

MOSFET

650V CoolMOS™ C7 Power Transistor

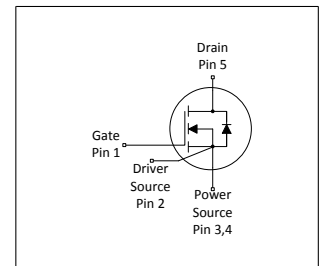
CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies.

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 $R_{DS(on)} * E_{oss}$ and $R_{DS(on)} * Q_g$
- **ThinPAK** SMD Package with very low parasitic inductance to enable fast and reliable switching with minimum of size to increase power-density
- 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 by lower switching losses
- Enabling higher frequency / increased power density solutions
- System cost / size savings due to reduced cooling requirements
- Higher system reliability due to lower operating temperatures



Potential applications

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

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
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	230	mΩ
$Q_{g,typ}$	20	nC
$I_{D,pulse}$	41	A
$E_{oss} @ 400V$	2.3	μJ
Body diode di_F/dt	55	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPL65R230C7	PG-VSON-4	65C7230	see Appendix A

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1 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	-	-	10 7	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	41	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	48	mJ	$I_D=4.8\text{A}; V_{DD}=50\text{V}$
Avalanche energy, repetitive	E_{AR}	-	-	0.24	mJ	$I_D=4.8\text{A}; V_{DD}=50\text{V}$
Avalanche current, single pulse	I_{AS}	-	-	4.8	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}	-	-	67	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	-	-	-	n.a.	Ncm	-
Continuous diode forward current	I_S	-	-	10	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	41	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	1	V/ns	$V_{DS}=0\dots400\text{V}, I_{SD}\leq I_S, T_j=25^\circ\text{C}$
Maximum diode commutation speed	di _f /dt	-	-	55	A/ μs	$V_{DS}=0\dots400\text{V}, I_{SD}\leq I_S, T_j=25^\circ\text{C}$
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

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	1.87	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	device on PCB, minimal footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	35	45	°C/W	Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm ² (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.
Reflow soldering temperature	T_{sold}	-	-	260	°C	reflow MSL2a

3 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	$V_{GS}=0\text{V}$, $I_D=1\text{mA}$
Gate threshold voltage	$V_{(GS)th}$	3	3.5	4	V	$V_{DS}=V_{GS}$, $I_D=0.24\text{mA}$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=650$, $V_{GS}=0\text{V}$, $T_j=25^\circ\text{C}$ $V_{DS}=650$, $V_{GS}=0\text{V}$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20\text{V}$, $V_{DS}=0\text{V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.204 0.488	0.230	Ω	$V_{GS}=10\text{V}$, $I_D=2.4\text{A}$, $T_j=25^\circ\text{C}$ $V_{GS}=10\text{V}$, $I_D=2.4\text{A}$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	1	-	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}	-	996	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=400\text{V}$, $f=250\text{kHz}$
Output capacitance	C_{oss}	-	14	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=400\text{V}$, $f=250\text{kHz}$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	29	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	313	-	pF	$I_D=\text{constant}$, $V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$
Turn-on delay time	$t_{d(on)}$	-	8	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=2.4\text{A}$, $R_G=10\Omega$
Rise time	t_r	-	5	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=2.4\text{A}$, $R_G=10\Omega$
Turn-off delay time	$t_{d(off)}$	-	71	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=2.4\text{A}$, $R_G=10\Omega$
Fall time	t_f	-	22	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=2.4\text{A}$, $R_G=10\Omega$

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{GS}	-	5	-	nC	$V_{DD}=400\text{V}$, $I_D=2.4\text{A}$, $V_{GS}=0$ to 10V
Gate to drain charge	Q_{gd}	-	6	-	nC	$V_{DD}=400\text{V}$, $I_D=2.4\text{A}$, $V_{GS}=0$ to 10V
Gate charge total	Q_g	-	20	-	nC	$V_{DD}=400\text{V}$, $I_D=2.4\text{A}$, $V_{GS}=0$ to 10V
Gate plateau voltage	$V_{plateau}$	-	5.0	-	V	$V_{DD}=400\text{V}$, $I_D=2.4\text{A}$, $V_{GS}=0$ to 10V

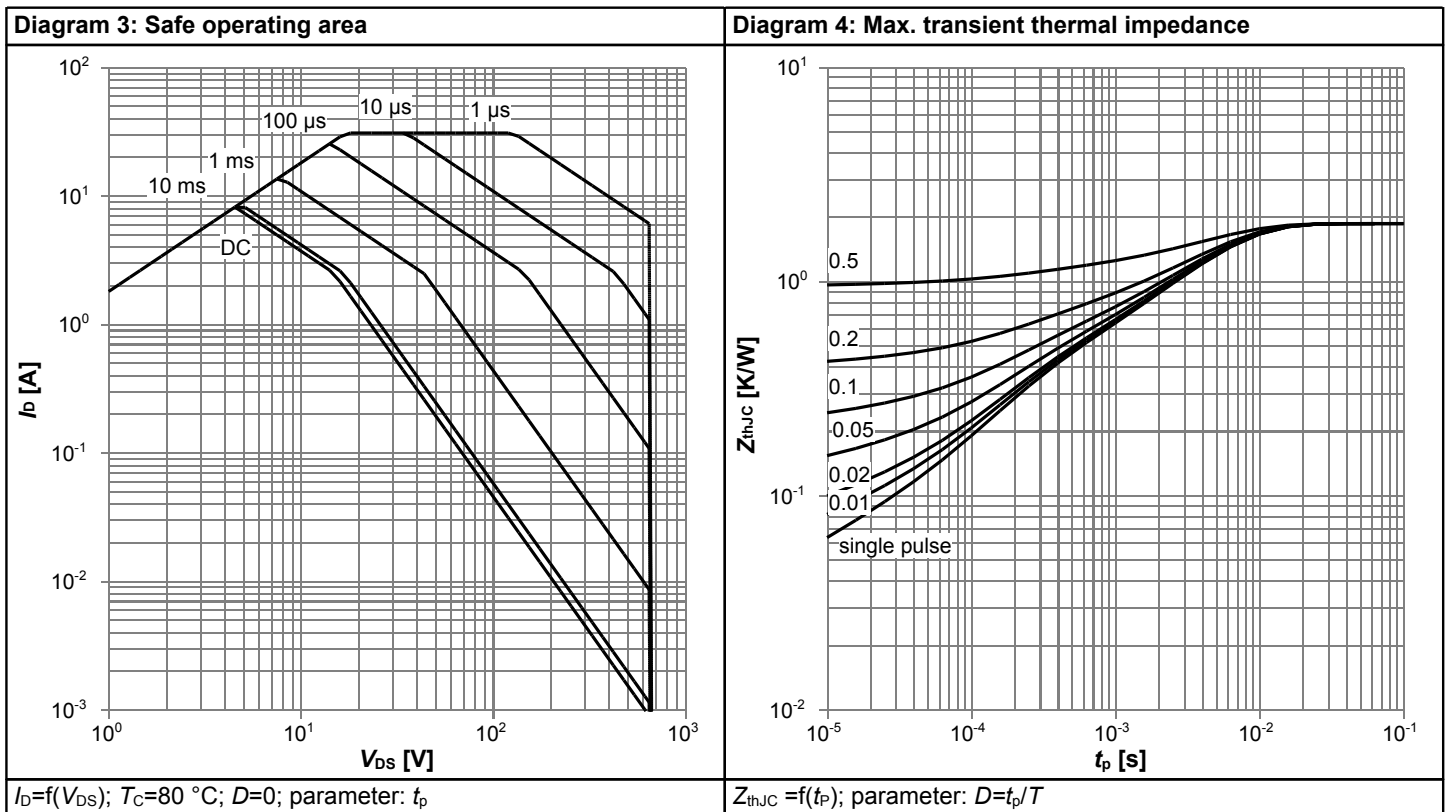
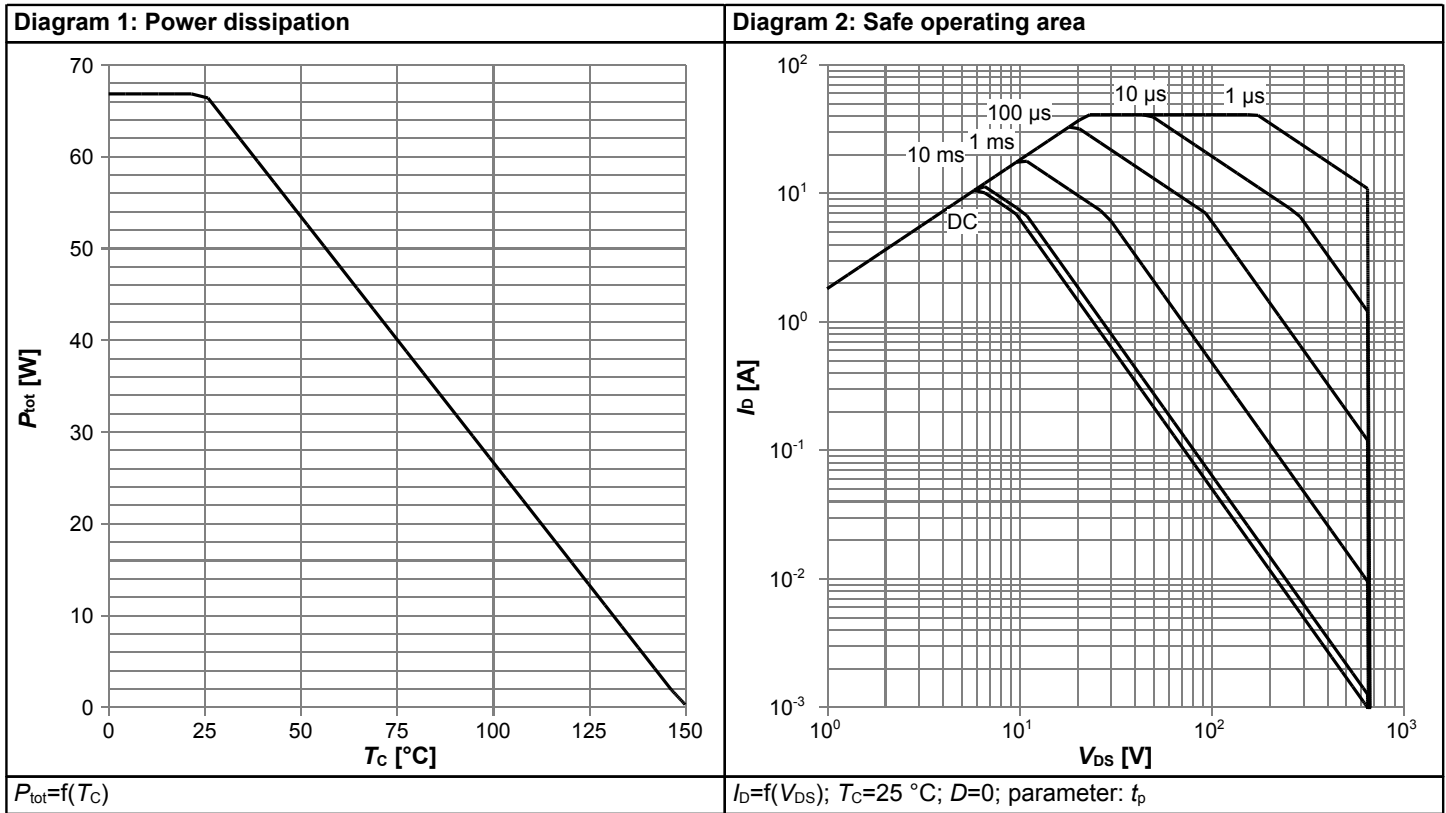
¹⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V

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}	-	0.8	-	V	$V_{GS}=0V, I_F=2.4A, T_j=25^{\circ}C$
Reverse recovery time	t_{rr}	-	414	-	ns	$V_R=400V, I_F=10A, di_F/dt=55A/\mu s$
Reverse recovery charge	Q_{rr}	-	3.1	-	μC	$V_R=400V, I_F=10A, di_F/dt=55A/\mu s$
Peak reverse recovery current	I_{rrm}	-	13.6	-	A	$V_R=400V, I_F=10A, di_F/dt=55A/\mu s$

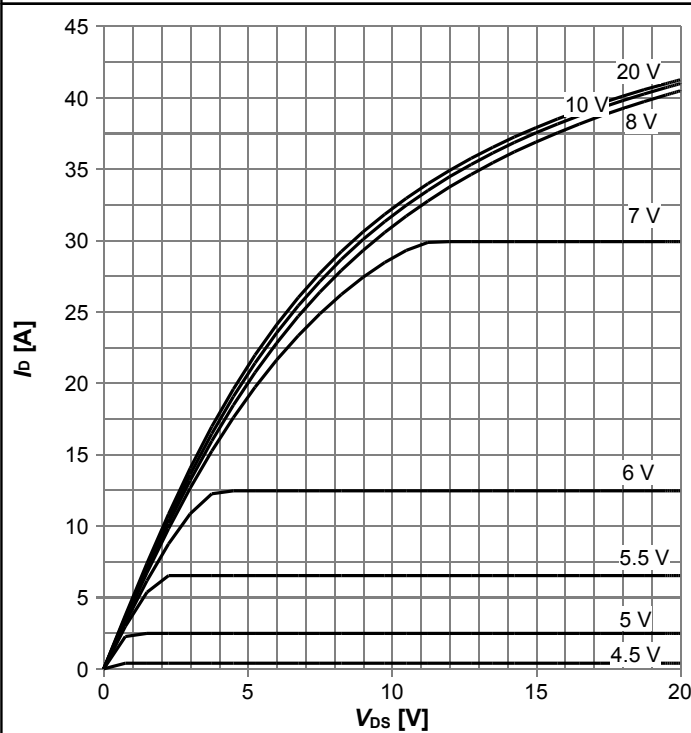
4 Electrical characteristics diagrams



650V CoolMOS™ C7 Power Transistor

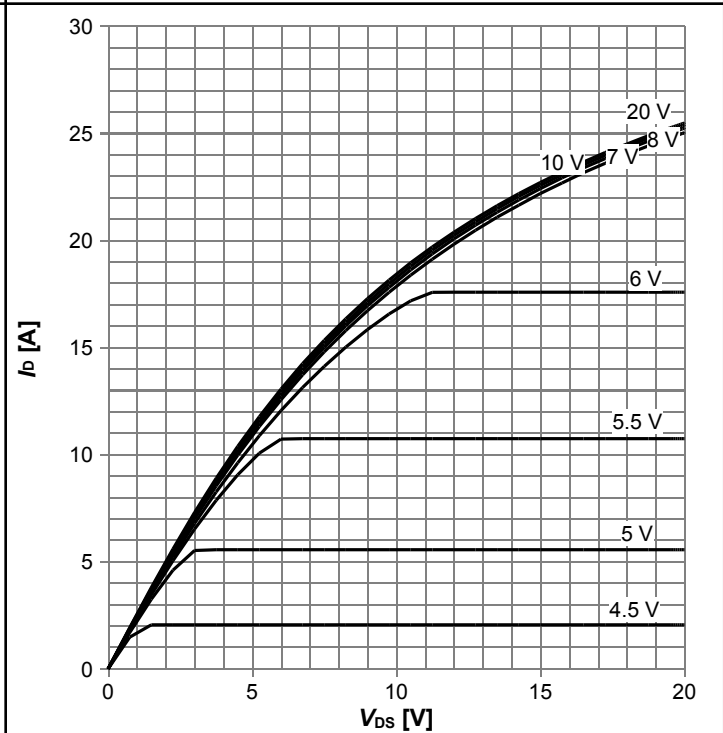
IPL65R230C7

Diagram 5: Typ. output characteristics



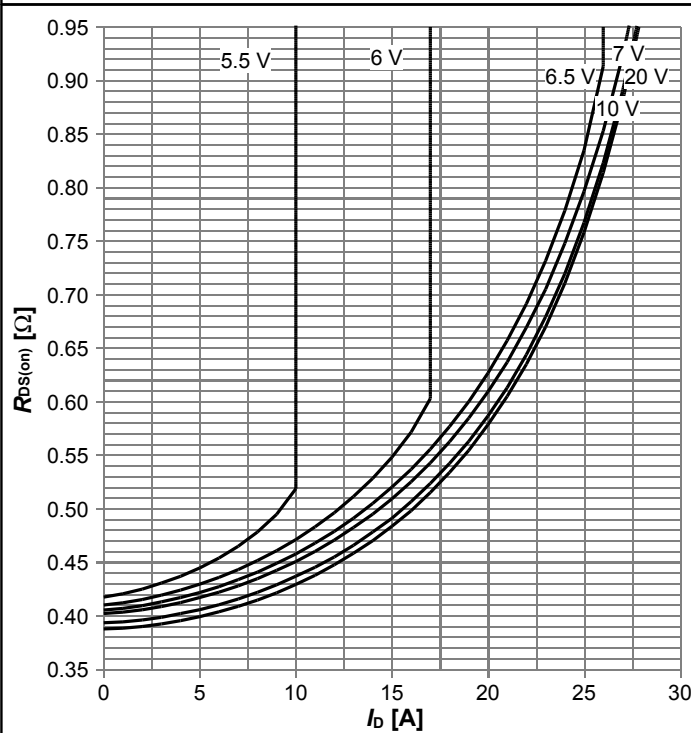
$I_D=f(V_{DS}); T_j=25\text{ °C}; \text{parameter: } V_{GS}$

Diagram 6: Typ. output characteristics



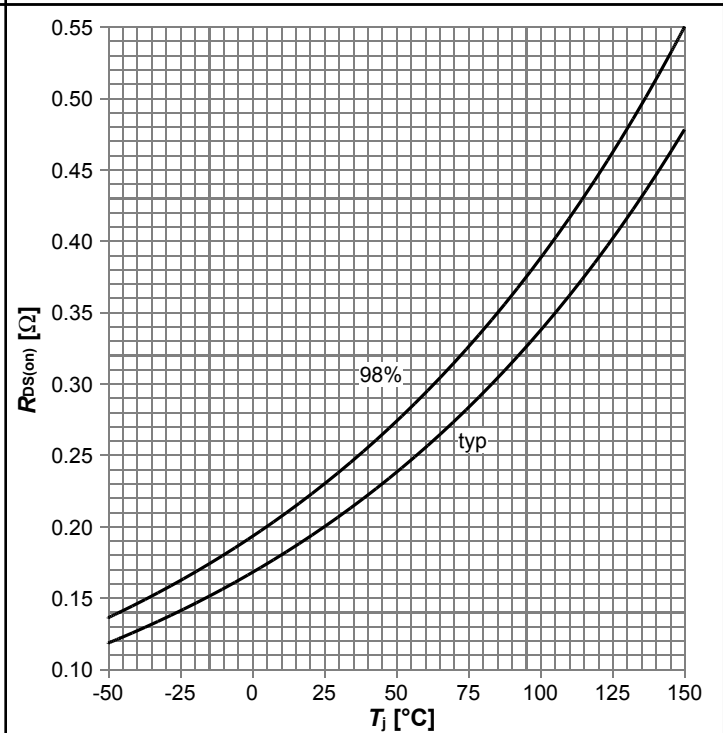
$I_D=f(V_{DS}); T_j=125\text{ °C}; \text{parameter: } V_{GS}$

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



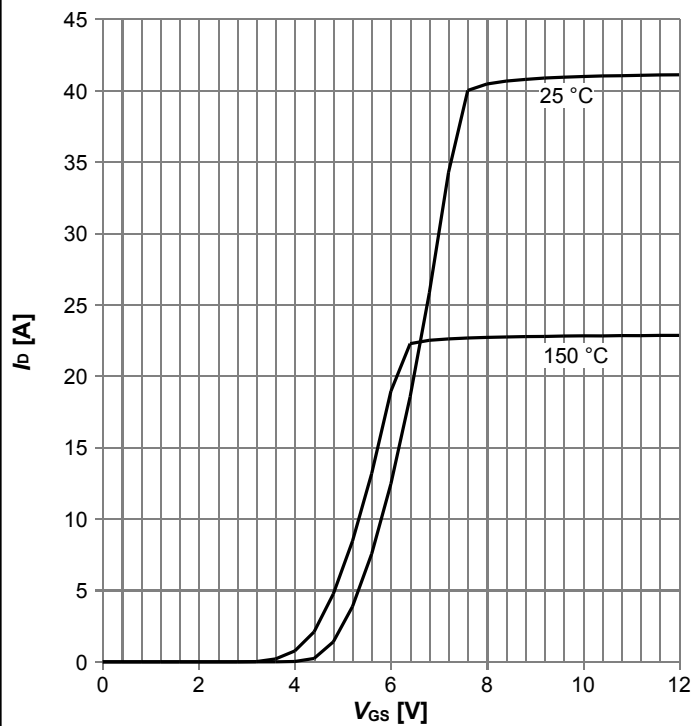
$R_{DS(on)}=f(I_D); T_j=125\text{ °C}; \text{parameter: } V_{GS}$

Diagram 8: Drain-source on-state resistance



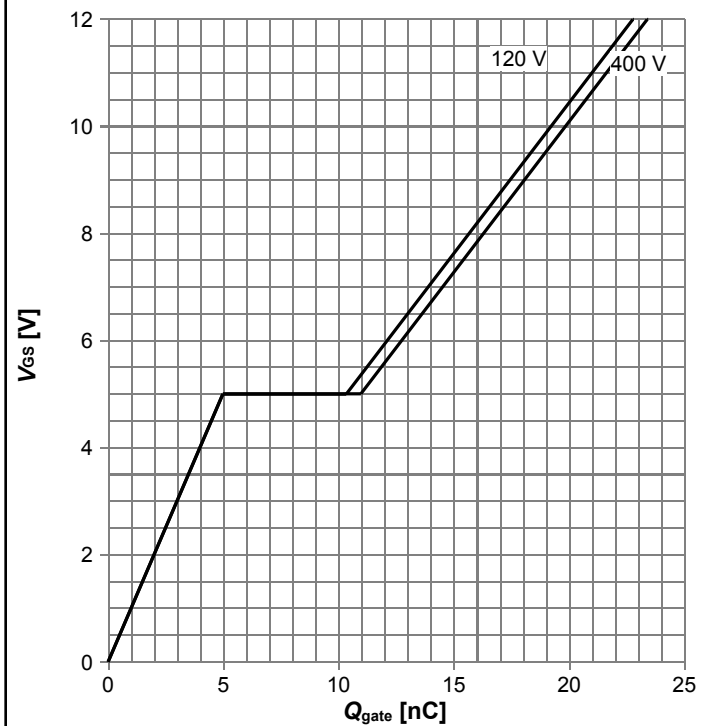
$R_{DS(on)}=f(T_j); I_D=2.4\text{ A}; V_{GS}=10\text{ V}$

Diagram 9: Typ. transfer characteristics



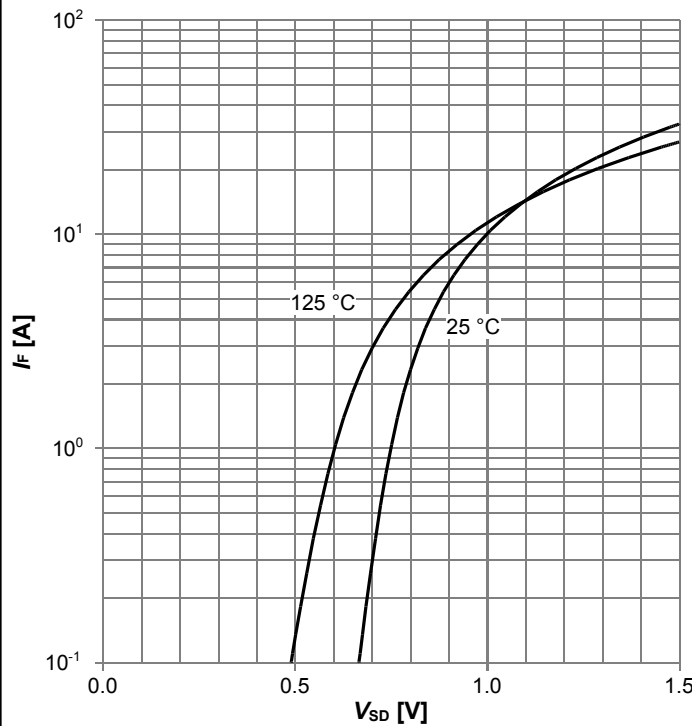
$I_D = f(V_{GS}); V_{DS} = 20V; \text{parameter: } T_j$

Diagram 10: Typ. gate charge



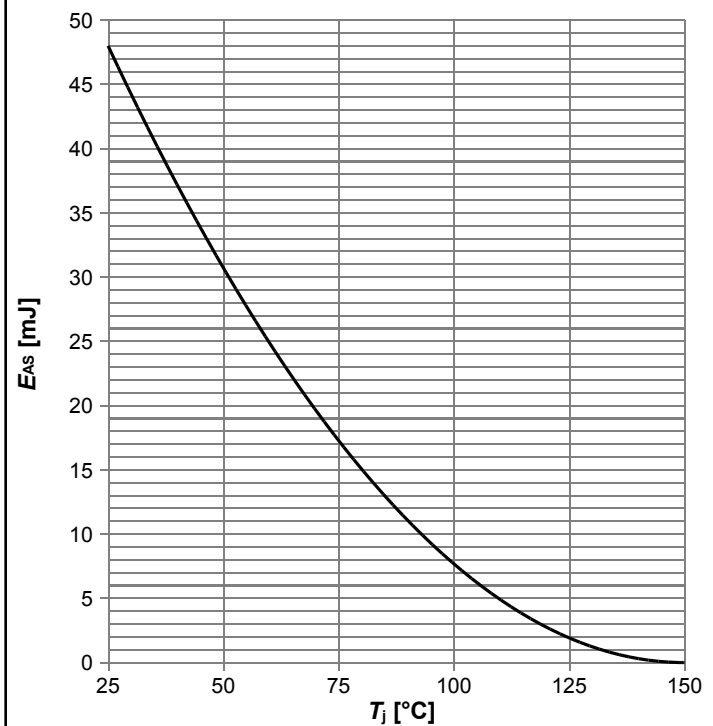
$V_{GS} = f(Q_{gate}); I_D = 2.4 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 11: Forward characteristics of reverse diode



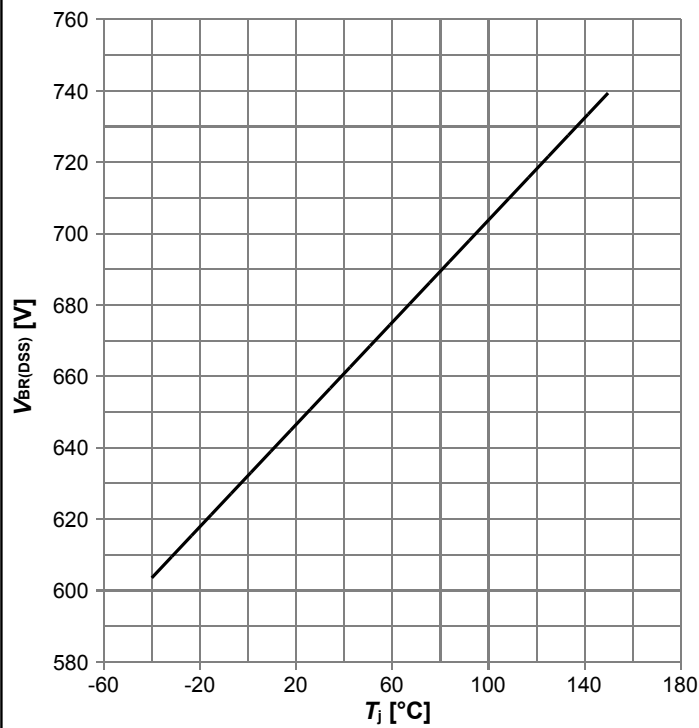
$I_F = f(V_{SD}); \text{parameter: } T_j$

Diagram 12: Avalanche energy



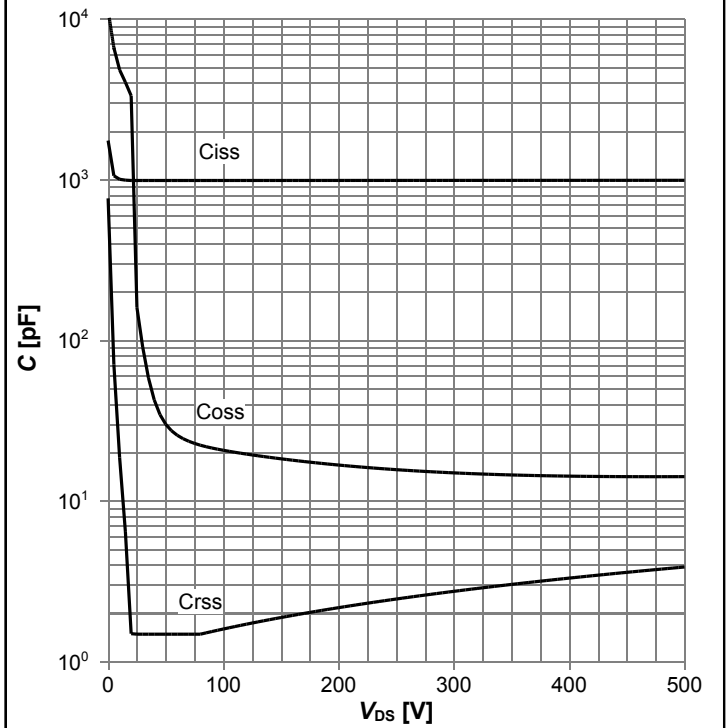
$E_{AS} = f(T_j); I_D = 4.8A; V_{DD} = 50 \text{ V}$

Diagram 13: Drain-source breakdown voltage



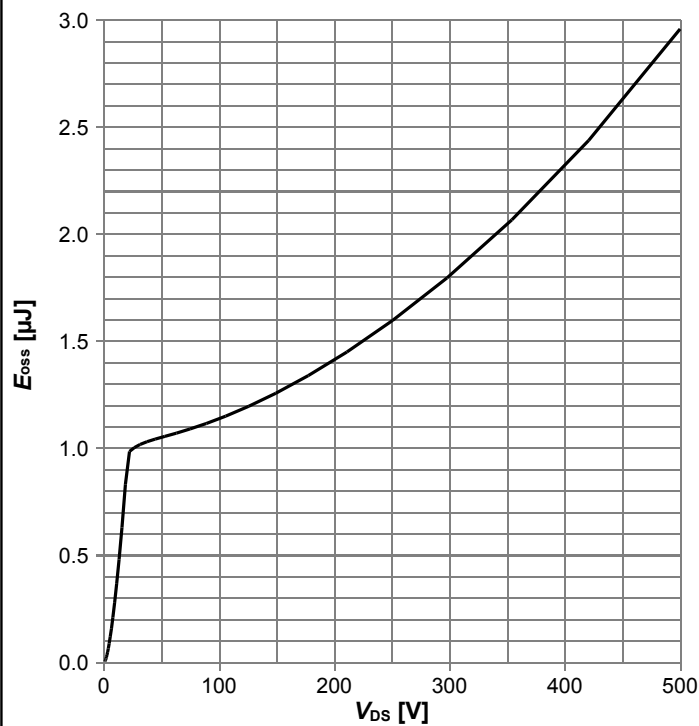
$V_{BR(DSS)}=f(T_j); I_D=1\text{mA}$

Diagram 14: Typ. capacitances



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

Diagram 15: Typ. Coss stored energy



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

5 Test Circuits

Table 8 Diode characteristics

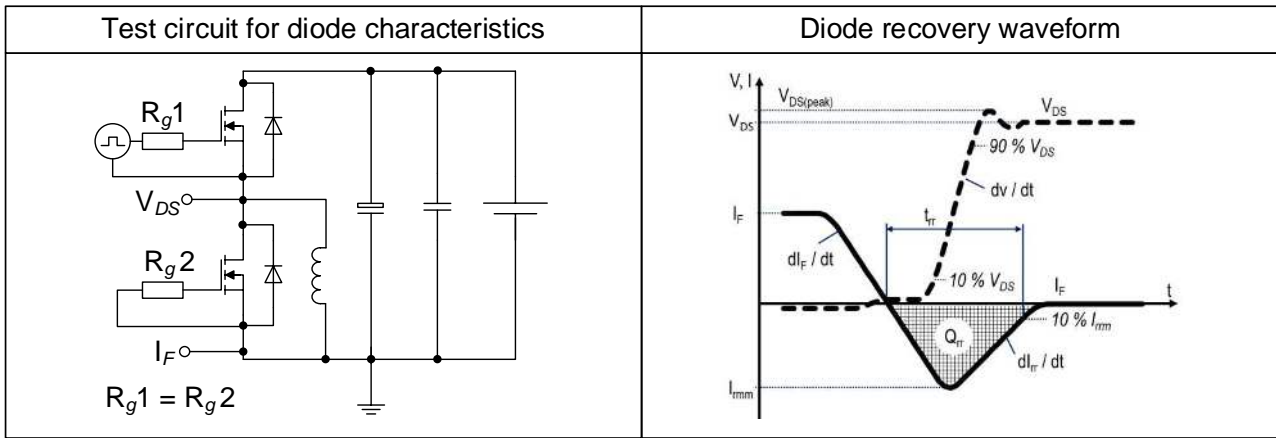


Table 9 switching times (ss)

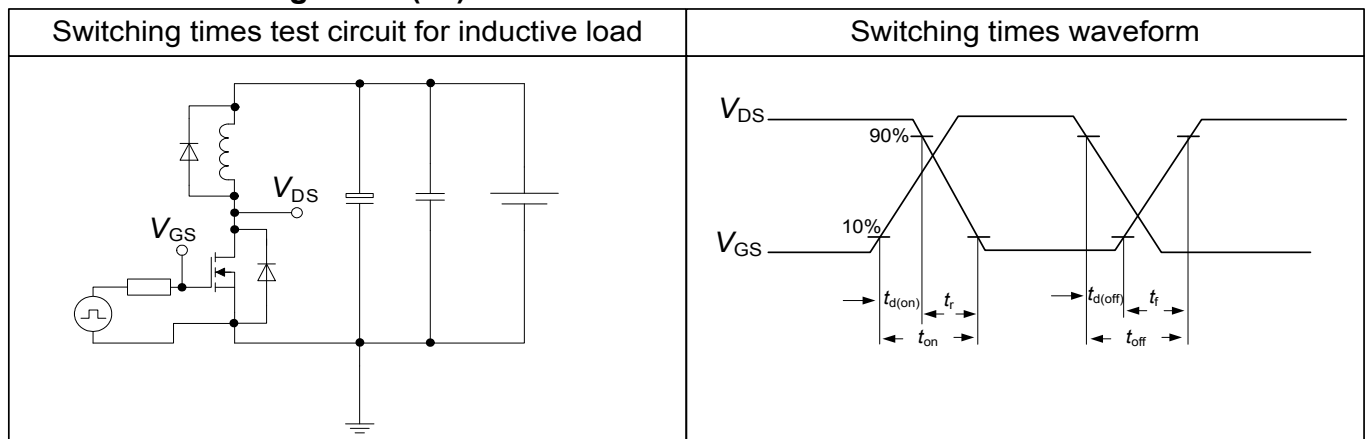
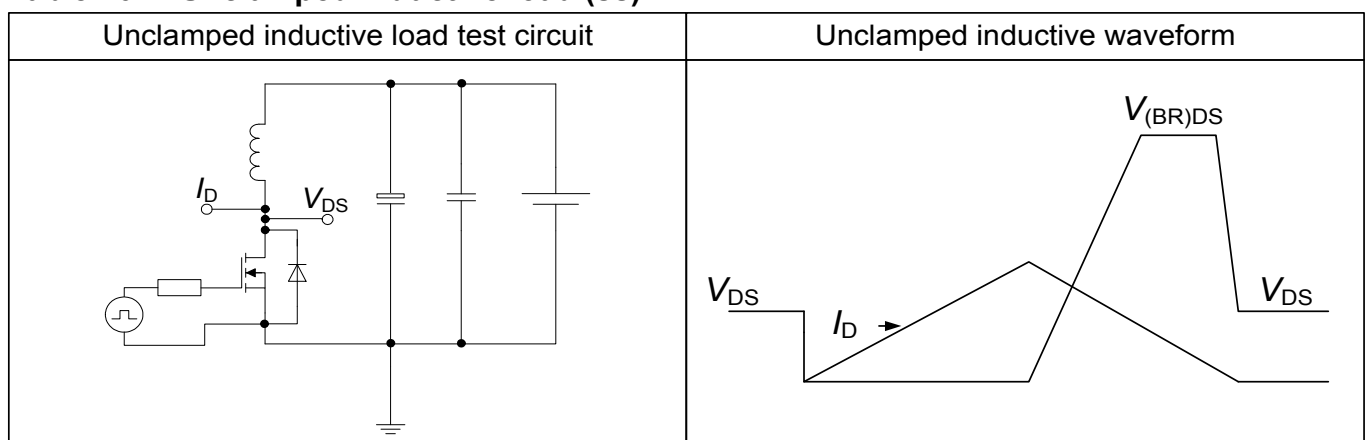


Table 10 Unclamped inductive load (ss)



6 Package Outlines

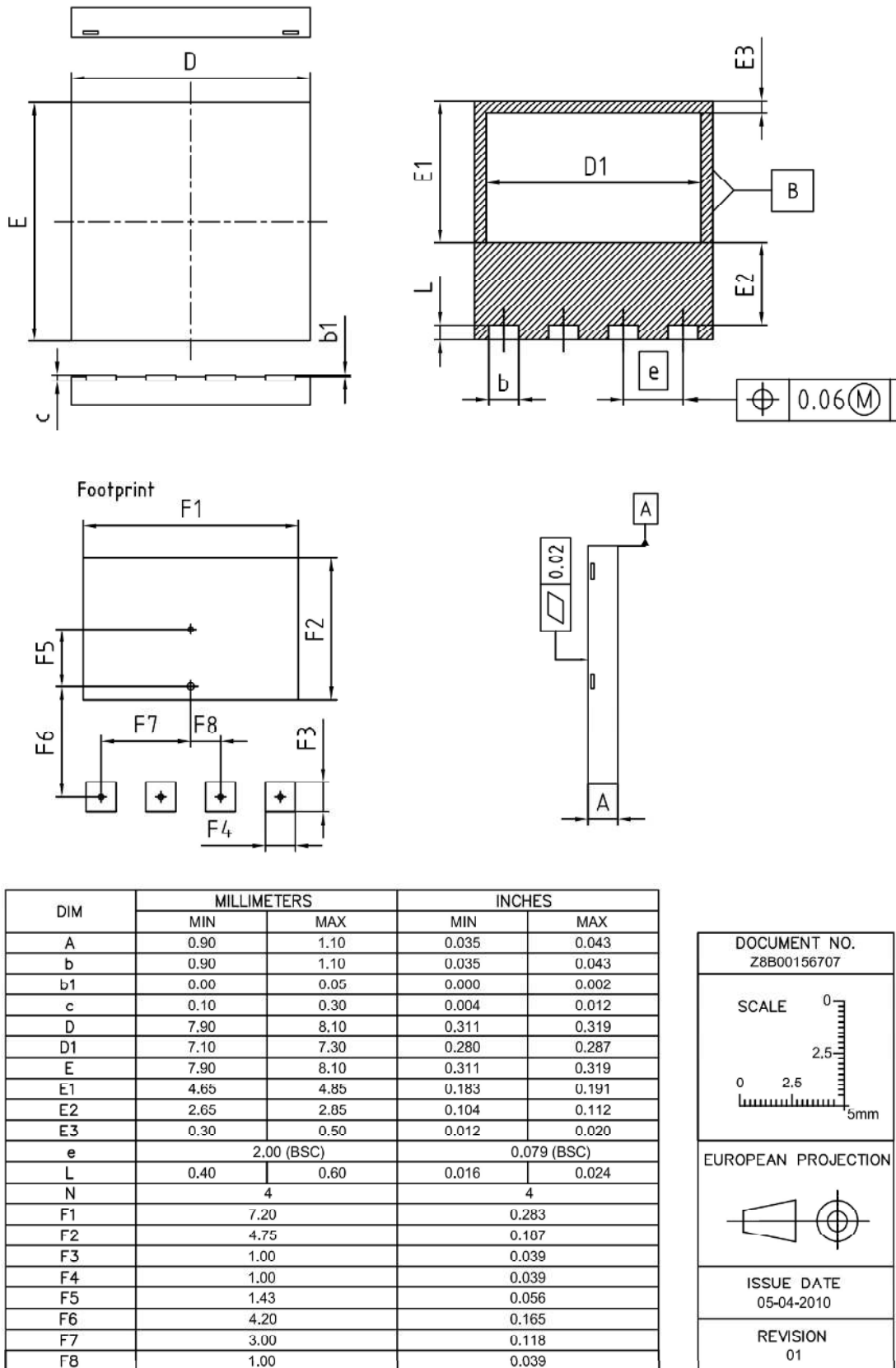


Figure 1 Outline PG-VSON-4, dimensions in mm/inches

7 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

IPL65R230C7

Revision: 2017-08-29, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2013-04-29	Release of final version
2.1	2017-08-29	Updated MSL; style updated

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