

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

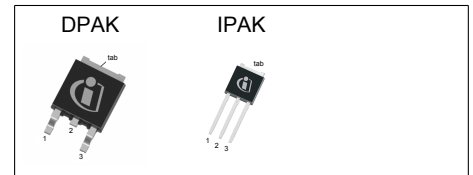
800V CoolMOS™ CE Power Transistor
IPx80R1K0CE

Data Sheet

Rev. 2.2
Final

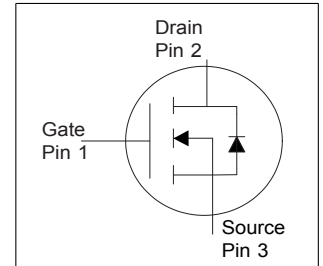
1 Description

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
$R_{DS(on),max}$	0.95	Ω
$Q_{g,typ}$	31	nC
$I_{D,pulse}$	18	A
$V_{GS(th),typ}$	3	V
$C_{O(tr),typ}$	69	pF

Type / Ordering Code	Package	Marking	Related Links
IPD80R1K0CE	PG-TO 252	8R1K0CE	see Appendix A
IPU80R1K0CE	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	-	-	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	$I_D = 1.6\text{A}$; $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	E_{AR}	-	-	0.20	mJ	$I_D = 1.6\text{A}$; $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}	-	-	1.6	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}	-	-	83	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	-	-	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	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_S$, $T_j = 25^\circ\text{C}$
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}	-	-	1.5	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient ⁴⁾	R_{thJA}	-	- 35	62 -	$^\circ\text{C/W}$	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 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm² copper area (thickness 70 μm) 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	$V_{DS}=V_{GS}, I_D=0.25mA$
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	$R_{DS(on)}$	-	0.8 2.2	0.95 -	Ω	$V_{GS}=10V, I_D=3.6A, T_j=25^\circ C$ $V_{GS}=10V, I_D=3.6A, T_j=150^\circ C$
Gate resistance	R_G	-	1.2	-	Ω	$f=1\text{ MHz}$, 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	$V_{DD}=400V, V_{GS}=0/10V, I_D=5.7A, R_G=15\Omega$
Rise time	t_r	-	15	-	ns	$V_{DD}=400V, V_{GS}=0/10V, I_D=5.7A, R_G=15\Omega$
Turn-off delay time	$t_{d(off)}$	-	72	-	ns	$V_{DD}=400V, V_{GS}=0/10V, I_D=5.7A, R_G=15\Omega$
Fall time	t_f	-	8	-	ns	$V_{DD}=400V, V_{GS}=10V, I_D=5.7A, R_G=15\Omega$

Table 6 Gate charge characteristics

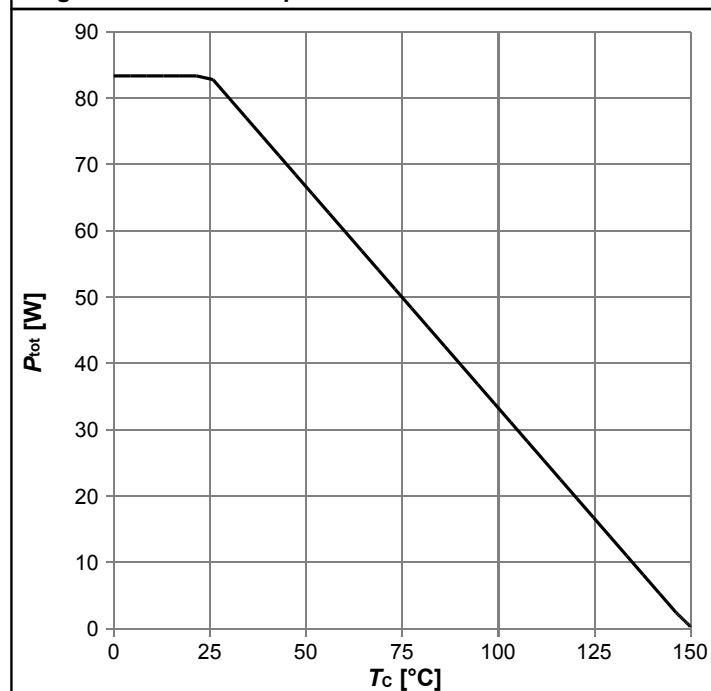
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	4	-	nC	$V_{DD}=640V, I_D=5.7A, V_{GS}=0\text{ to }10V$
Gate to drain charge	Q_{gd}	-	15	-	nC	$V_{DD}=640V, I_D=5.7A, V_{GS}=0\text{ to }10V$
Gate charge total	Q_g	-	31	-	nC	$V_{DD}=640V, I_D=5.7A, V_{GS}=0\text{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

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% $V_{(BR)DSS}$

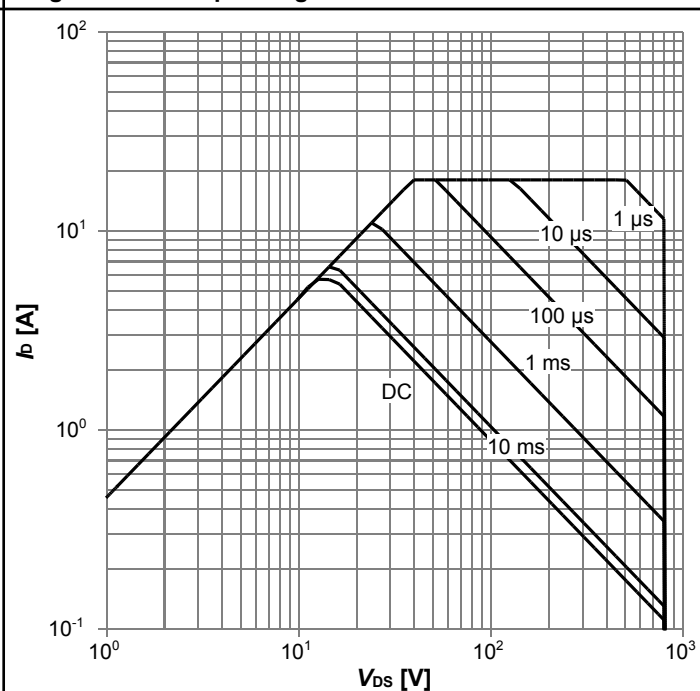
Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1	1.2	V	$V_{GS}=0V$, $I_F=5.7A$, $T_j=25^{\circ}C$
Reverse recovery time	t_{rr}	-	520	-	ns	$V_R=400V$, $I_F=5.7A$, $di_F/dt=100A/\mu s$
Reverse recovery charge	Q_{rr}	-	5	-	μC	$V_R=400V$, $I_F=5.7A$, $di_F/dt=100A/\mu s$
Peak reverse recovery current	I_{rrm}	-	18	-	A	$V_R=400V$, $I_F=5.7A$, $di_F/dt=100A/\mu s$

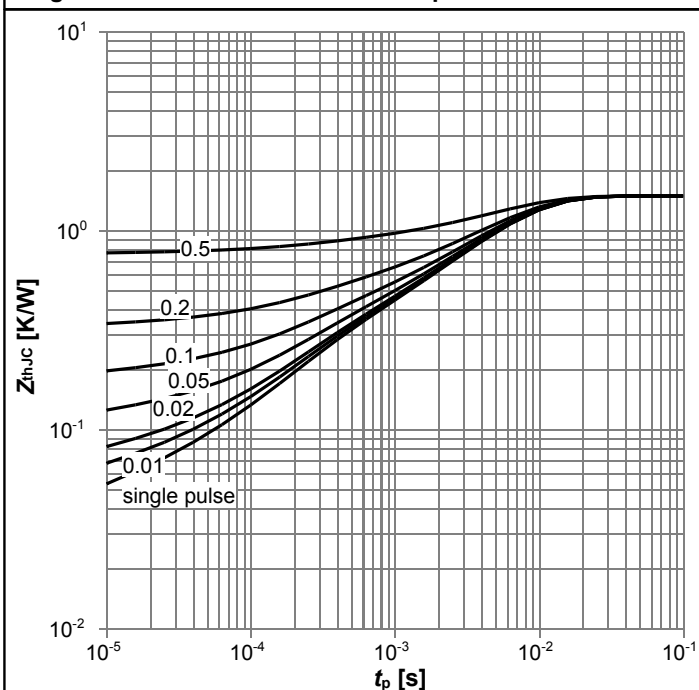
5 Electrical characteristics diagrams

Diagram 1: Power dissipation


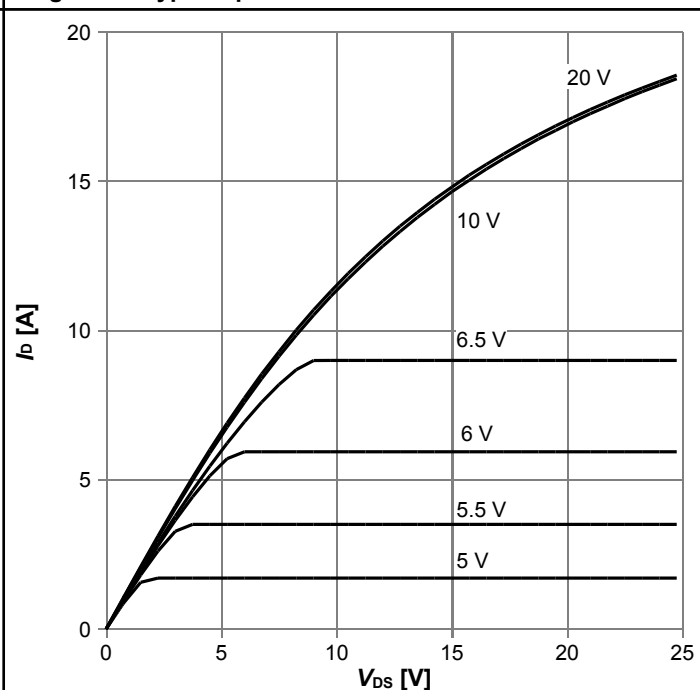
$$P_{tot}=f(T_c)$$

Diagram 2: Safe operating area


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

Diagram 3: Max. transient thermal impedance


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

Diagram 4: Typ. output characteristics


$$I_D=f(V_{DS}); T_j=25\text{ °C}; t_p=10\text{ μs}; \text{parameter: } V_{GS}$$

Diagram 5: Typ. output characteristics

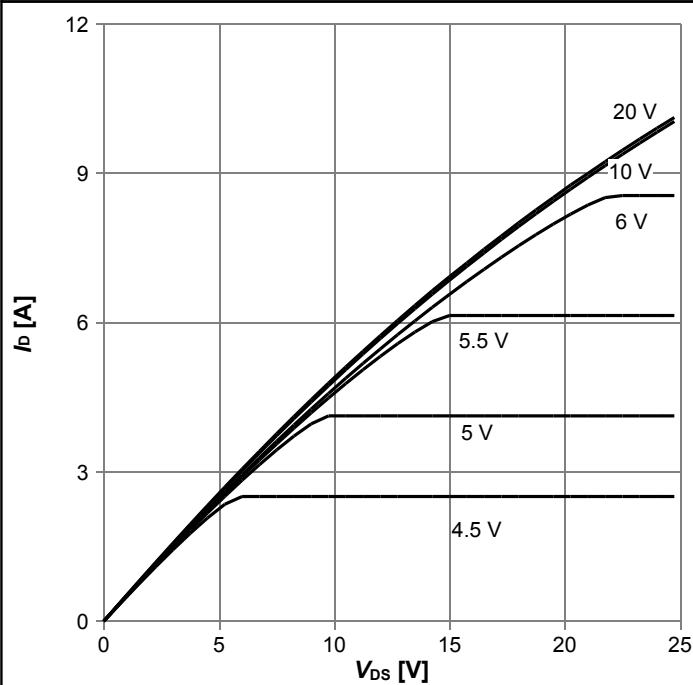

 $I_D = f(V_{DS})$; $T_J = 150^\circ\text{C}$; $t_p = 10\ \mu\text{s}$; parameter: V_{GS}

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

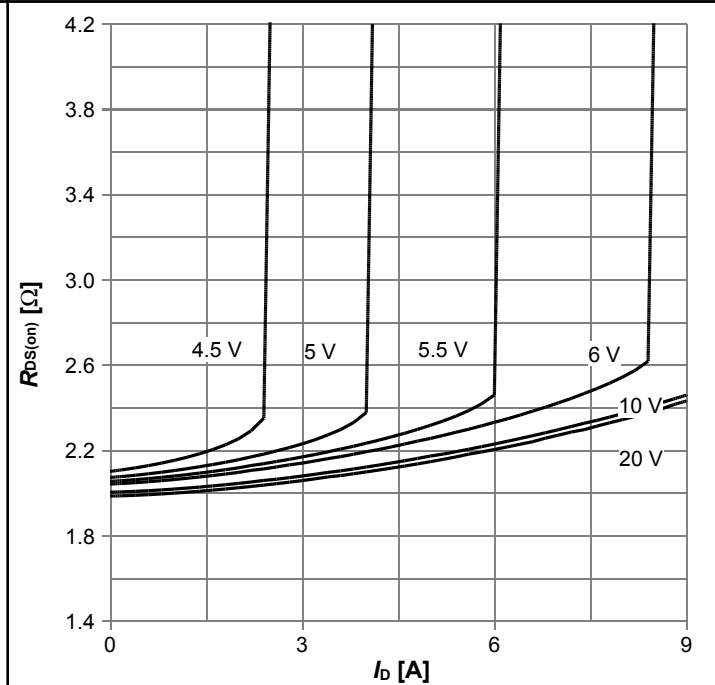

 $R_{DS(on)} = f(I_D)$; $T_J = 150^\circ\text{C}$; parameter: V_{GS}

Diagram 7: Drain-source on-state resistance

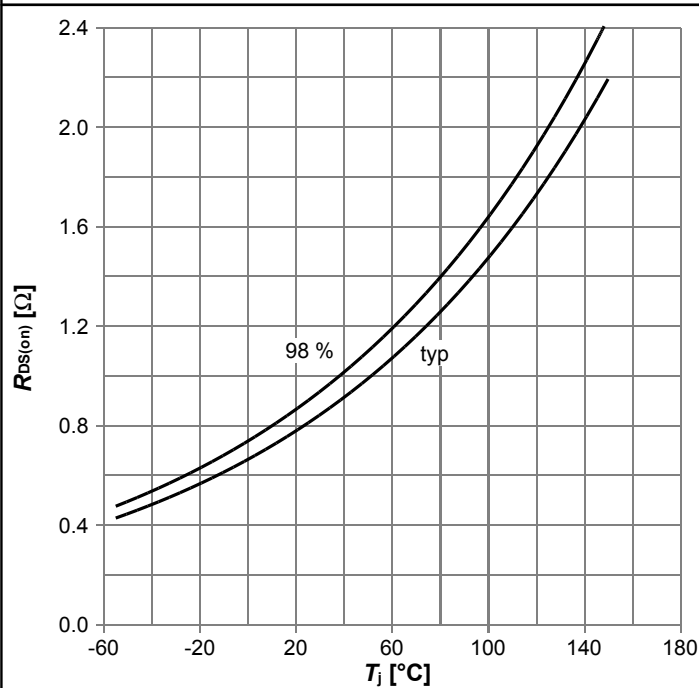

 $R_{DS(on)} = f(T_J)$; $I_D = 3.6\ \text{A}$; $V_{GS} = 10\ \text{V}$

Diagram 8: Typ. transfer characteristics

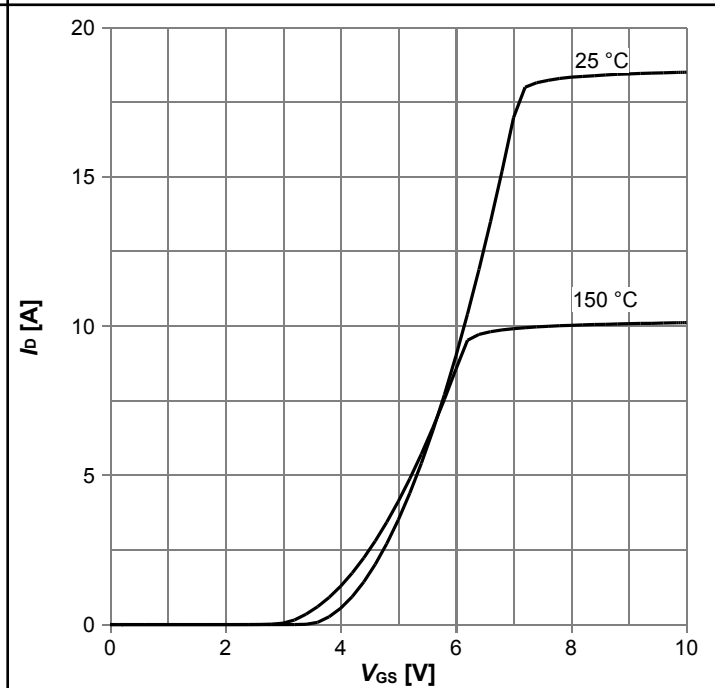

 $I_D = f(V_{GS})$; $|V_{DS}| > 2|I_D|/R_{DS(on)\text{max}}$; $t_p = 10\ \mu\text{s}$; parameter: T_J

Diagram 9: Typ. gate charge

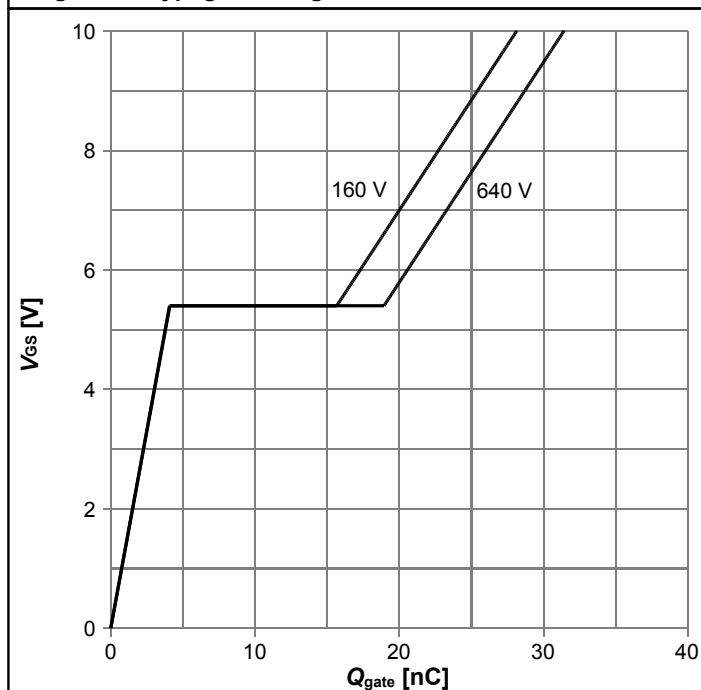

 $V_{GS}=f(Q_{gate}); I_D=5.7 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 10: Forward characteristics of reverse diode

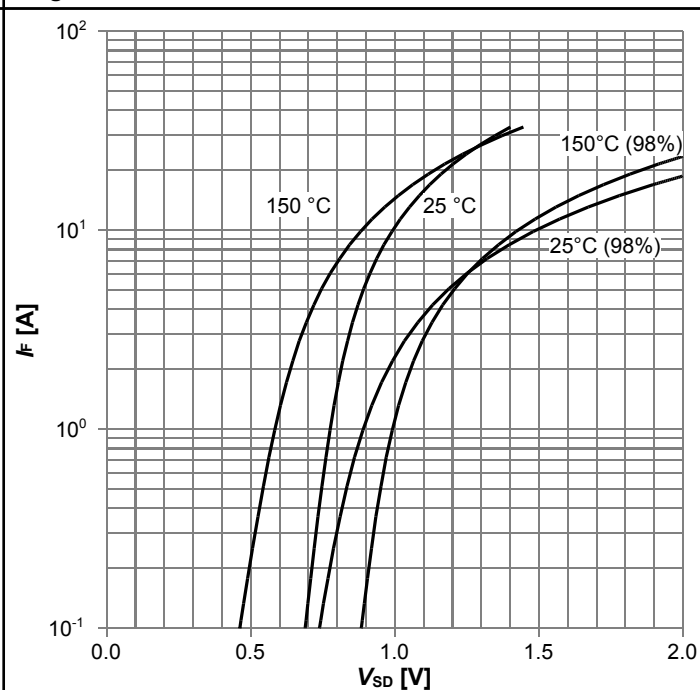

 $I_F=f(V_{SD}); t_p=10 \mu s; \text{parameter: } T_j$

Diagram 11: Avalanche energy

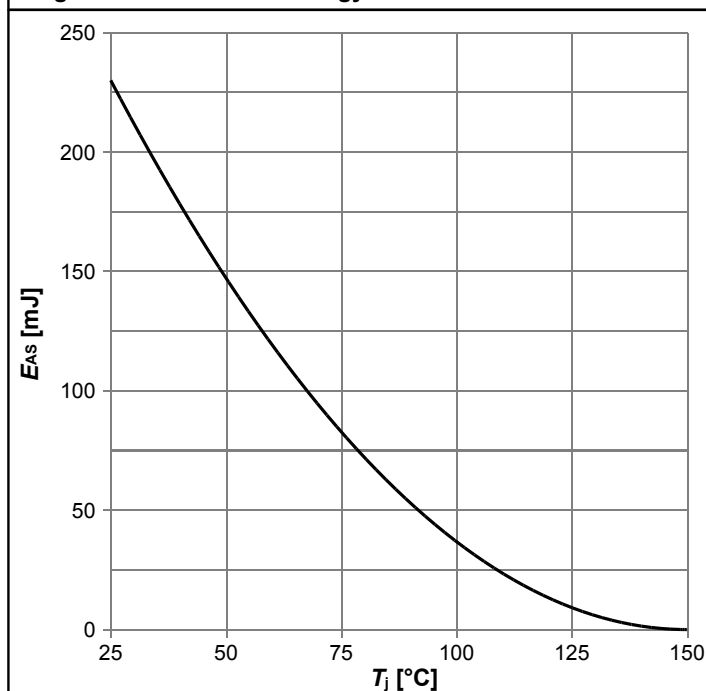

 $E_{AS}=f(T_j); I_D=1.6 \text{ A}; V_{DD}=50 \text{ V}$

Diagram 12: Drain-source breakdown voltage

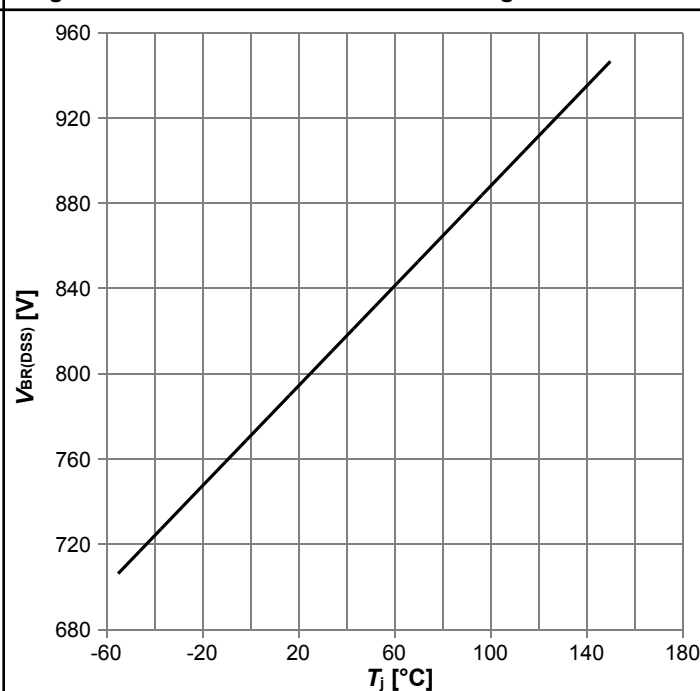

 $V_{BR(DSS)}=f(T_j); I_D=0.25 \text{ mA}$

Diagram 13: Typ. capacitances

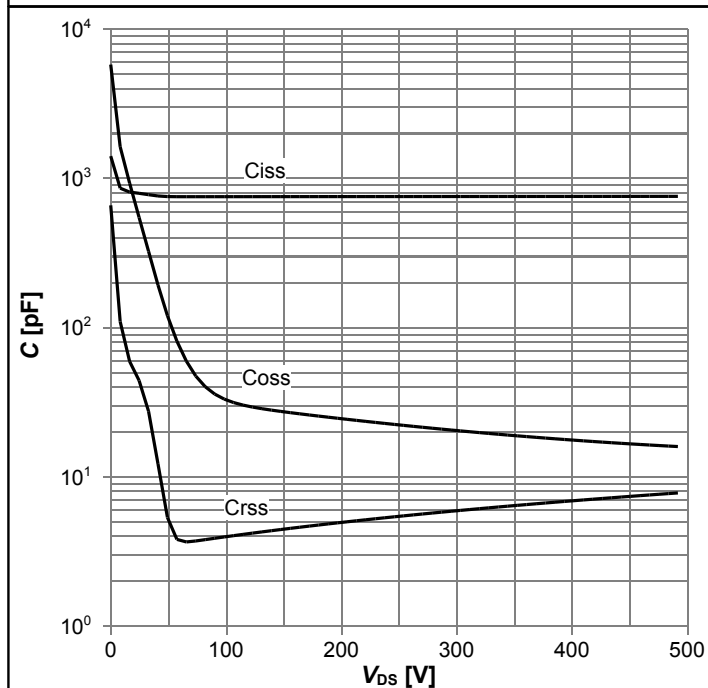
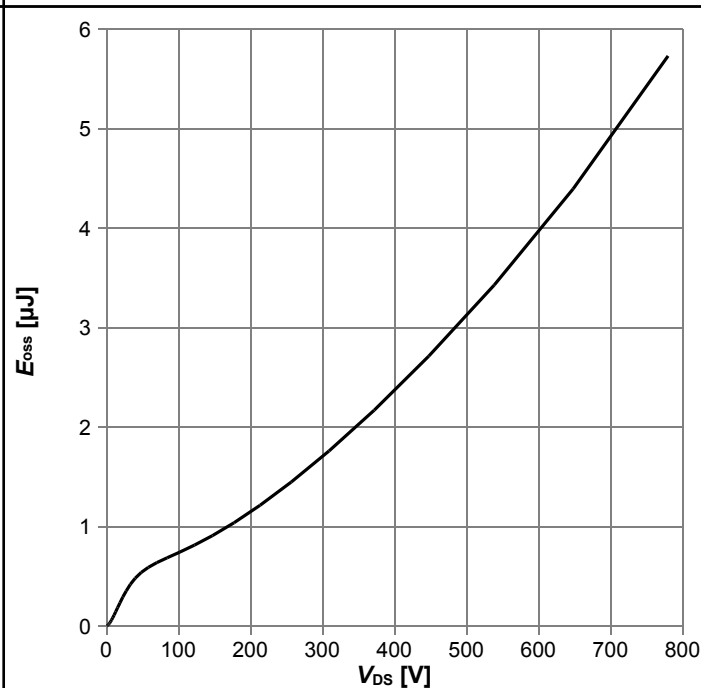

 $C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$

Diagram 14: Typ. Coss stored energy


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

6 Test Circuits

Table 8 Diode characteristics

Test circuit for diode characteristics

$R_{g1} = R_{g2}$

Diode recovery waveform

$t_{rr} = t_F + t_S$
 $Q_{rr} = Q_F + Q_S$

Table 9 Switching times

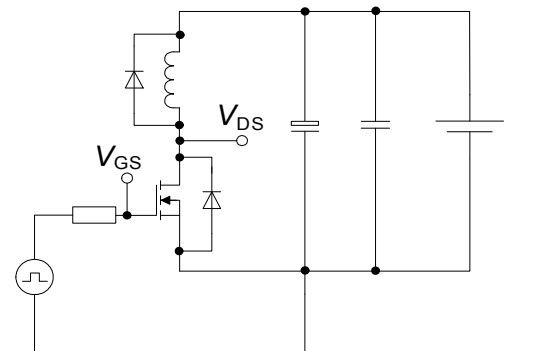
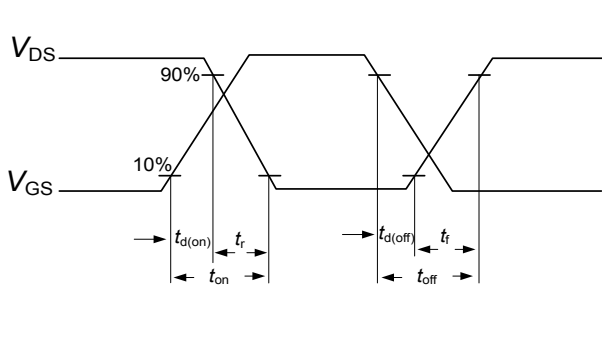
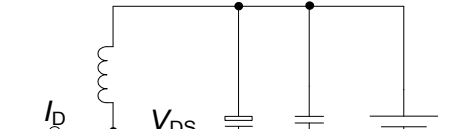
Switching times test circuit for inductive load	Switching times waveform
 The circuit diagram illustrates a switching test setup for an inductive load. A MOSFET is driven by a pulse generator connected to its gate through a resistor. The gate voltage is labeled V_{GS}. The MOSFET's drain is connected to a DC source and an inductive load (represented by an inductor and a diode in parallel). The drain voltage is labeled V_{DS}. The load is connected to ground. The MOSFET's source is also connected to ground.	 The timing diagram shows the switching waveforms for V_{DS} and V_{GS}. The V_{GS} waveform is a square wave that transitions between a low level and a high level. The V_{DS} waveform shows the voltage across the MOSFET during these transitions. Key time intervals are labeled: $t_{d(on)}$ (delay time to turn on), t_r (rise time), t_{on} (total turn-on time), $t_{d(off)}$ (delay time to turn off), t_f (fall time), and t_{off} (total turn-off time). The diagram also indicates the 10% and 90% voltage levels for the transitions.

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

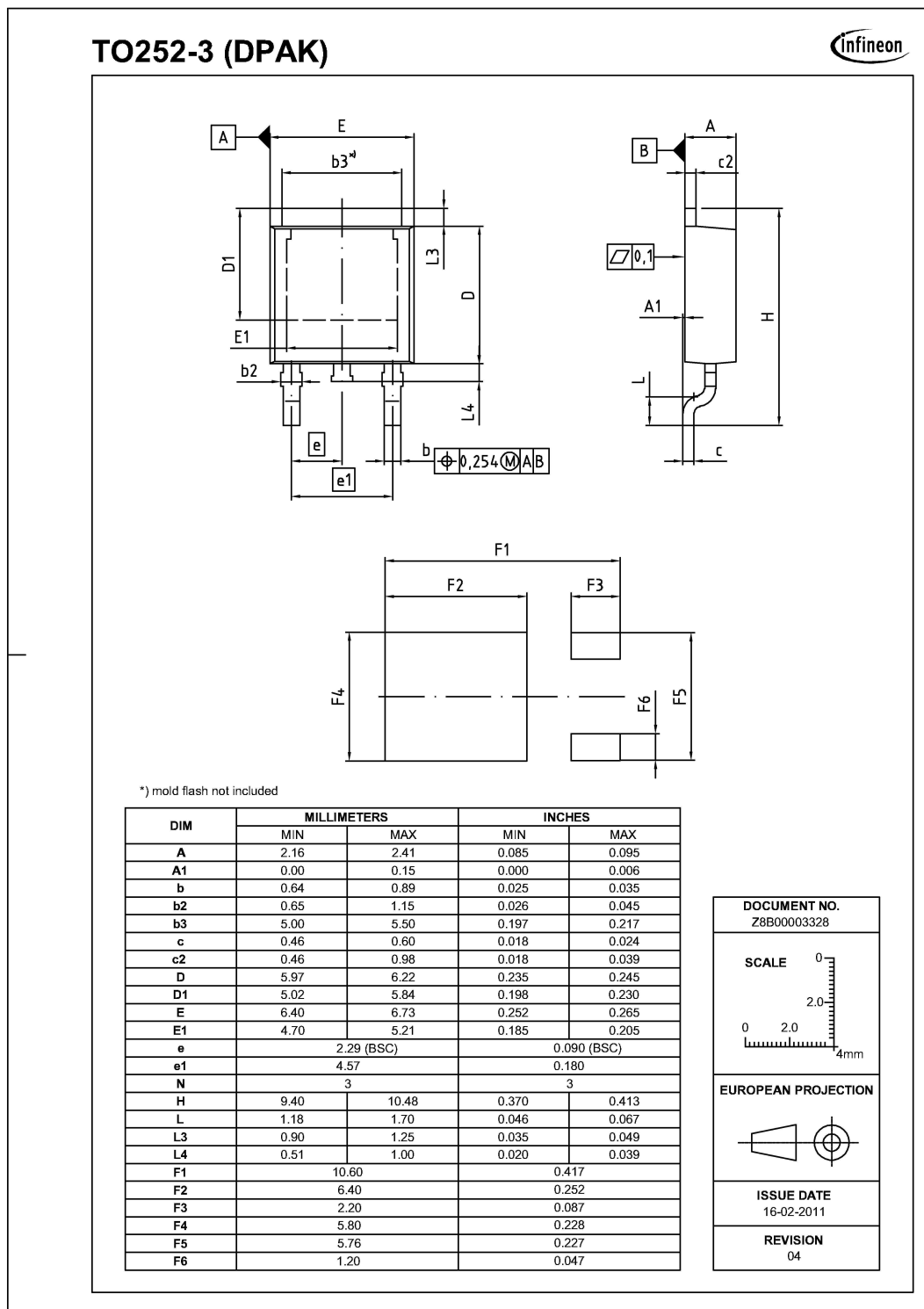
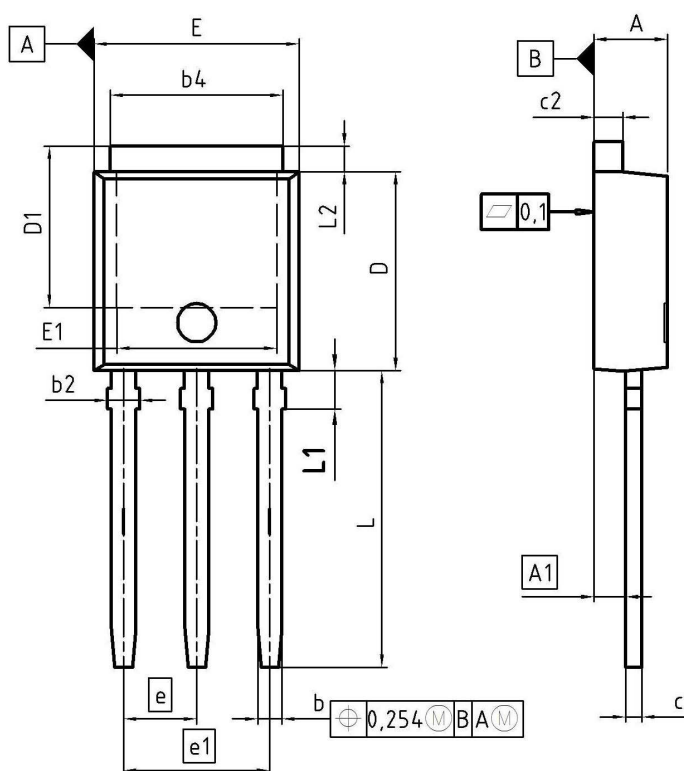


Figure 1 Outline PG-TO 252, dimensions in mm/inches



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

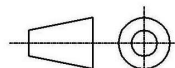
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EUROPEAN PROJECTION 
ISSUE DATE 19-03-2008
REVISION 03

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

IPx80R1K0CE

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	update to halogen free mold compound
2.2	2016-04-27	Non-halogen free version discontinued

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