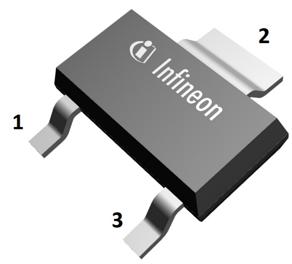
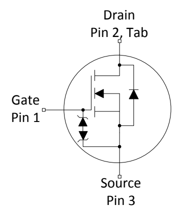
MOSFET

700V CoolMOS™ P7 Power Transistor

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies.
The latest CoolMOS™ P7 is an optimized platform tailored to target cost sensitive applications in consumer markets such as charger, adapter, lighting, TV, etc.
The new series provides all the benefits of a fast switching Superjunction MOSFET, combined with an excellent price/performance ratio and state of the art ease-of-use level. The technology meets highest efficiency standards and supports high power density, enabling customers going towards very slim designs.

PG-SOT223





Features

- Extremely low losses due to very low FOM $R_{DS(on)}$*Q_g and $R_{DS(on)}$*E_{oss}
- Excellent thermal behavior
- Integrated ESD protection diode
- Low switching losses (E_{oss})
- Product validation acc. JEDEC Standard

Benefits

- Cost competitive technology
- Lower temperature
- High ESD ruggedness
- Enables efficiency gains at higher switching frequencies
- Enables high power density designs and small form factors

Potential applications

Recommended for Flyback topologies for example used in Chargers, Adapters, Lighting Applications, etc.

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

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j=25°C}$	700	V
$R_{DS(on),max}$	1.2	Ω
$Q_{g,typ}$	4.8	nC
$I_{D,pulse}$	9.4	A
E_{oss} @ 400V	0.7	µJ
$V_{(GS)th,typ}$	3	V
ESD class (HBM)	1C	

Type / Ordering Code	Package	Marking	Related Links
IPN70R1K2P7S	PG-SOT223	70S1K2	see Appendix A

Table of Contents

1 Maximum ratings

at T_j = 25°C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	- -	- -	4.5 3.0	A	T_C = 20°C T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	9.4	A	T_C=25°C
Application (Flyback) relevant avalanche current, single pulse[3]	I_{AS}	-	-	1.6	A	measured with standard leakage inductance of transformer of 5µH
MOSFET dv/dt ruggedness	dv/dt	-	-	100	V/ns	V_{DS} =0...400V
Gate source voltage	V_{GS}	-16 -30	- -	16 30	V	static; AC (f>1 Hz)
Power dissipation	P_{tot}	-	-	6.3	W	T_C=25°C
Operating and storage temperature	T_j, T_{stg}	-40	-	150	°C	-
Continuous diode forward current	I_S	-	-	1.5	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	9.4	A	T_C = 25°C
Reverse diode dv/dt[4]	dv/dt	-	-	1	V/ns	V_{DS} =0...400V, I_{SD}<=I_S, T_j=25°C
Maximum diode commutation speed[4]	di_f/dt	-	-	50	A/µs	V_{DS} =0...400V, I_{SD}<=I_S, T_j=25°C
Insulation withstand voltage	V_{ISO}	-	-	n.a.	V	V_{rms}, T_C=25°C, t=1min

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - solder point	R_{thJS}	-	-	19.7	°C/W	-
Thermal resistance, junction - ambient for minimal footprint	R_{thJA}	-	-	160	°C/W	minimal footprint
Thermal resistance, junction - ambient soldered on copper area	R_{thJA}	-	-	75	°C/W	Device on 40mm*40mm*1.5 epoxy PCB FR4 with 6cm^2 (one layer 70µm thick) copper area for drain connection and cooling. PCB is vertical without blown air.
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	reflow MSL1

[1] DPAK / IPAK equivalent. Limited by $T_{j\,max}$. T_j = 20°C. Maximum duty cycle D=0.5
[2] Pulse width t_p limited by $T_{j,max}$
[3] Proven during verification test. For explanation please read AN - CoolMOS™ 700V P7.
[4] V_{DClink}=400V; $V_{DS,peak}$<$V_{(BR)DSS}$; identical low side and high side switch with identical R_G

3 Electrical characteristics

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	700	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.50	3	3.50	V	V_{DS}=V_{GS}, I_D=0.04mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=700V, V_{GS}=0V, T_j=25°C V_{DS}=700V, V_{GS}=0V, T_j=150°C
Gate-source leakage current incl. Zener diode	I_{GSS}	-	-	1	µA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.98 2.24	1.20 -	Ω	V_{GS}=10V, I_D=0.9A, T_j=25°C V_{GS}=10V, I_D=0.9A, T_j=150°C
Gate resistance	R_G	-	1.6	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	174	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	3.6	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1]	$C_{o(er)}$	-	10	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2]	$C_{o(tr)}$	-	132	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	12	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=0.6A, R_G=8.2Ω
Rise time	t_r	-	4.8	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=0.6A, R_G=8.2Ω
Turn-off delay time	$t_{d(off)}$	-	60	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=0.6A, R_G=8.2Ω
Fall time	t_f	-	48	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=0.6A, R_G=8.2Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	0.8	-	nC	V_{DD}=400V, I_D=0.6A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	1.9	-	nC	V_{DD}=400V, I_D=0.6A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	4.8	-	nC	V_{DD}=400V, I_D=0.6A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	4.3	-	V	V_{DD}=400V, I_D=0.6A, V_{GS}=0 to 10V

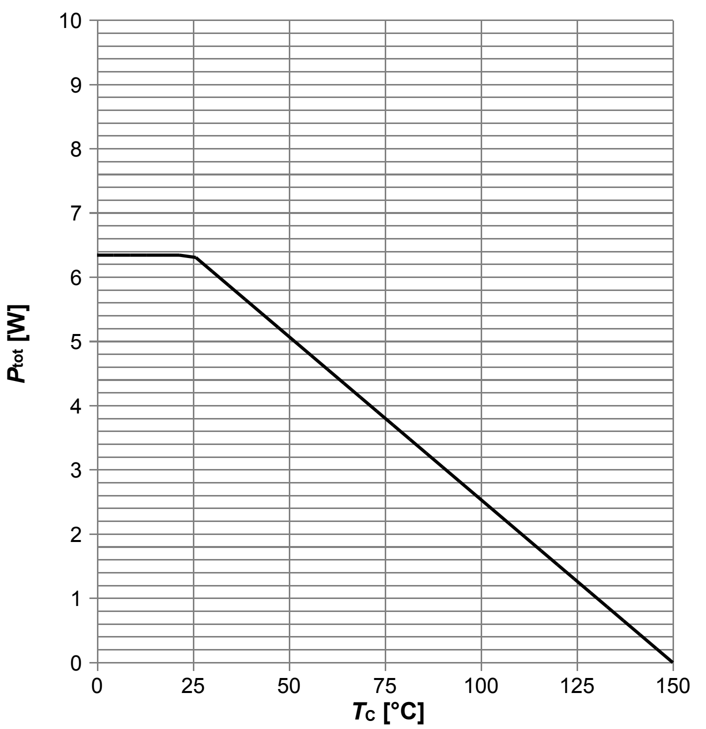
[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

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=1.1A, T_j=25°C
Reverse recovery time	t_{rr}	-	145	-	ns	V_R=400V, I_F=0.6A, di_F/dt=50A/µs
Reverse recovery charge	Q_{rr}	-	0.5	-	µC	V_R=400V, I_F=0.6A, di_F/dt=50A/µs
Peak reverse recovery current	I_{rrm}	-	6	-	A	V_R=400V, I_F=0.6A, di_F/dt=50A/µs

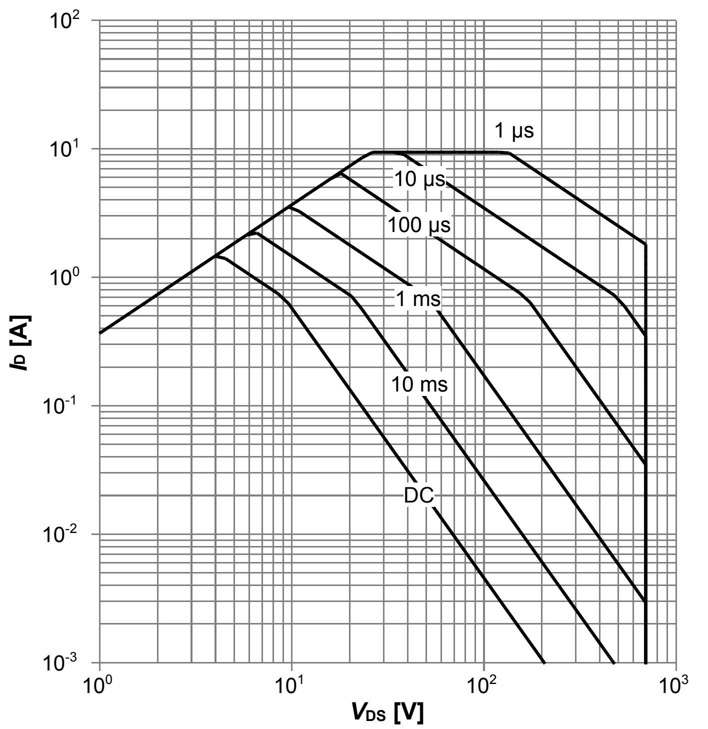
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



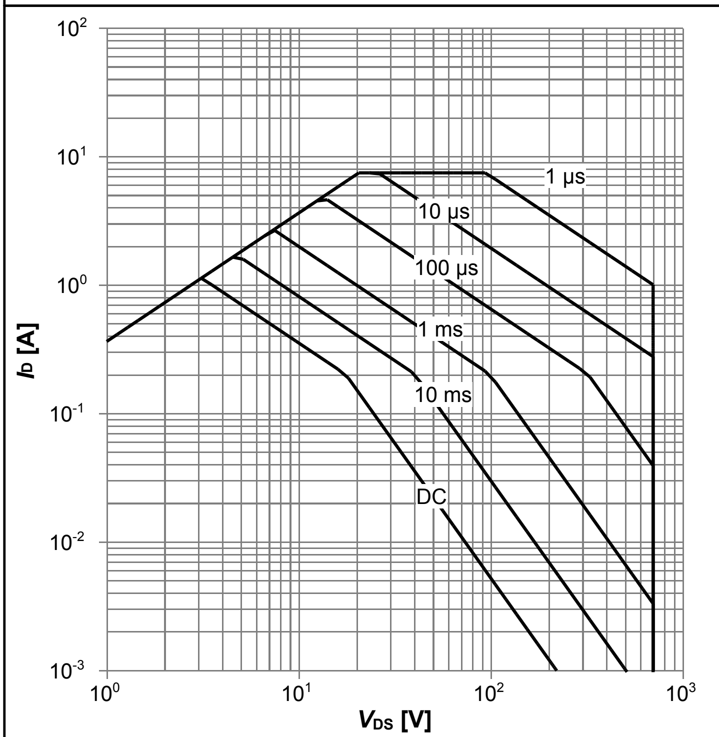
P_{tot}=f(T_C)

Diagram 2: Safe operating area



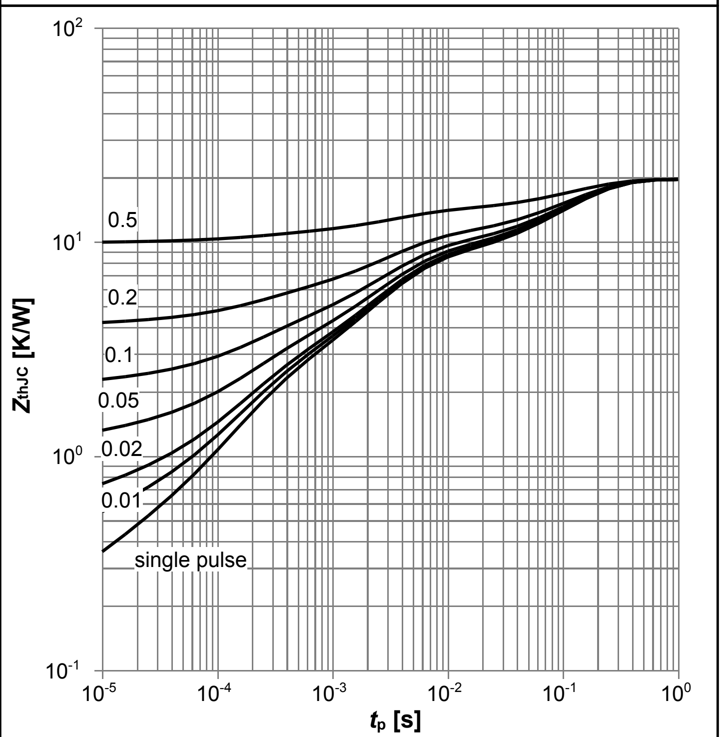
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



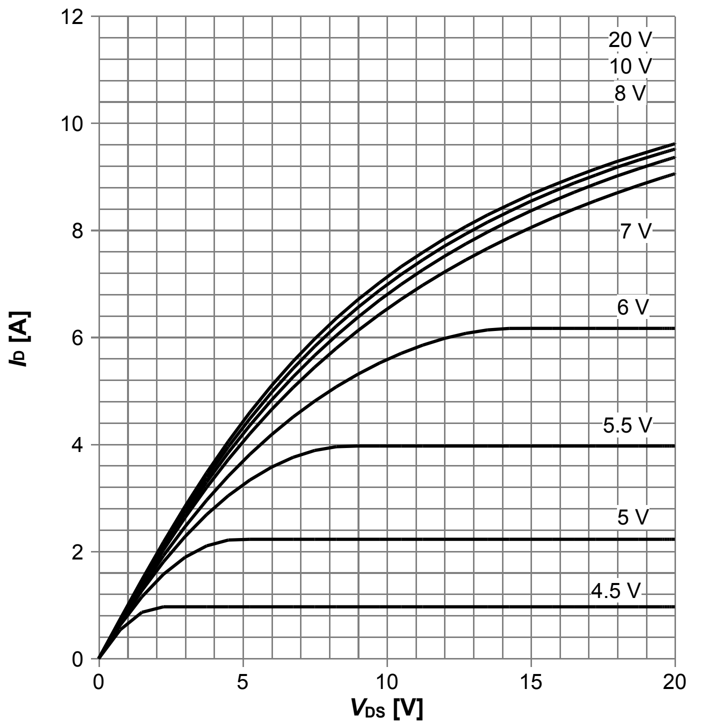
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



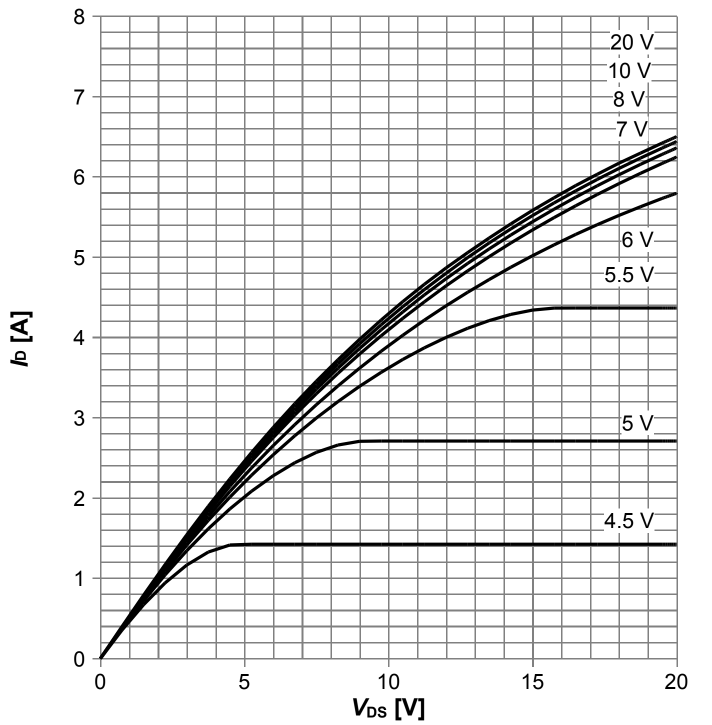
Z_{thJC} =f(t_P); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



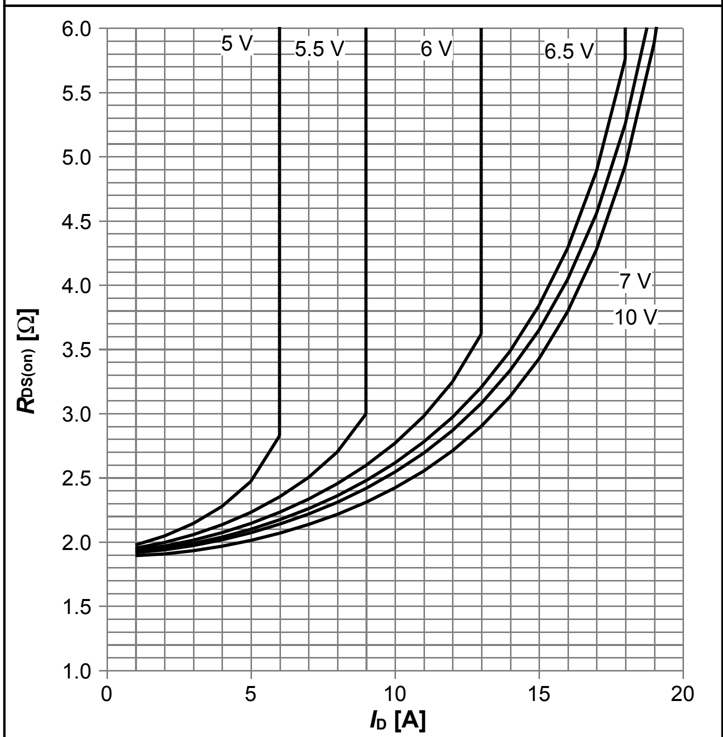
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



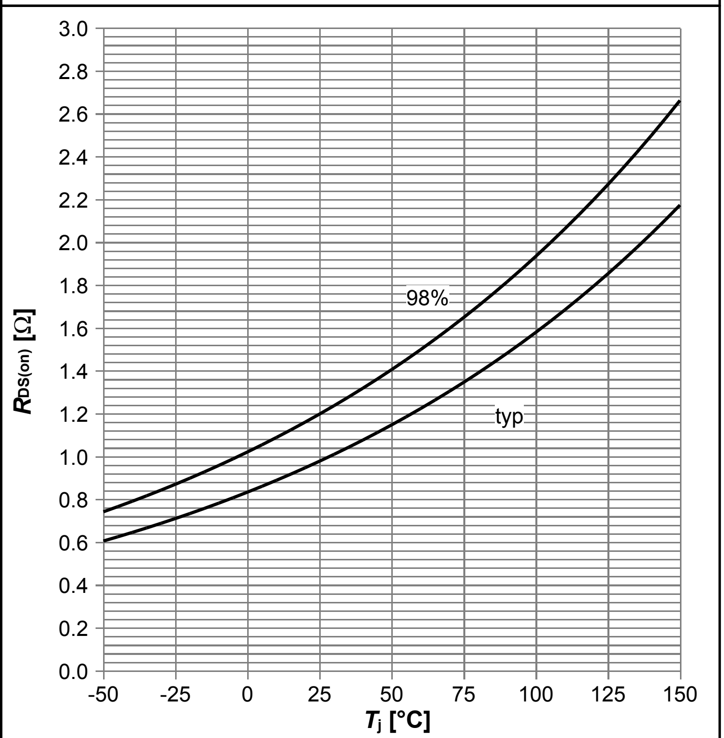
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

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



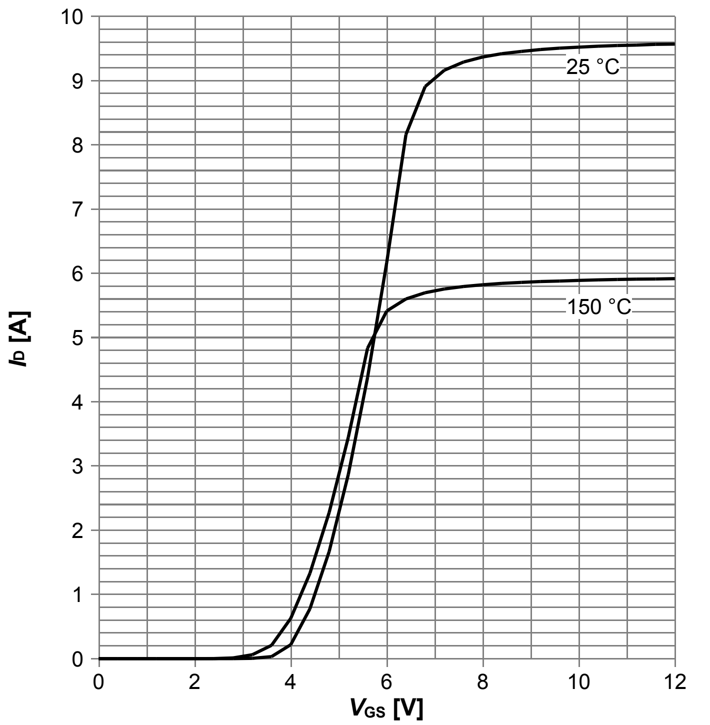
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



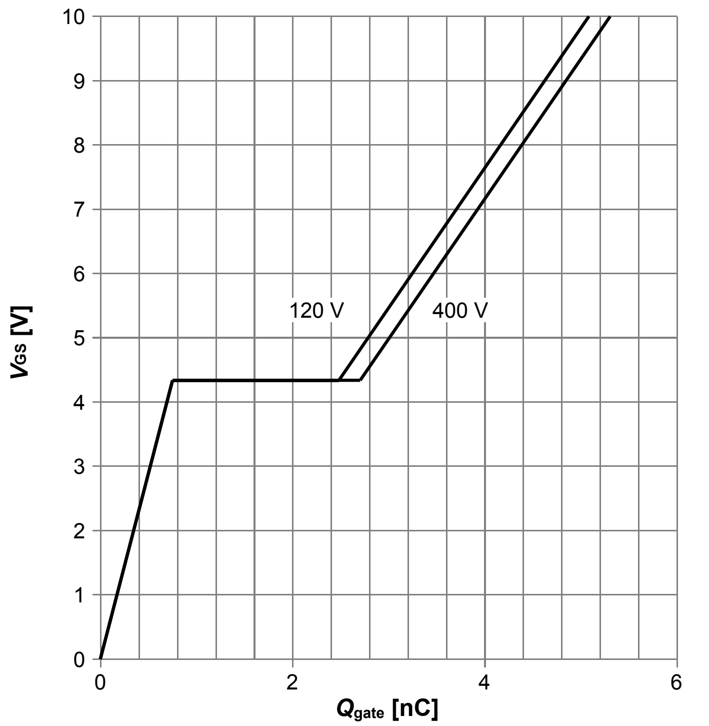
$R_{DS(on)}$=f(T_j); I_D=0.9 A; V_{GS}=10 V

Diagram 9: Typ. transfer characteristics



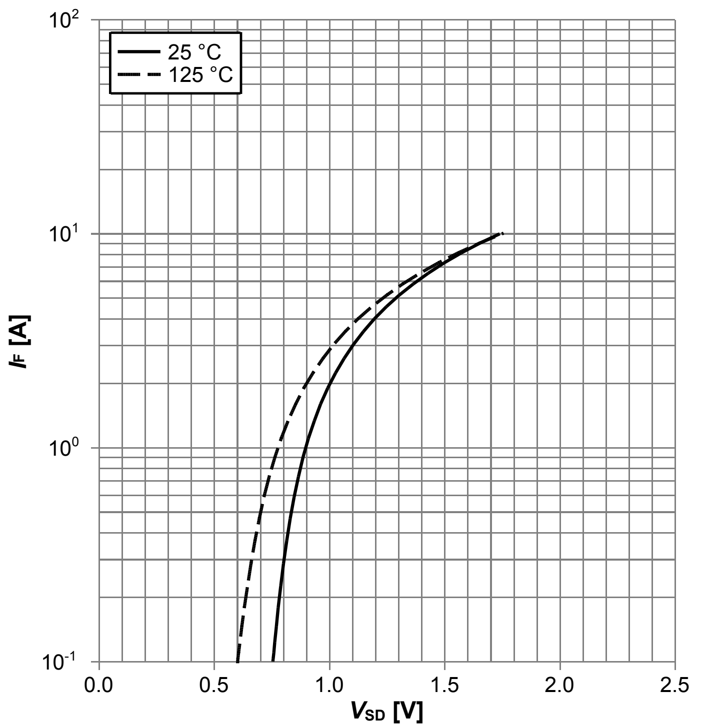
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



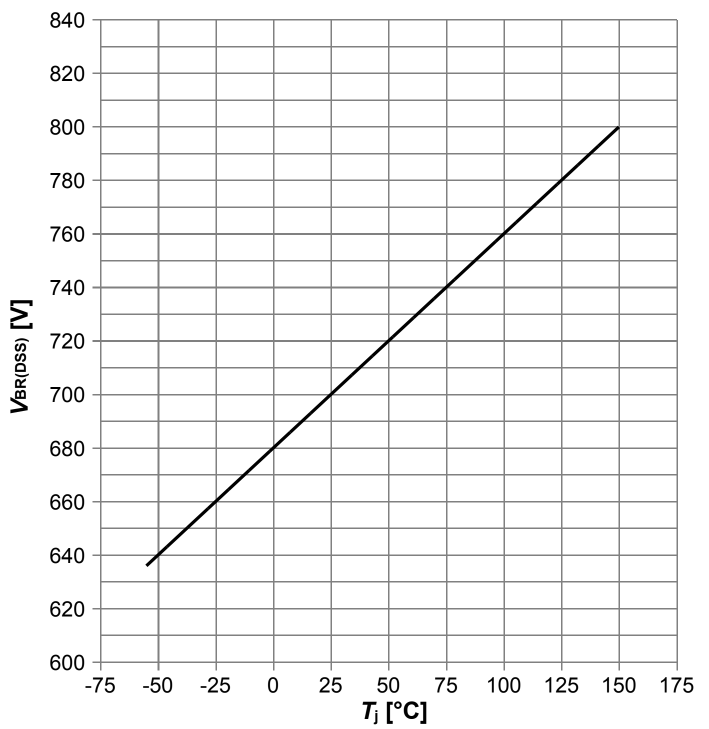
V_{GS}=f(Q_{gate}); I_D=0.6 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode

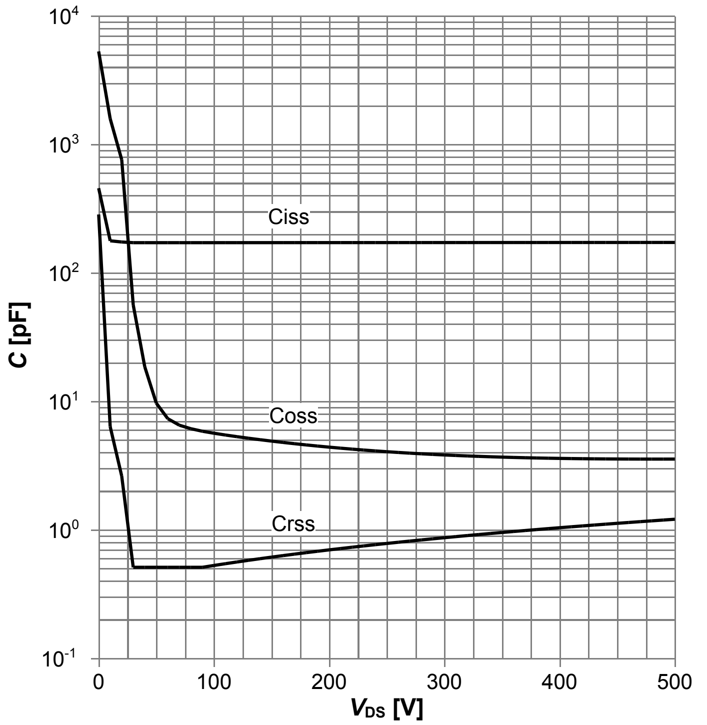
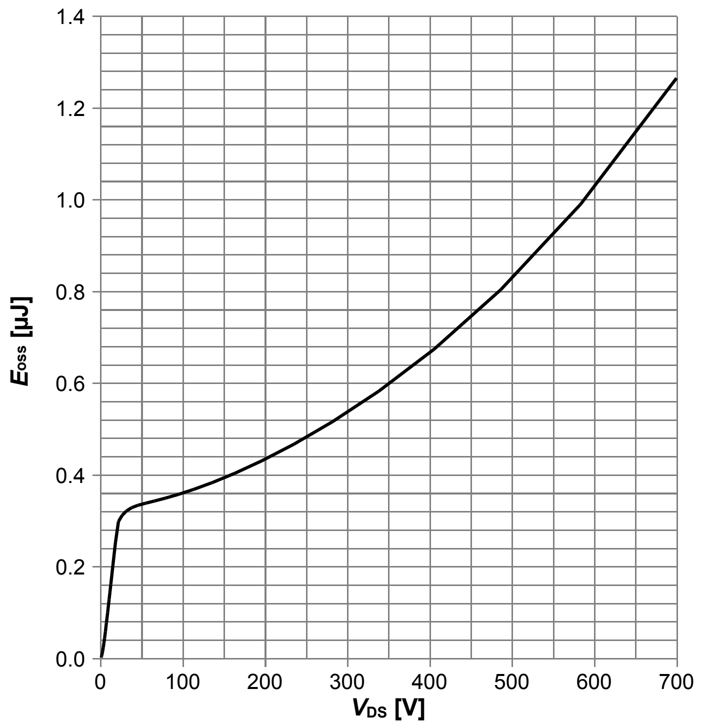


I_F=f(V_{SD}); parameter: T_j

Diagram 13: Drain-source breakdown voltage



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

Diagram 14: Typ. capacitances	Diagram 15: Typ. Coss stored energy
	
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=250$ kHz	$E_{oss}=f(V_{DS})$

5 Test Circuits

Table 8 Diode characteristics

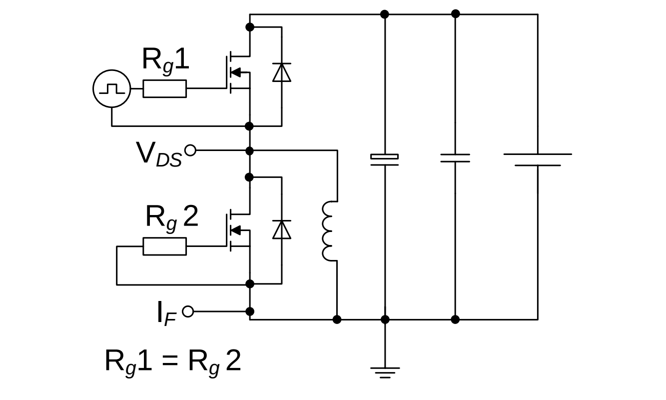
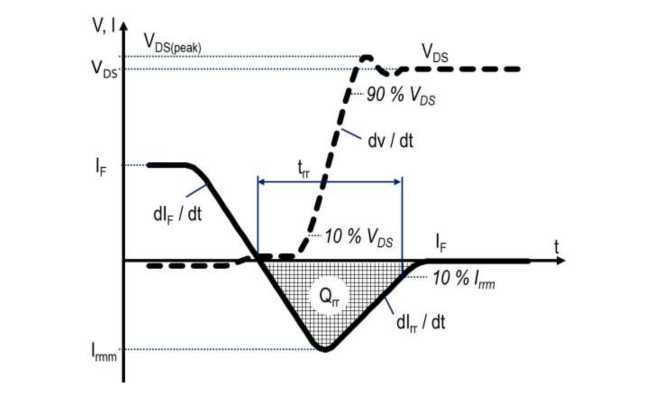
<table>
<tr><th>Test circuit for diode characteristics</th><th>Diode recovery waveform</th></tr>
<tr><td>
</td><td>
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Table 9 Switching times

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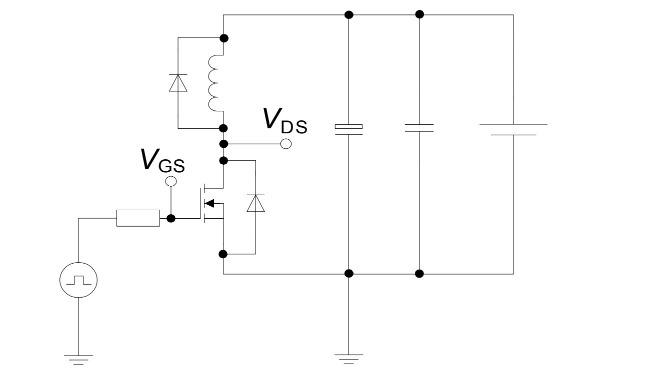
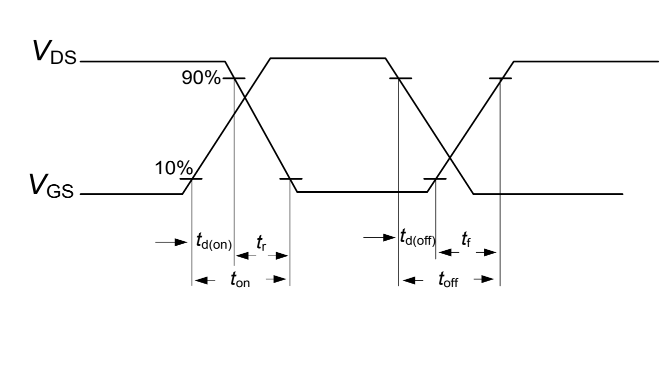
<tr><th>Switching times test circuit for inductive load</th><th>Switching times waveform</th></tr>
<tr><td>
</td><td>
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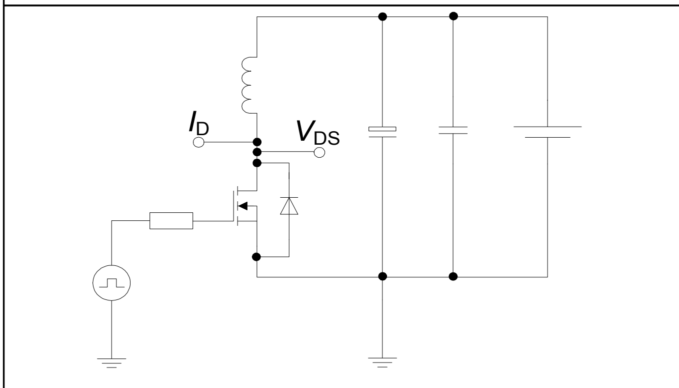
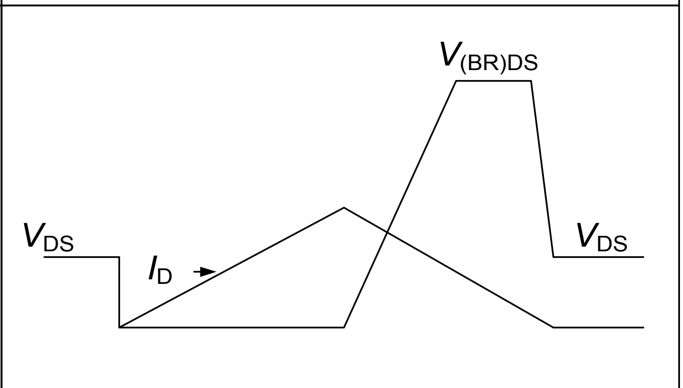
Table 10 Unclamped inductive load

<table>
<tr><th>Unclamped inductive load test circuit</th><th>Unclamped inductive waveform</th></tr>
<tr><td>
</td><td>
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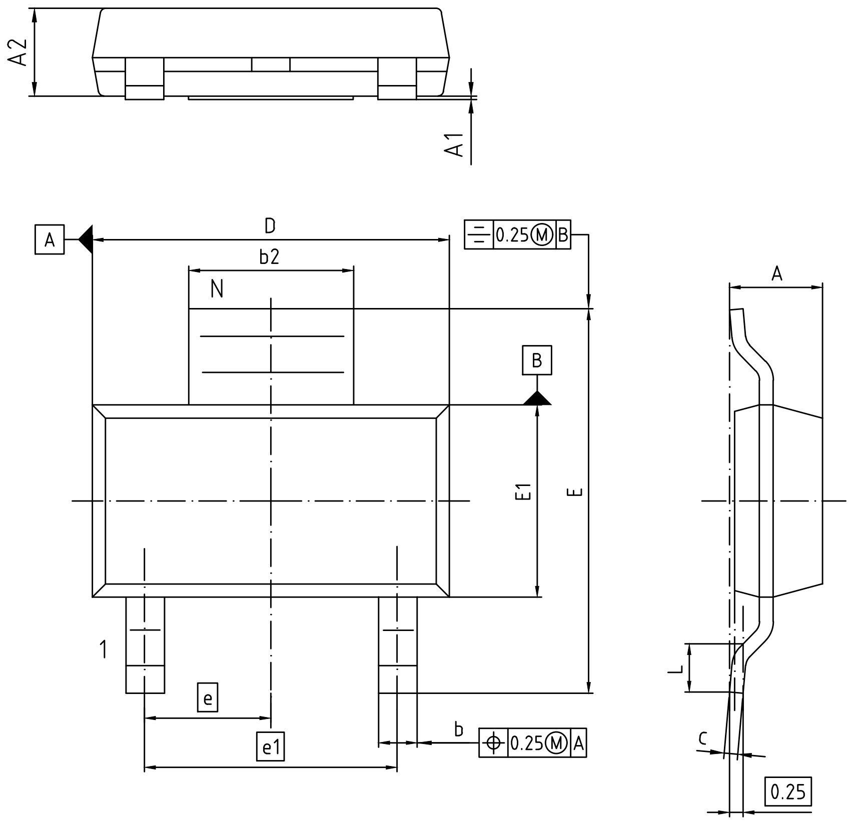
6 Package Outlines



NOTES:

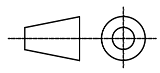
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-261

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.52	1.80	0.060	0.071
A1	-	0.10	-	0.004
A2	1,50	1.70	0.059	0.067
b	0.60	0.80	0.024	0.031
b2	2.95	3.10	0.116	0.122
c	0.24	0.32	0.009	0.013
D	6.30	6.70	0.248	0.264
E	6.70	7.30	0.264	0.287
E1	3.30	3.70	0.130	0.146
e	2.3 BASIC		0.091 BASIC	
e1	4.6 BASIC		0.181 BASIC	
L	0.75	1.10	0.030	0.043
N	3		3	
O	0°	10°	0°	10°

DOCUMENT NO.
Z8B00180553

SCALE
0 2.5 5mm

EUROPEAN PROJECTION



ISSUE DATE
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REVISION
01

Figure 1 Outline PG-SOT223, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS™ P7 Webpage:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPN70R1K2P7S

Revision: 2018-02-12, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2017-09-15	Release of final version
2.1	2018-02-12	Corrected front page text

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