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MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

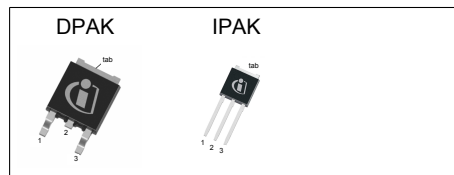
800V CoolMOS™ CE Power Transistor
IPx80R1K4CE

Data Sheet

Rev. 2.2
Final

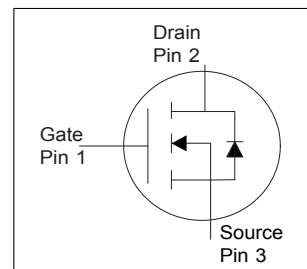
1 Description

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 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; halogen free mold compound



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
$V_{DS} @ T_j=25^{\circ}C$	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		

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

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	$^\circ\text{C}/\text{W}$	-
Thermal resistance, junction - ambient ⁴⁾	R_{thJA}	-	- 35	62 -	$^\circ\text{C}/\text{W}$	SMD version, device on PCB, minimal footprint SMD version, device on PCB, 6cm^2 cooling area ⁴⁾
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}	-	-	260	$^\circ\text{C}$	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 $40\text{mm} \times 40\text{mm} \times 1.5\text{mm}$ one layer epoxy PCB FR4 with 6cm^2 copper area (thickness $70\mu\text{m}$) 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}	-	-	10	μA	$V_{DS}=800V, V_{GS}=0V, T_j=25^\circ C$ $V_{DS}=800V, V_{GS}=0V, T_j=150^\circ C$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	1.2	1.4	Ω	$V_{GS}=10V, I_D=2.3A, T_j=25^\circ C$ $V_{GS}=10V, I_D=2.3A, T_j=150^\circ C$
Gate resistance	R_G	-	1.2	-	Ω	$f=1\text{ MHz}, \text{open drain}$

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	$V_{GS}=0V, V_{DS}=0\dots 480V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	51	-	pF	$I_D=\text{constant}, V_{GS}=0V, V_{DS}=0\dots 480V$
Turn-on delay time	$t_{d(on)}$	-	25	-	ns	$V_{DD}=400V, V_{GS}=0/10V, I_D=3.9A, R_G=22\Omega$
Rise time	t_r	-	15	-	ns	$V_{DD}=400V, V_{GS}=0/10V, I_D=3.9A, R_G=22\Omega$
Turn-off delay time	$t_{d(off)}$	-	72	-	ns	$V_{DD}=400V, V_{GS}=0/10V, I_D=3.9A, R_G=22\Omega$
Fall time	t_f	-	12	-	ns	$V_{DD}=400V, V_{GS}=10\text{ V}, I_D=3.9A, R_G=22\Omega$

Table 6 Gate charge characteristics

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

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	$V_{GS}=0V, I_F=3.9A, T_j=25^\circ C$
Reverse recovery time	t_{rr}	-	520	-	ns	$V_R=400V, I_F=3.9A, di_F/dt=100A/\mu s$
Reverse recovery charge	Q_{rr}	-	4	-	μC	$V_R=400V, I_F=3.9A, di_F/dt=100A/\mu s$
Peak reverse recovery current	I_{rrm}	-	12	-	A	$V_R=400V, I_F=3.9A, di_F/dt=100A/\mu s$

5 Electrical characteristics diagrams

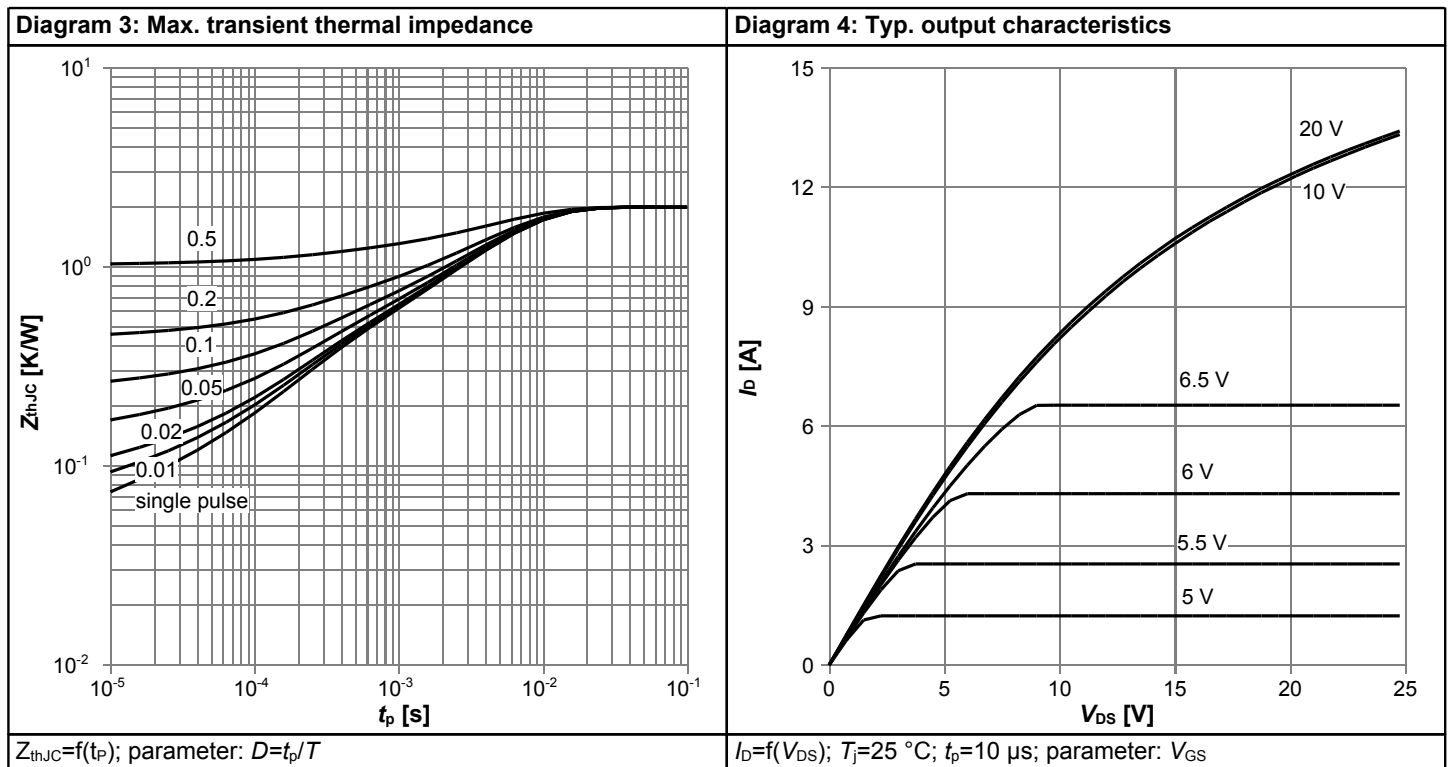
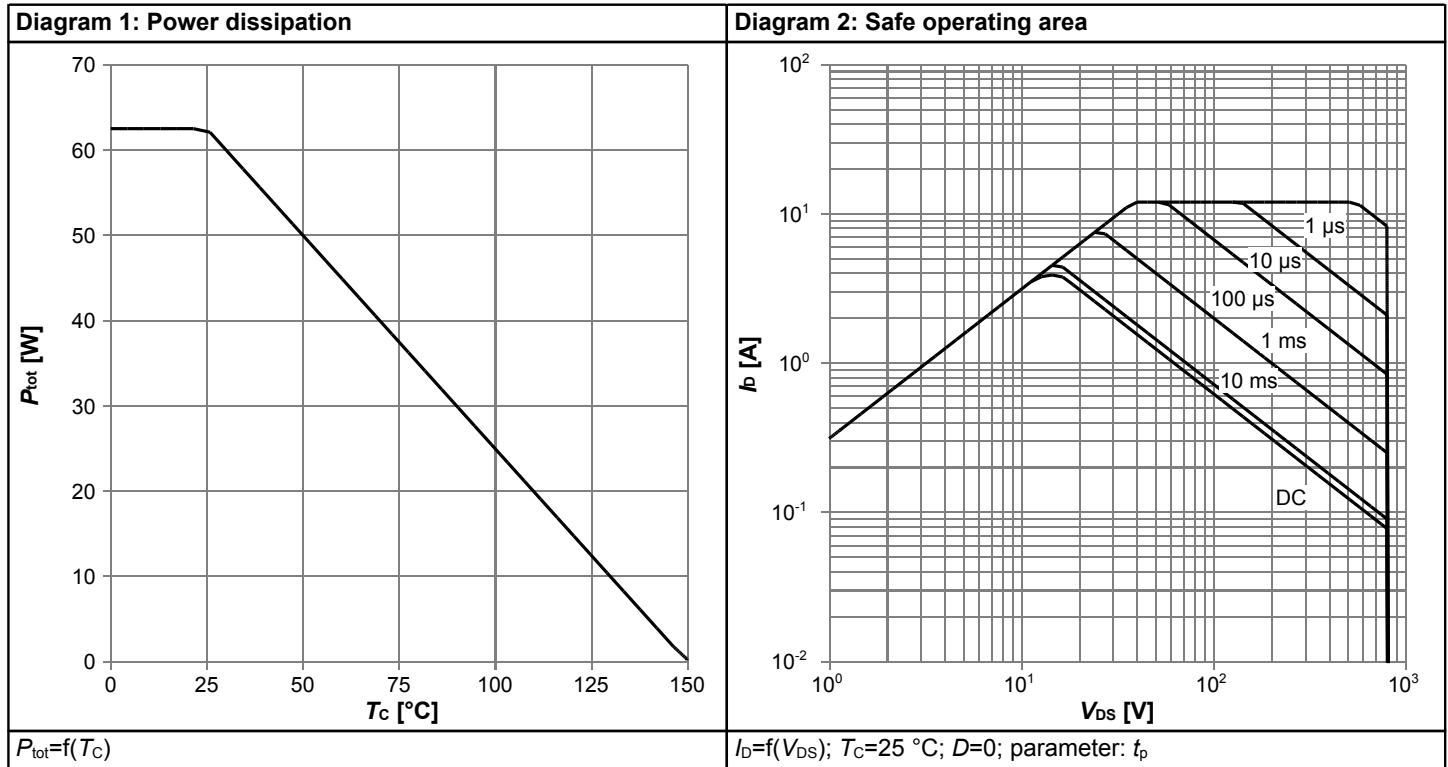
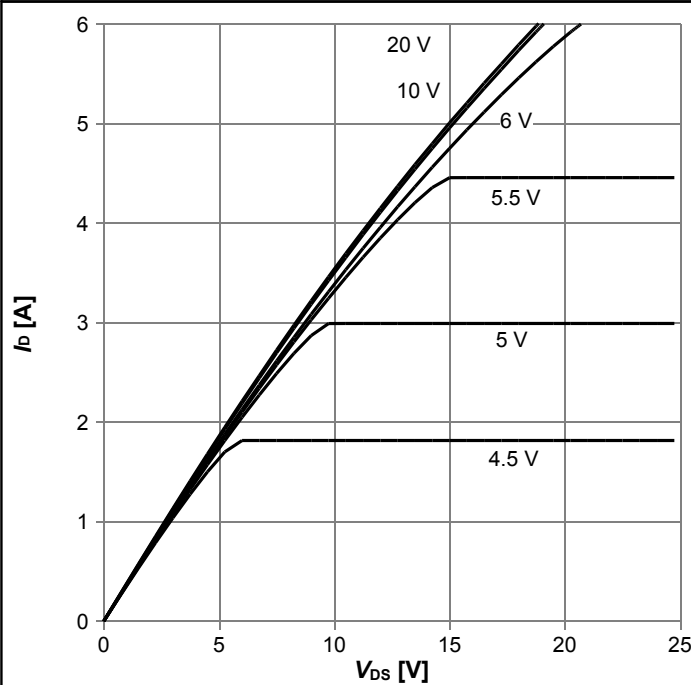
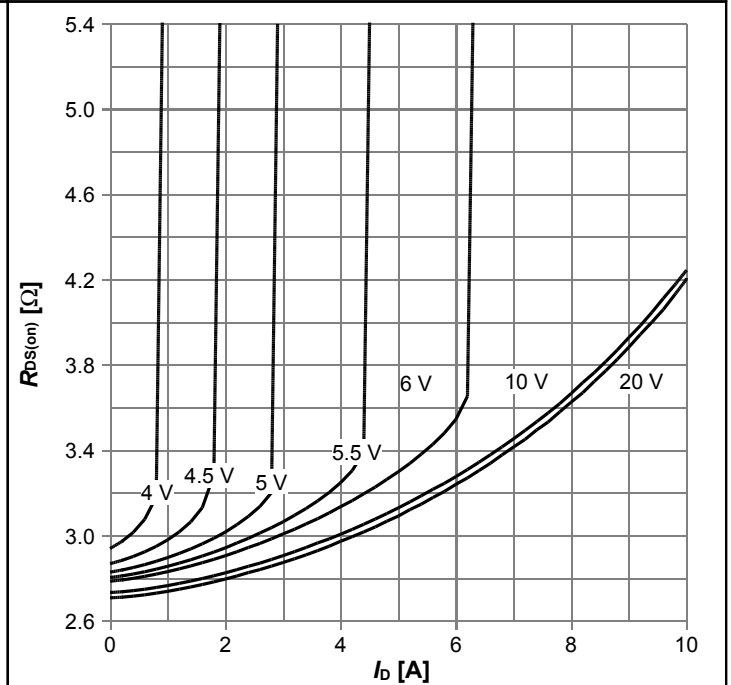


Diagram 5: Typ. output characteristics



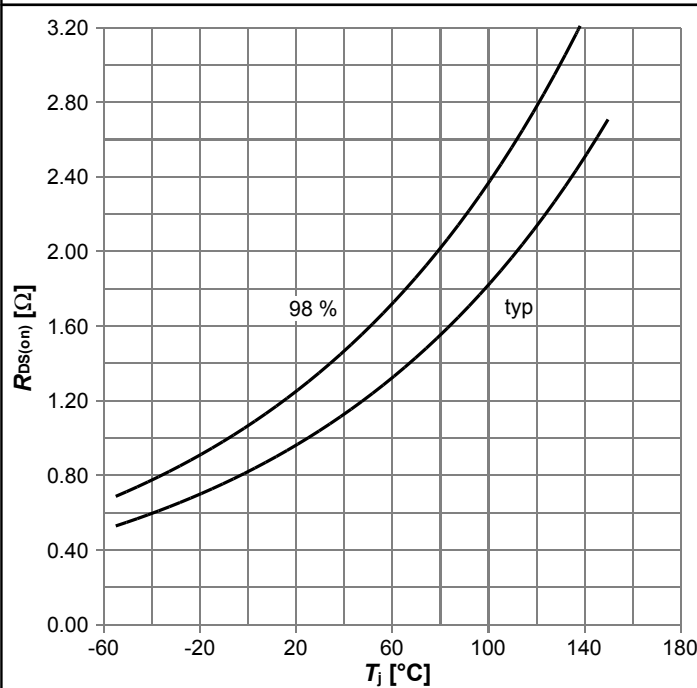
$I_D=f(V_{DS}); T_j=150\text{ }^\circ\text{C}; t_p=10\text{ }\mu\text{s};$ parameter: V_{GS}

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



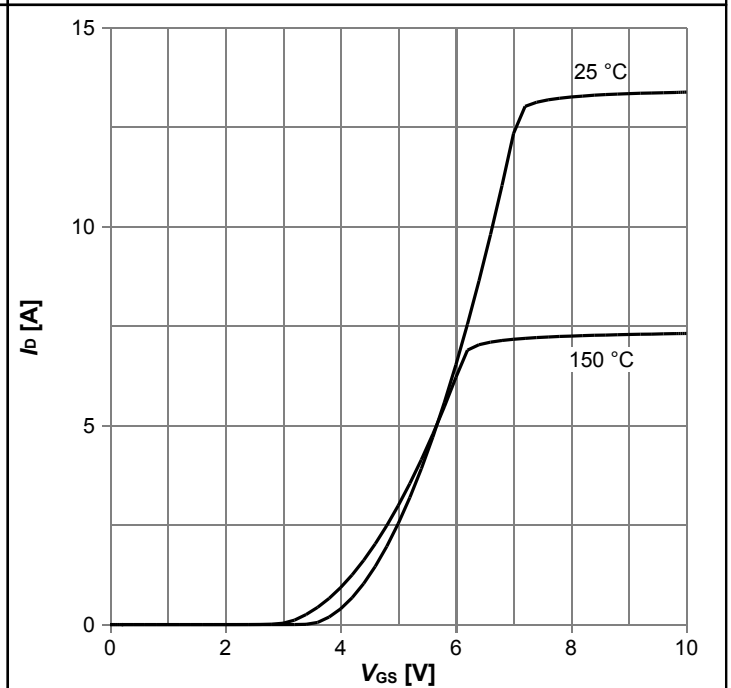
$R_{DS(on)}=f(I_D); T_j=150\text{ }^\circ\text{C};$ parameter: V_{GS}

Diagram 7: Drain-source on-state resistance



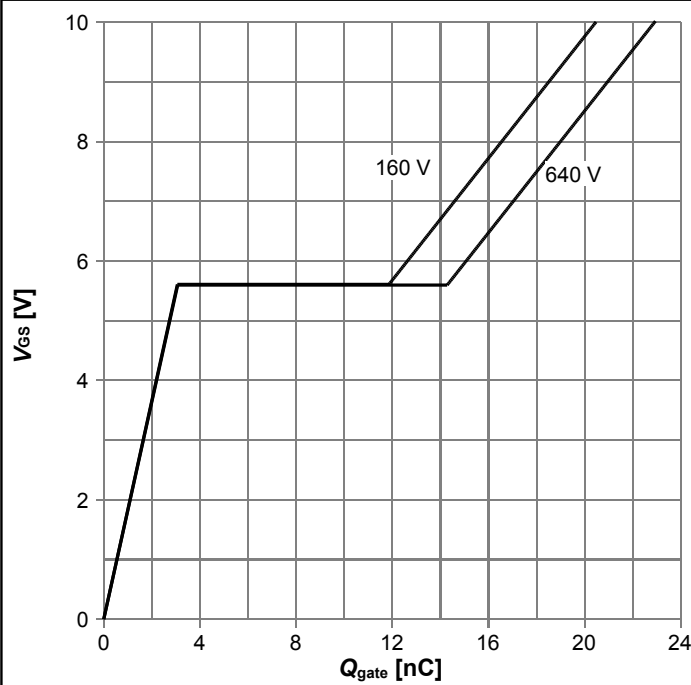
$R_{DS(on)}=f(T_j); I_D=2.3\text{ A}; V_{GS}=10\text{ V}$

Diagram 8: Typ. transfer characteristics



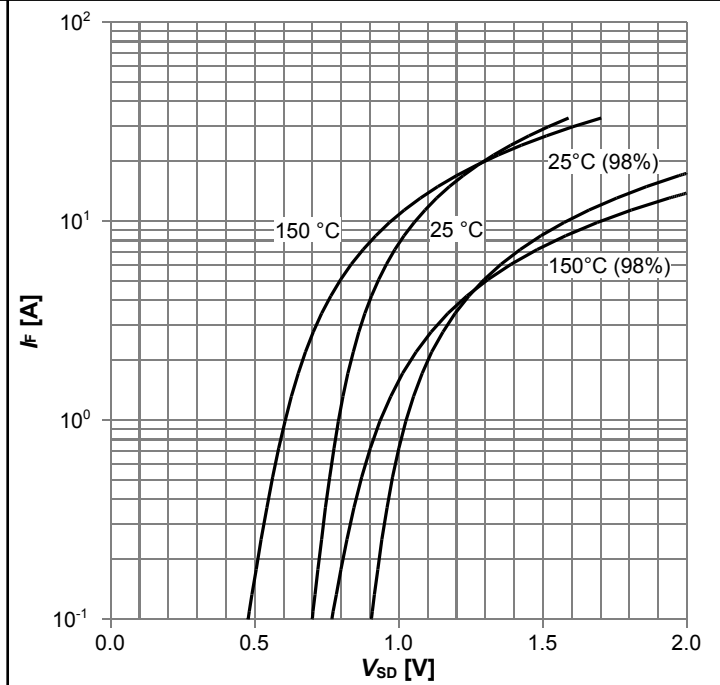
$I_D=f(V_{GS}); |V_{DS}|>2|I_D|R_{DS(on)max}; t_p=10\text{ }\mu\text{s};$ parameter: T_j

Diagram 9: Typ. gate charge



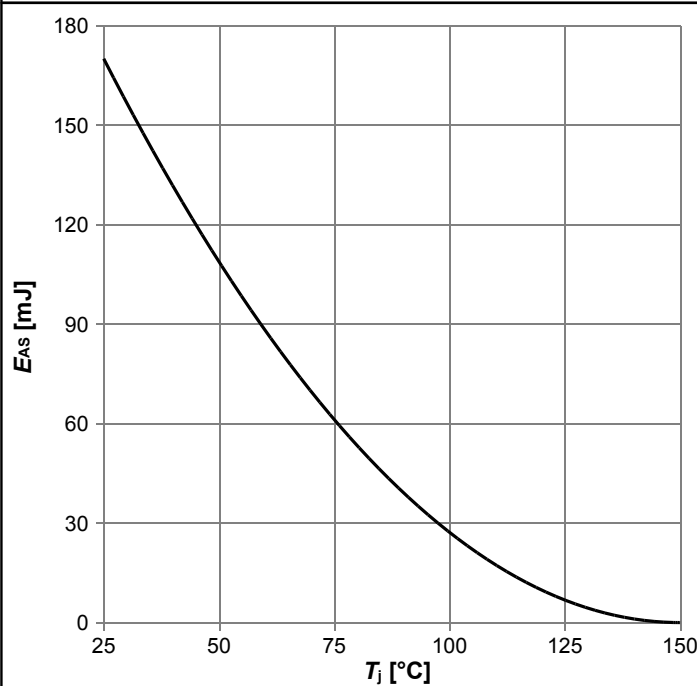
$V_{GS}=f(Q_{gate}); I_D=3.9 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 10: Forward characteristics of reverse diode



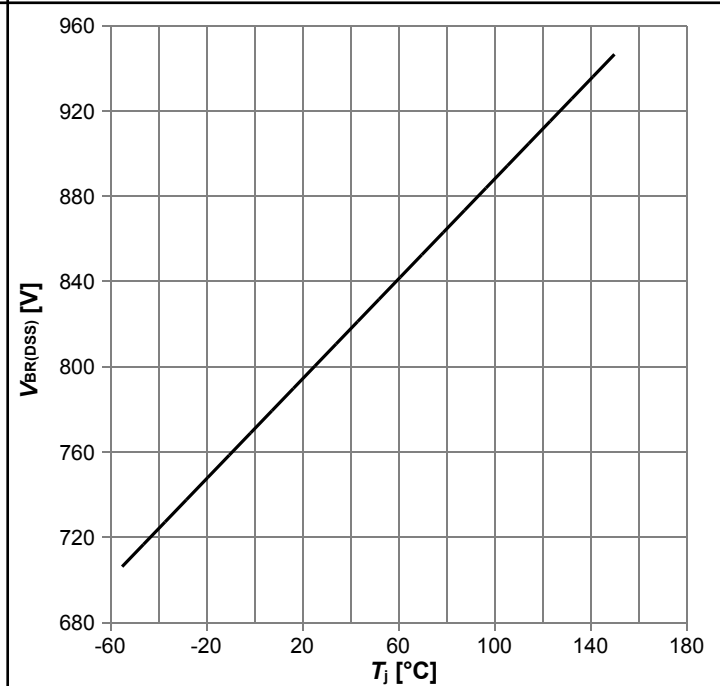
$I_F=f(V_{SD}); t_p=10 \mu\text{s}; \text{parameter: } T_j$

Diagram 11: Avalanche energy



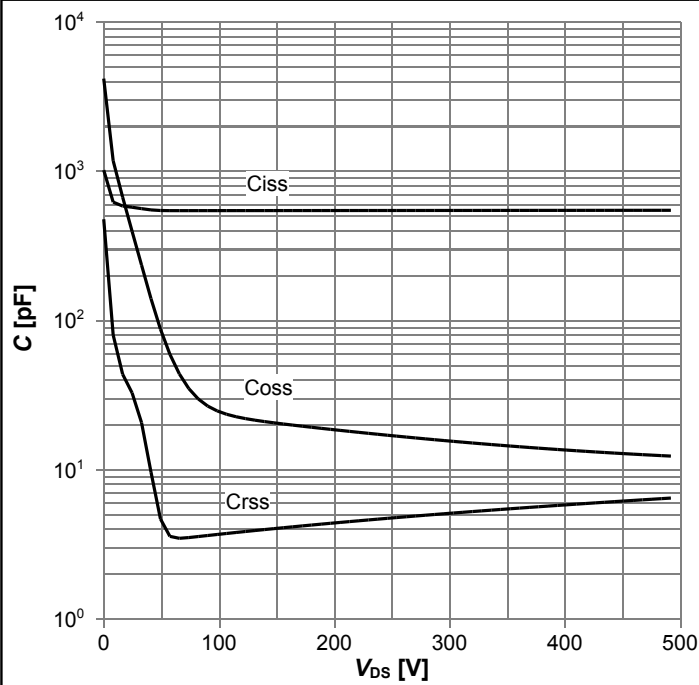
$E_{AS}=f(T_j); I_D=1.2 \text{ A}; V_{DD}=50 \text{ V}$

Diagram 12: Drain-source breakdown voltage



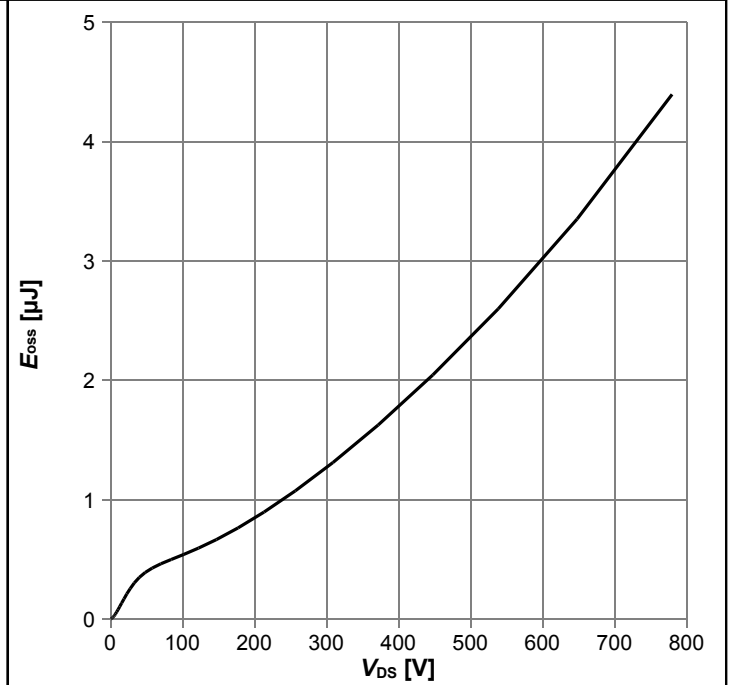
$V_{BR(DSS)}=f(T_j); I_D=0.25 \text{ mA}$

Diagram 13: Typ. capacitances



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

Diagram 14: Typ. Coss stored energy



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

6 Test Circuits

Table 8 Diode characteristics

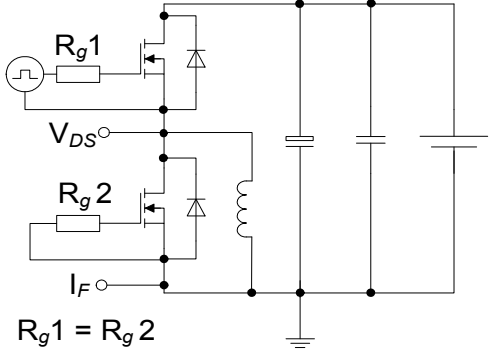
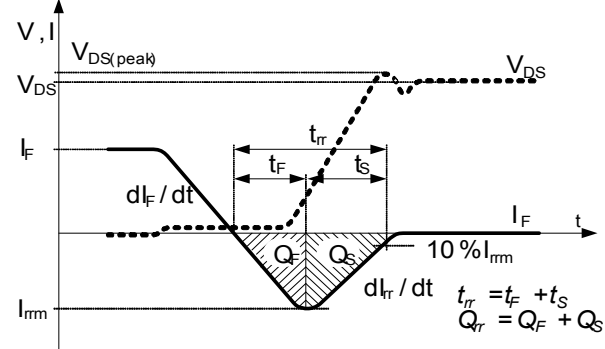
Test circuit for diode characteristics	Diode recovery waveform
 <p>$R_{g1} = R_{g2}$</p>	 <p>$t_{tr} = t_F + t_S$ $Q_r = Q_F + Q_S$</p>

Table 9 Switching times

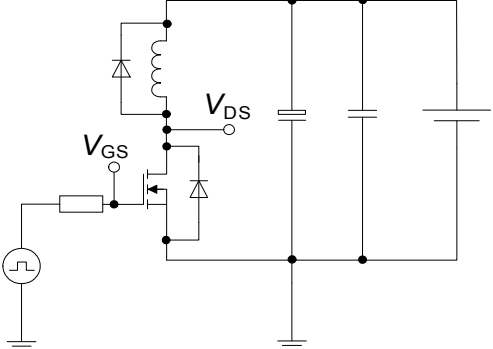
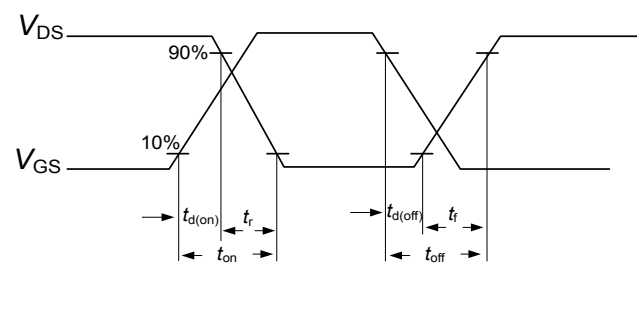
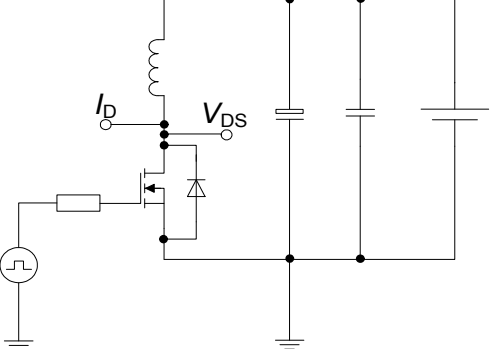
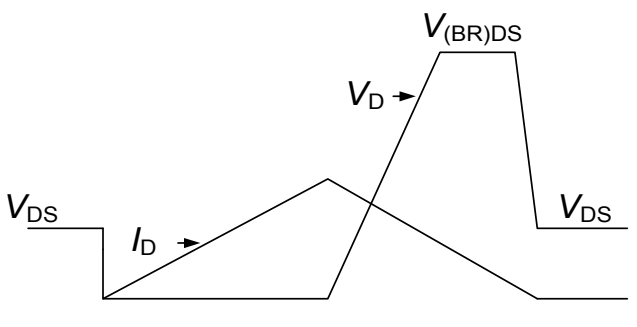
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

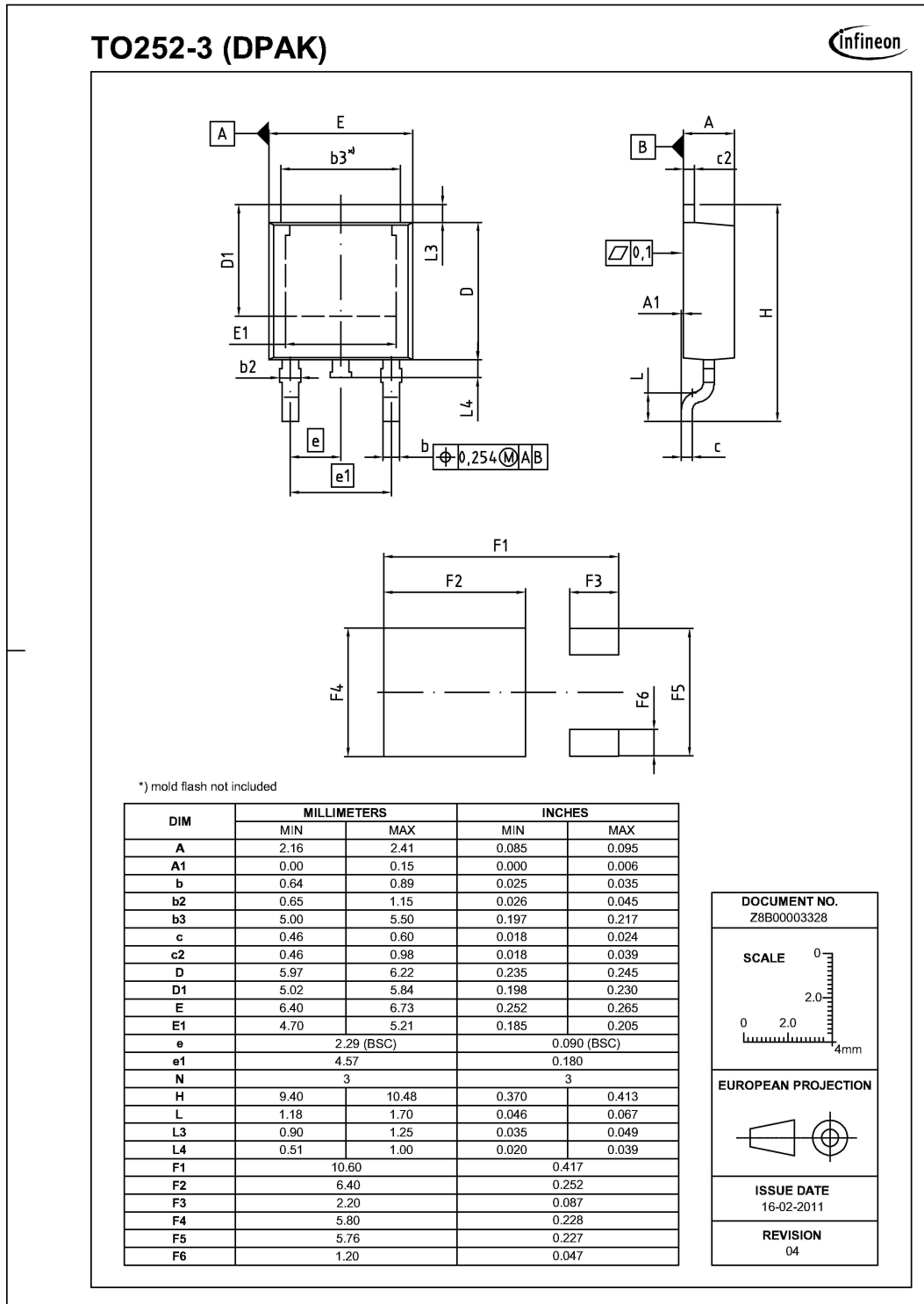
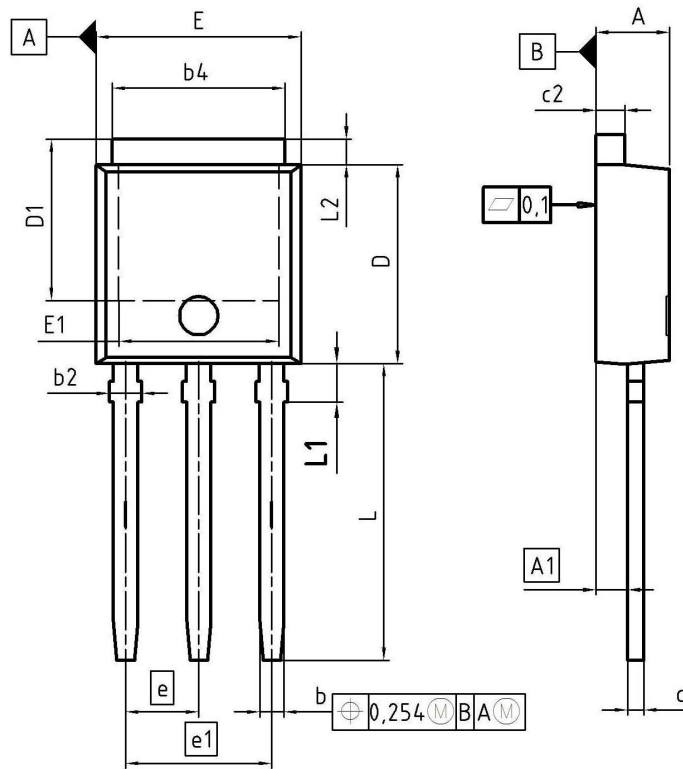


Figure 1 Outline PG-TO 252, dimensions in mm/inches



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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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

IPx80R1K4CE

Revision: 2016-04-27, Rev. 2.2

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
2.2	2016-04-27	Non-halogen free version discontinued

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