T_{stg}	-40	-	150	$^\circ\text{C}$	-
Operating junction temperature	T_j	-40	-	150	$^\circ\text{C}$	-
Mounting torque	-	-	-	50	Ncm	M2.5 screws
Continuous diode forward current	I_S	-	-	5.7	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	18	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	4	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	-	-	400	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 for TO-220FP	V_{ISO}	-	-	2500	V	V_{rms} , $T_C=25^\circ\text{C}$, $t=1\text{min}$

¹⁾ Limited by $T_{j,max} < 150^\circ\text{C}$.

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 TO-220 FullPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	3.9	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	80	°C/W	leaded
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	$V_{(BR)DSS}$	800	-	-	V	$V_{GS}=0V$, $I_D=0.25mA$
Gate threshold voltage	$V_{(GS)th}$	2.1	3.0	3.9	V	$V_{DS}=V_{GS}$, $I_D=0.25mA$
Zero gate voltage drain current	I_{DSS}	-	-	10	μA	$V_{DS}=800$, $V_{GS}=0V$, $T_j=25^\circ\text{C}$ $V_{DS}=800$, $V_{GS}=0V$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20V$, $V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.83 2.19	0.95 -	Ω	$V_{GS}=10V$, $I_D=3.6A$, $T_j=25^\circ\text{C}$ $V_{GS}=10V$, $I_D=3.6A$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	1.2	-	Ω	$f=1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	785	-	pF	$V_{GS}=0V$, $V_{DS}=100V$, $f=1MHz$
Output capacitance	C_{oss}	-	33	-	pF	$V_{GS}=0V$, $V_{DS}=100V$, $f=1MHz$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	26	-	pF	$V_{GS}=0V$, $V_{DS}=0...480V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	69	-	pF	$I_D=\text{constant}$, $V_{GS}=0V$, $V_{DS}=0...480V$
Turn-on delay time	$t_{d(on)}$	-	25	-	ns	$V_{DD}=400V$, $V_{GS}=10V$, $I_D=5.7A$, $R_G=15\Omega$; see table 9
Rise time	t_r	-	15	-	ns	$V_{DD}=400V$, $V_{GS}=10V$, $I_D=5.7A$, $R_G=15\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	72	-	ns	$V_{DD}=400V$, $V_{GS}=10V$, $I_D=5.7A$, $R_G=15\Omega$; see table 9
Fall time	t_f	-	8	-	ns	$V_{DD}=400V$, $V_{GS}=10V$, $I_D=5.7A$, $R_G=15\Omega$; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	4	-	nC	$V_{DD}=640V$, $I_D=5.7A$, $V_{GS}=0$ to $10V$
Gate to drain charge	Q_{gd}	-	15	-	nC	$V_{DD}=640V$, $I_D=5.7A$, $V_{GS}=0$ to $10V$
Gate charge total	Q_g	-	31	-	nC	$V_{DD}=640V$, $I_D=5.7A$, $V_{GS}=0$ to $10V$
Gate plateau voltage	$V_{plateau}$	-	5.5	-	V	$V_{DD}=640V$, $I_D=5.7A$, $V_{GS}=0$ 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 480V

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 480V

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1	-	V	$V_{GS}=0V$, $I_F=5.7A$, $T_j=25^{\circ}C$
Reverse recovery time	t_{rr}	-	520	-	ns	$V_R=400V$, $I_F=5.7A$, $di_F/dt=100A/\mu s$; see table 8
Reverse recovery charge	Q_{rr}	-	5	-	μC	$V_R=400V$, $I_F=5.7A$, $di_F/dt=100A/\mu s$; see table 8
Peak reverse recovery current	I_{rrm}	-	18	-	A	$V_R=400V$, $I_F=5.7A$, $di_F/dt=100A/\mu s$; see table 8

5 Electrical characteristics diagrams

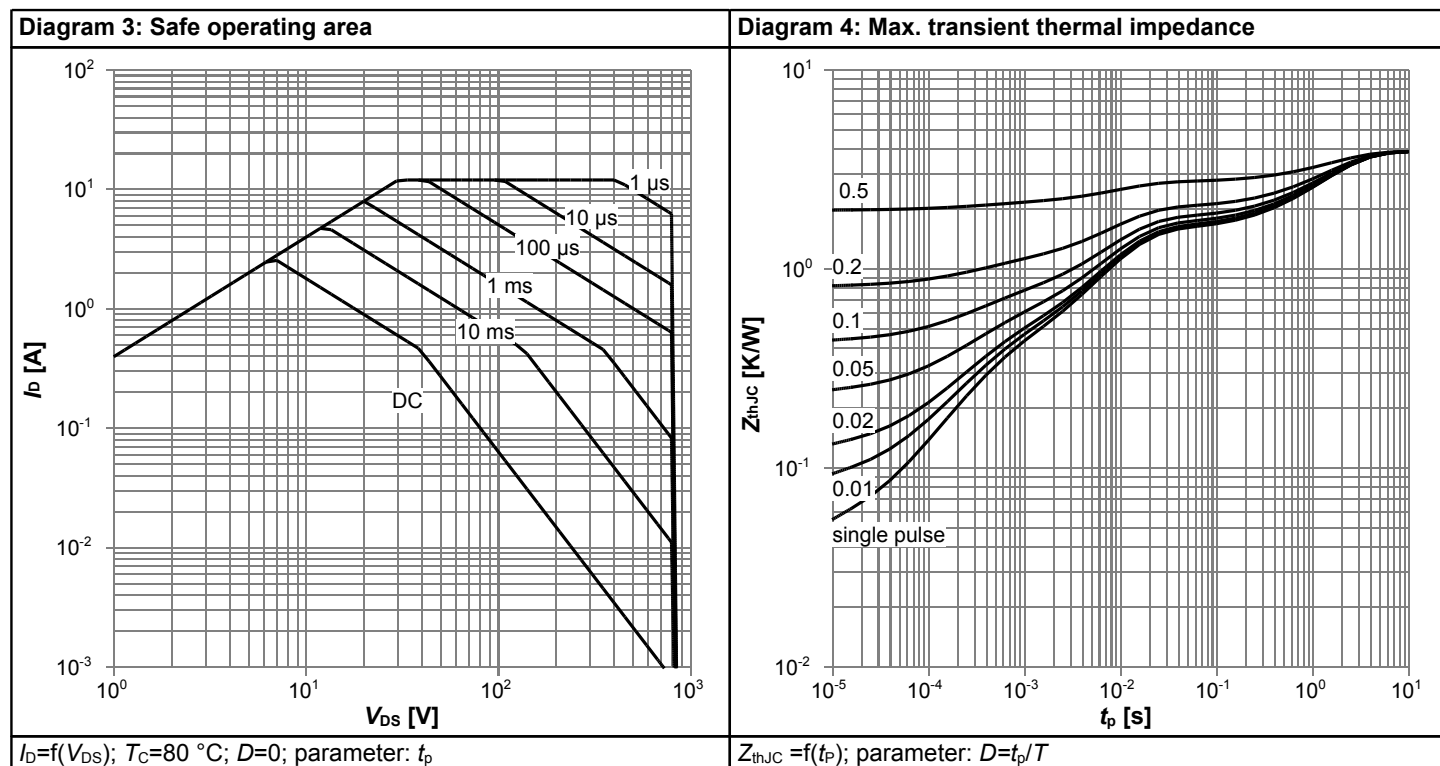
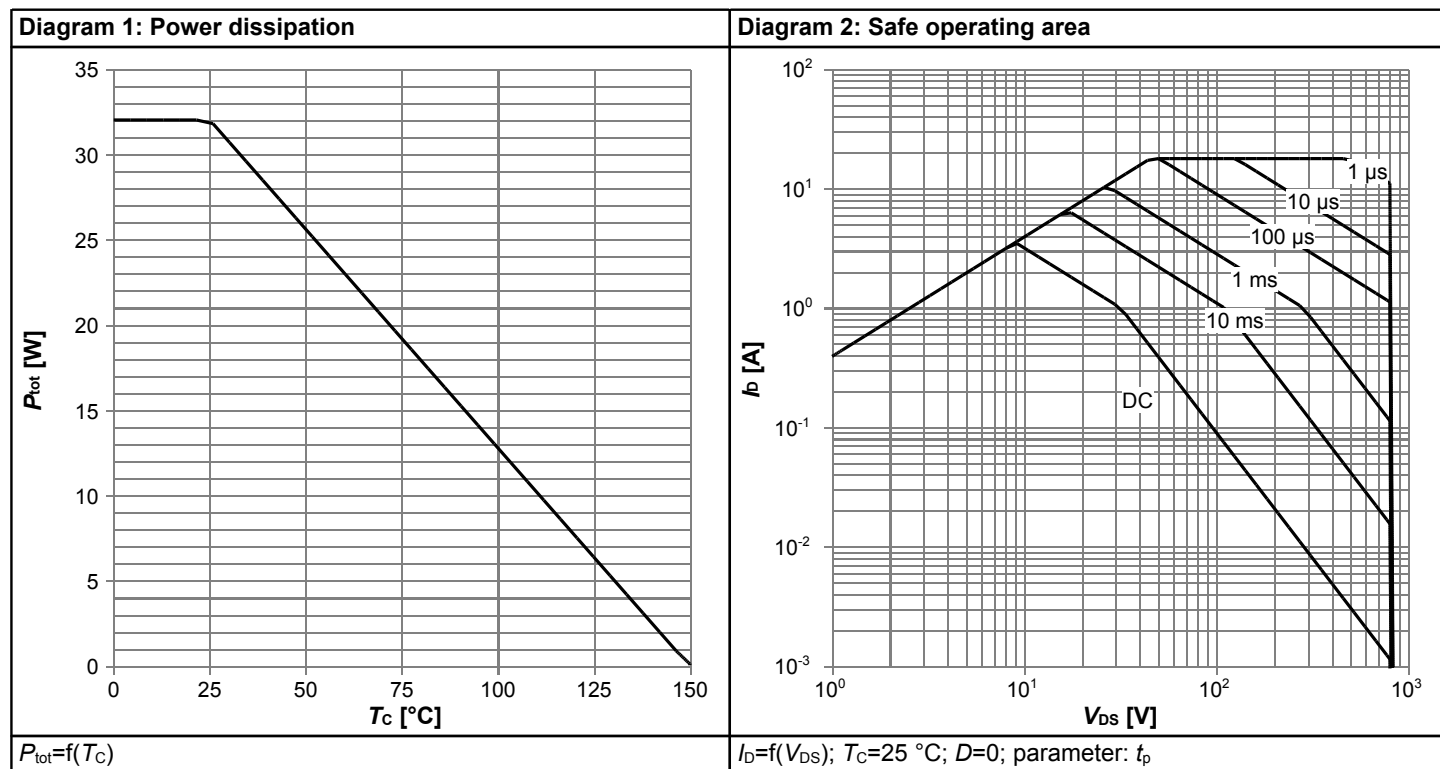


Diagram 5: Typ. output characteristics

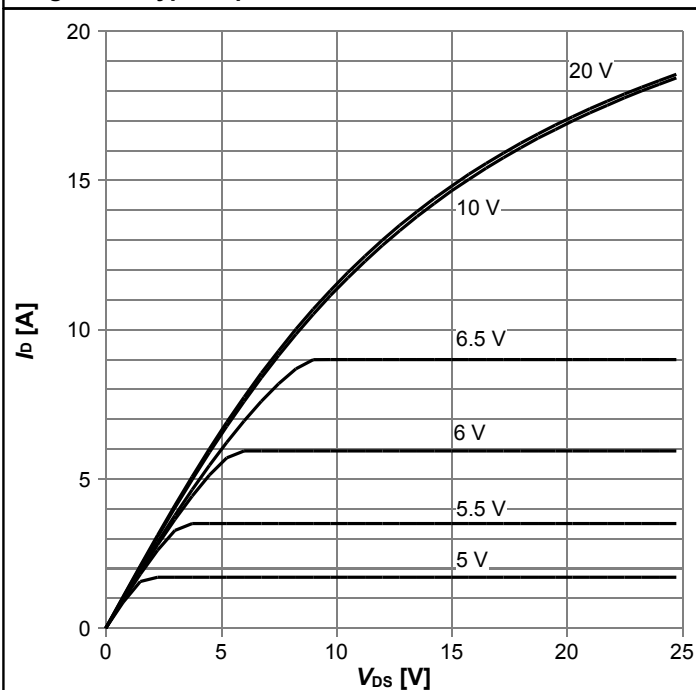

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; t_p = 10\text{ }\mu\text{s}; \text{parameter: } V_{GS}$

Diagram 6: Typ. output characteristics

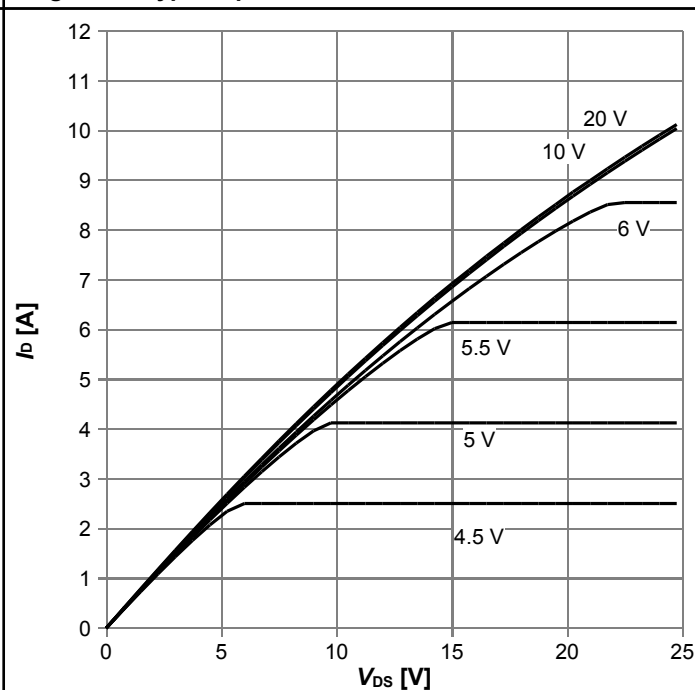

 $I_D = f(V_{DS}); T_J = 150^\circ\text{C}; t_p = 10\text{ }\mu\text{s}; \text{parameter: } V_{GS}$

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

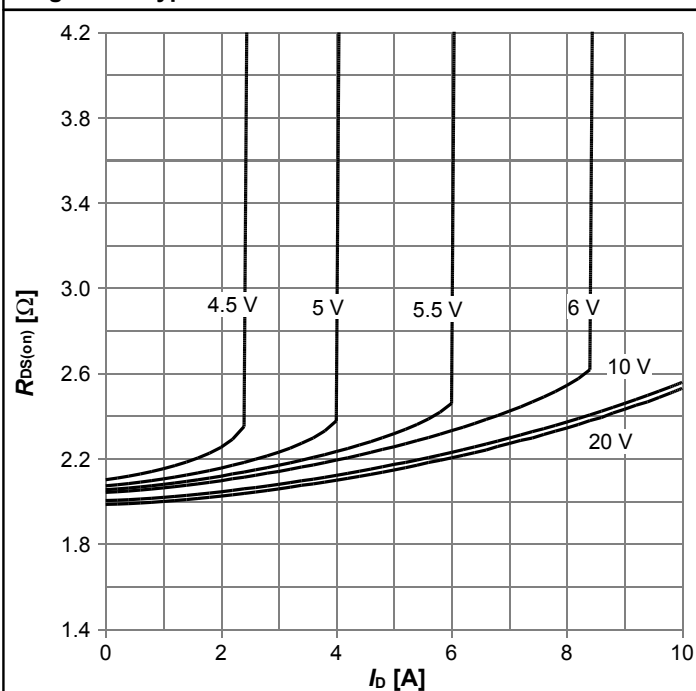

 $R_{DS(on)} = f(I_D); T_J = 150^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 8: Drain-source on-state resistance

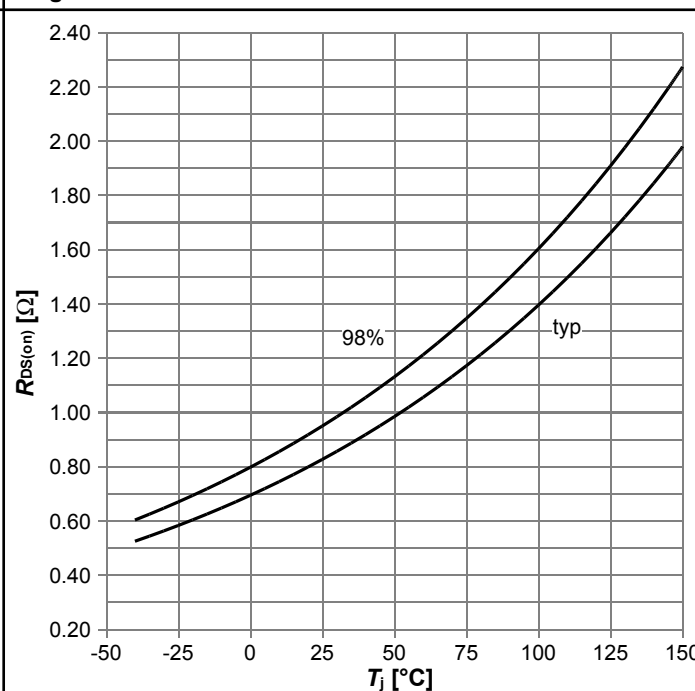

 $R_{DS(on)} = f(T_J); I_D = 3.6\text{ A}; V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics

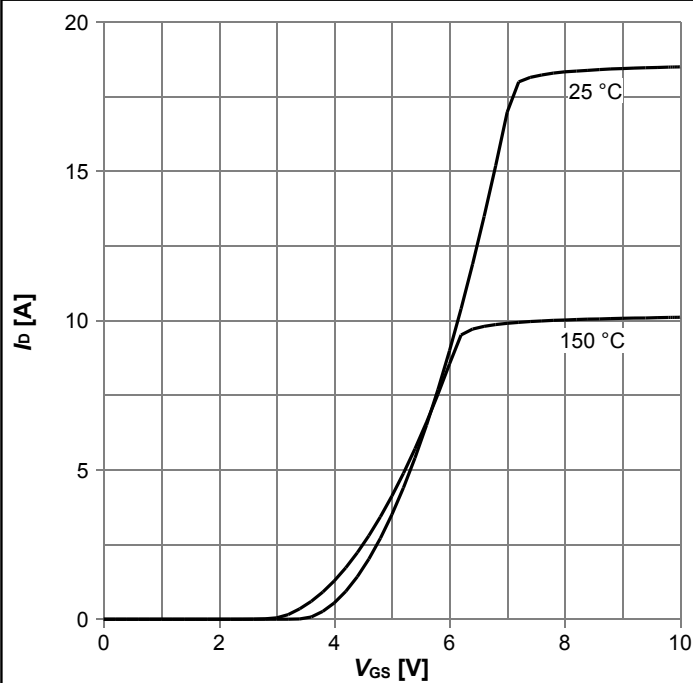

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}; t_p = 10 \mu s; \text{parameter: } T_j$

Diagram 10: Typ. gate charge

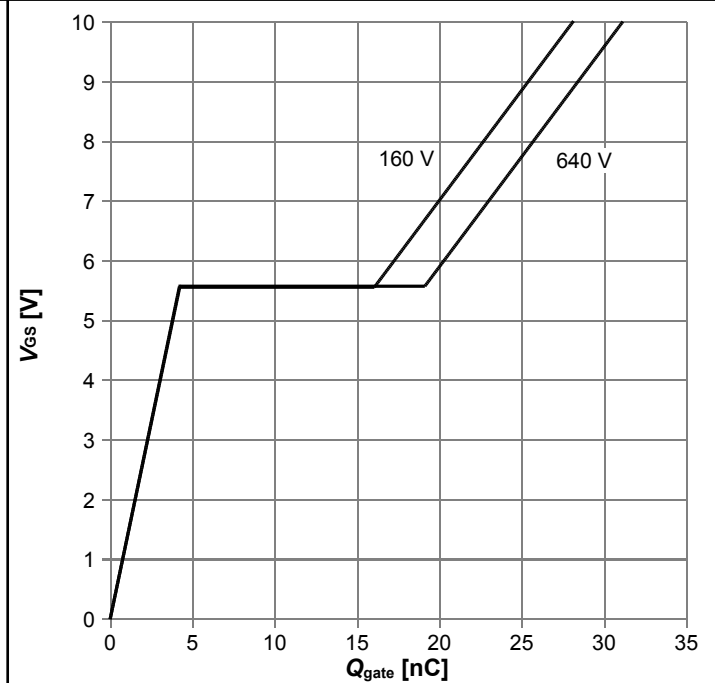

 $V_{GS} = f(Q_{gate}); I_D = 5.7 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 11: Forward characteristics of reverse diode

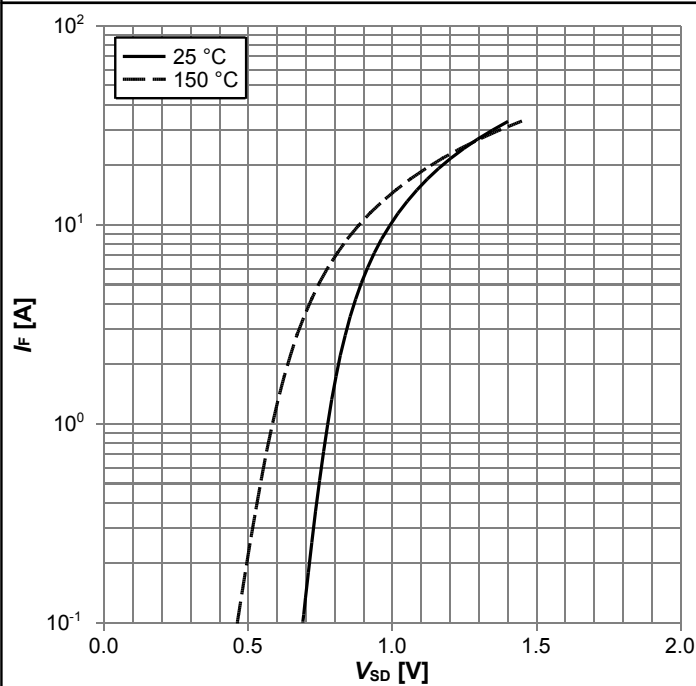

 $I_F = f(V_{SD}); t_p = 10 \mu s; \text{parameter: } T_j$

Diagram 12: Avalanche energy

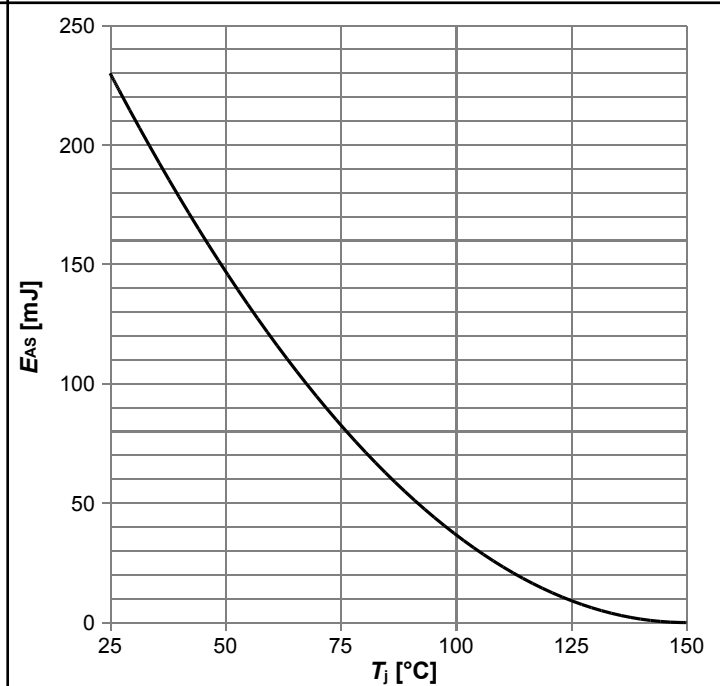
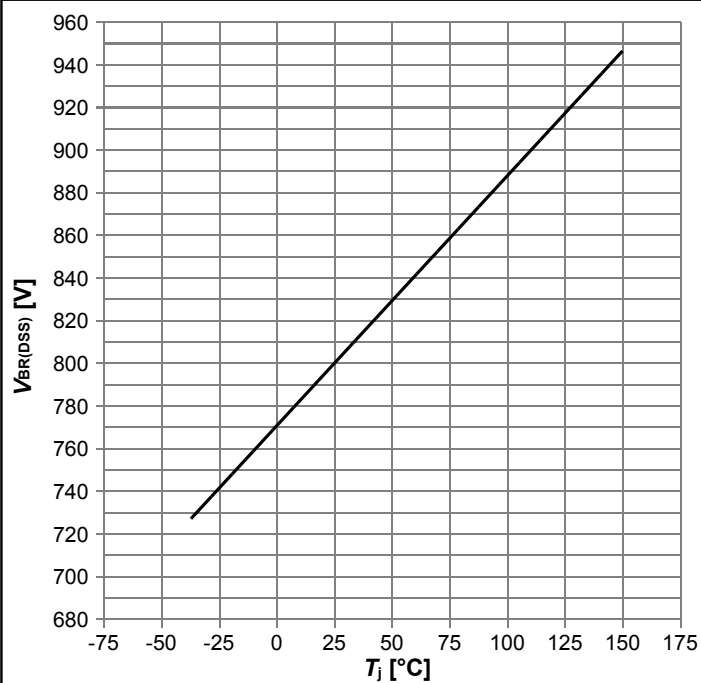
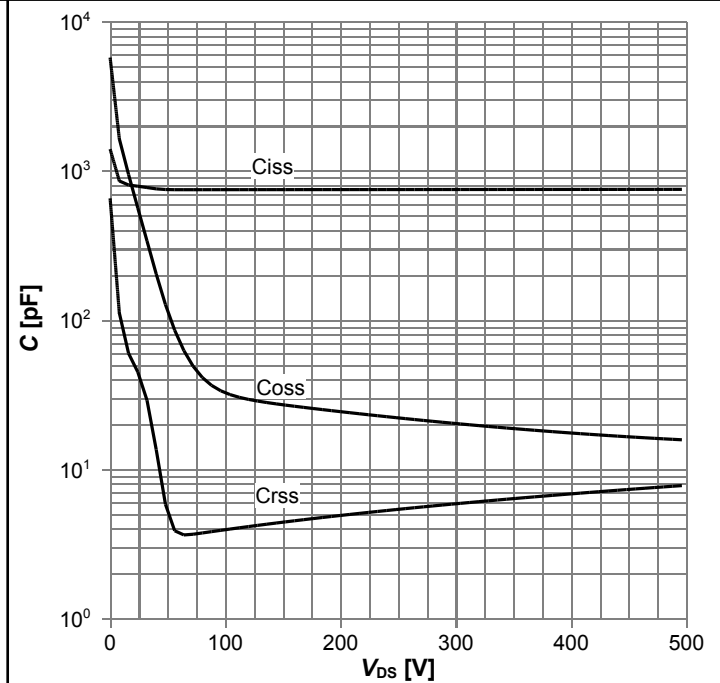

 $E_{AS} = f(T_j); I_D = 1.6 \text{ A}; V_{DD} = 50 \text{ V}$

Diagram 13: Drain-source breakdown voltage



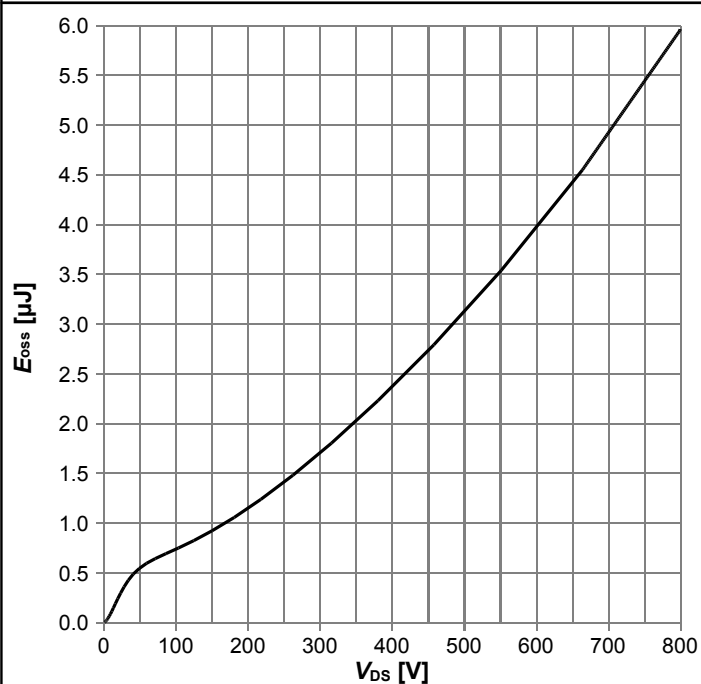
$$V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$$

Diagram 14: Typ. capacitances



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

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

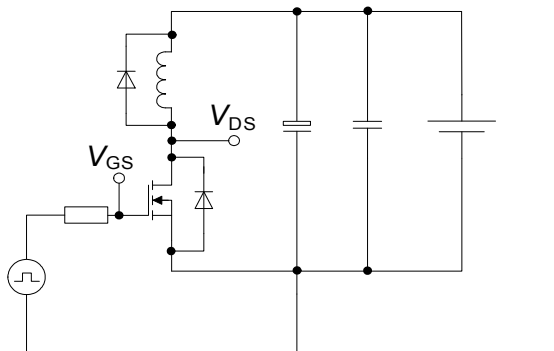
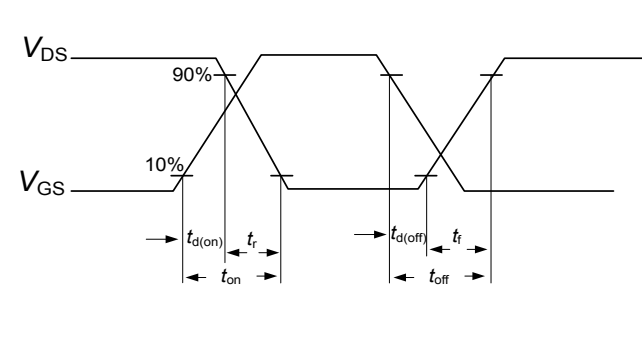
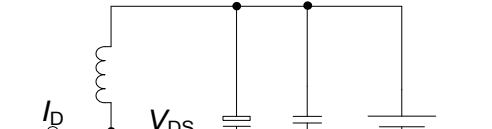
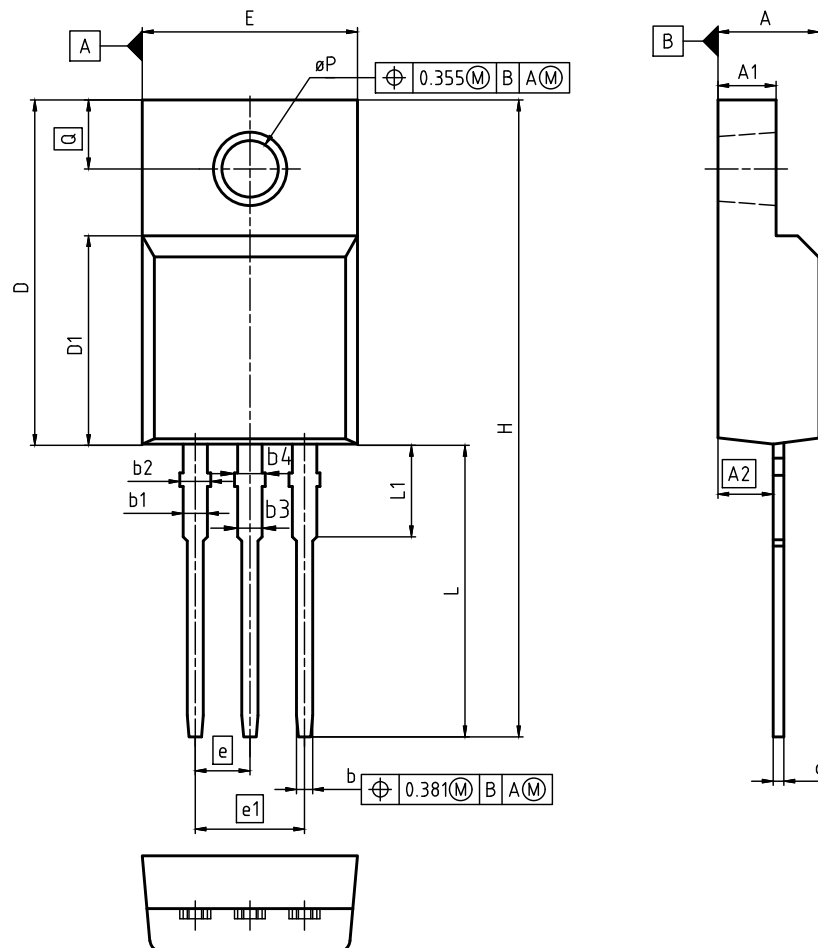
Switching times test circuit for inductive load	Switching times waveform
 The circuit diagram illustrates a switching test setup for an inductive load. A MOSFET is driven by a pulse generator connected to its gate through a resistor. The drain of the MOSFET is connected to an inductor, which is in series with a freewheeling diode. The other end of the inductor and diode is connected to a parallel combination of a capacitor and a battery. The drain-source voltage V_{DS} is measured across the load.	 The timing diagram shows the switching waveforms for V_{DS} and V_{GS}. The V_{GS} signal transitions from low to high (turn-on) and back to low (turn-off). The V_{DS} signal transitions from high to low (turn-on) and back to high (turn-off). Key time intervals are marked: $t_{d(on)}$: Delay time from V_{GS} rising to 10% to V_{DS} falling to 90%. t_r: Rise time of V_{DS} during turn-on. t_{on}: Total turn-on time from 10% V_{GS} to 90% V_{DS}. $t_{d(off)}$: Delay time from V_{GS} falling to 10% to V_{DS} rising to 90%. t_f: Fall time of V_{DS} during turn-off. t_{off}: Total turn-off time from 90% V_{DS} to 10% V_{GS}.

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.50	4.90	0.177	0.193
A1	2.34	2.85	0.092	0.112
A2	2.42	2.86	0.095	0.113
b	0.65	0.90	0.026	0.035
b1	0.95	1.38	0.037	0.054
b2	0.95	1.51	0.037	0.059
b3	0.65	1.38	0.026	0.054
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.67	16.15	0.617	0.636
D1	8.97	9.83	0.353	0.387
E	10.00	10.65	0.394	0.419
e	2.54 (BSC)		0.100 (BSC)	
e1	5.08		0.200	
N	3		3	
H	28.70	29.75	1.130	1.171
L	12.78	13.75	0.503	0.541
L1	2.83	3.45	0.111	0.136
øP	2.95	3.38	0.116	0.133
Q	3.15	3.50	0.124	0.138

Dimensions do not include mold flash, protrusions or gate burrs

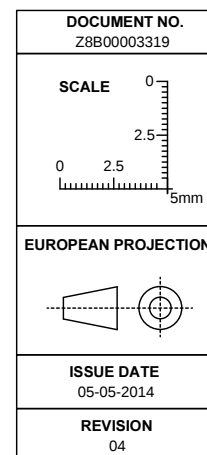


Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm/inches

8 Appendix A

Table 11 Related Links

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

Revision History

IPA80R1K0CE

Revision: 2015-06-23, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2014-09-25	Release of final version
2.1	2015-06-23	Continuous current Id update

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
© 2015 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.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.