

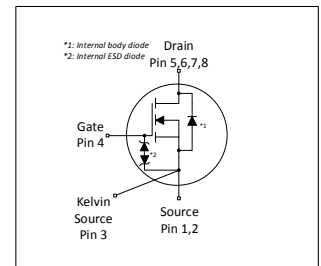
# MOSFET

## 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.



## Features

- Extremely low losses due to very low FOM  $R_{DS(on)} \cdot Q_g$  and  $R_{DS(on)} \cdot E_{oss}$
- Excellent thermal behavior
- Integrated ESD protection diode
- Low switching losses ( $E_{oss}$ )
- Fully qualified acc. JEDEC for Industrial Applications

## 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 in Chargers and Adapters

*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
$V_{DS} @ T_J=25^\circ\text{C}$	700	V
$R_{DS(on),max}$	0.6	$\Omega$
$Q_{g,typ}$	10.5	nC
$I_{D,pulse}$	20.5	A
$E_{oss} @ 400V$	1.2	$\mu\text{J}$
$V_{(GS)th,typ}$	3	V
ESD class (HBM)	2	

Type / Ordering Code	Package	Marking	Related Links
IPLK70R600P7	ThinPAK 5x6 SMD	70R600P7	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 <sup>1)</sup>	$I_D$	-	-	8.4 5.2	A	$T_C = 20^\circ\text{C}$ $T_C = 100^\circ\text{C}$
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	-	-	20.5	A	$T_C = 25^\circ\text{C}$
Application (Flyback) relevant avalanche current, single pulse <sup>3)</sup>	$I_{AS}$	-	3.2	-	A	measured with standard leakage inductance of transformer of $7\mu\text{H}$
MOSFET dv/dt ruggedness	dv/dt	-	-	100	V/ns	$V_{DS} = 0 \dots 400\text{V}$
Gate source voltage	$V_{GS}$	-16 -30	-	16 30	V	static; AC ( $f > 1\text{ Hz}$ )
Power dissipation	$P_{tot}$	-	-	46.3	W	$T_C = 25^\circ\text{C}$
Operating and storage temperature	$T_j, T_{stg}$	-55	-	150	$^\circ\text{C}$	-
Continuous diode forward current	$I_S$	-	-	5.1	A	$T_C = 25^\circ\text{C}$
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$	-	-	20.5	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt <sup>4)</sup>	dv/dt	-	-	1	V/ns	$V_{DS} = 0 \dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j = 25^\circ\text{C}$
Maximum diode commutation speed <sup>4)</sup>	di/dt	-	-	50	A/ $\mu\text{s}$	$V_{DS} = 0 \dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j = 25^\circ\text{C}$
Insulation withstand voltage	$V_{ISO}$	-	-	n.a.	V	$V_{rms}$ , $T_C = 25^\circ\text{C}$ , $t = 1\text{ min}$

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction	$R_{thJC}$	-	-	2.7	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	80	$^\circ\text{C/W}$	Device on PCB, minimal footprint
Thermal resistance, junction - ambient for SMD version	$R_{thJA}$	-	35	62	$^\circ\text{C/W}$	Device on $40\text{mm} \times 40\text{mm} \times 1.5$ epoxy PCB FR4 with $6\text{cm}^2$ (one layer $70\mu\text{m}$ thickness) copper area for drain connection and cooling. PCB is vertical without airflow.
Soldering temperature, wave- & reflow soldering allowed	$T_{sold}$	-	-	260	$^\circ\text{C}$	reflow MSL1

<sup>1)</sup> Limited by  $T_{j,max}$ .  $T_j = 20^\circ\text{C}$ . Maximum duty cycle  $D=0.5$

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Proven during verification test. Avalanche value is assuming only the energy from a Flyback transformer leakage inductance is transferred to the MOSFET. For less common avalanche situations it is recommended to contact Infineon for more information. For explanation please read AN - CoolMOS™ 700V P7.

<sup>4)</sup>  $V_{DClamp}=400\text{V}$ ;  $V_{DS,peak} < V_{(BR)DSS}$ ; 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	$V_{DS}=V_{GS}$ , $I_D=0.09mA$
Zero gate voltage drain current	$I_{DSS}$	-	-	1	$\mu A$	$V_{DS}=700V$ , $V_{GS}=0V$ , $T_j=25^\circ C$ $V_{DS}=700V$ , $V_{GS}=0V$ , $T_j=150^\circ C$
Gate-source leakage current incl. Zener diode	$I_{GSS}$	-	-	1	$\mu A$	$V_{GS}=20V$ , $V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.49 1.03	0.60 -	$\Omega$	$V_{GS}=10V$ , $I_D=1.8A$ , $T_j=25^\circ C$ $V_{GS}=10V$ , $I_D=1.8A$ , $T_j=150^\circ C$
Gate resistance	$R_G$	-	10	-	$\Omega$	$f=1\text{ MHz}$ , open drain

**Table 5 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	$C_{iss}$	-	364	-	pF	$V_{GS}=0V$ , $V_{DS}=400V$ , $f=250kHz$
Output capacitance	$C_{oss}$	-	7	-	pF	$V_{GS}=0V$ , $V_{DS}=400V$ , $f=250kHz$
Effective output capacitance, energy related <sup>1)</sup>	$C_{o(er)}$	-	17	-	pF	$V_{GS}=0V$ , $V_{DS}=0...400V$
Effective output capacitance, time related <sup>2)</sup>	$C_{o(tr)}$	-	200	-	pF	$I_D=\text{constant}$ , $V_{GS}=0V$ , $V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	14	-	ns	$V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ , $R_G=5.3\Omega$
Rise time	$t_r$	-	5.5	-	ns	$V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ , $R_G=5.3\Omega$
Turn-off delay time	$t_{d(off)}$	-	63	-	ns	$V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ , $R_G=5.3\Omega$
Fall time	$t_f$	-	23	-	ns	$V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ , $R_G=5.3\Omega$

**Table 6 Gate charge characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	$Q_{gs}$	-	1.6	-	nC	$V_{DD}=400V$ , $I_D=1.4A$ , $V_{GS}=0$ to 10V
Gate to drain charge	$Q_{gd}$	-	3.7	-	nC	$V_{DD}=400V$ , $I_D=1.4A$ , $V_{GS}=0$ to 10V
Gate charge total	$Q_g$	-	10.5	-	nC	$V_{DD}=400V$ , $I_D=1.4A$ , $V_{GS}=0$ to 10V
Gate plateau voltage	$V_{plateau}$	-	4.4	-	V	$V_{DD}=400V$ , $I_D=1.4A$ , $V_{GS}=0$ to 10V

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

<sup>2)</sup>  $C_{o(tr)}$  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	$V_{GS}=0V, I_F=2.5A, T_J=25^{\circ}C$
Reverse recovery time	$t_{rr}$	-	289	-	ns	$V_R=400V, I_F=1.4A, di_F/dt=50A/\mu s$
Reverse recovery charge	$Q_{rr}$	-	0.9	-	$\mu C$	$V_R=400V, I_F=1.4A, di_F/dt=50A/\mu s$
Peak reverse recovery current	$I_{rrm}$	-	9	-	A	$V_R=400V, I_F=1.4A, di_F/dt=50A/\mu s$

## 4 Electrical characteristics diagrams

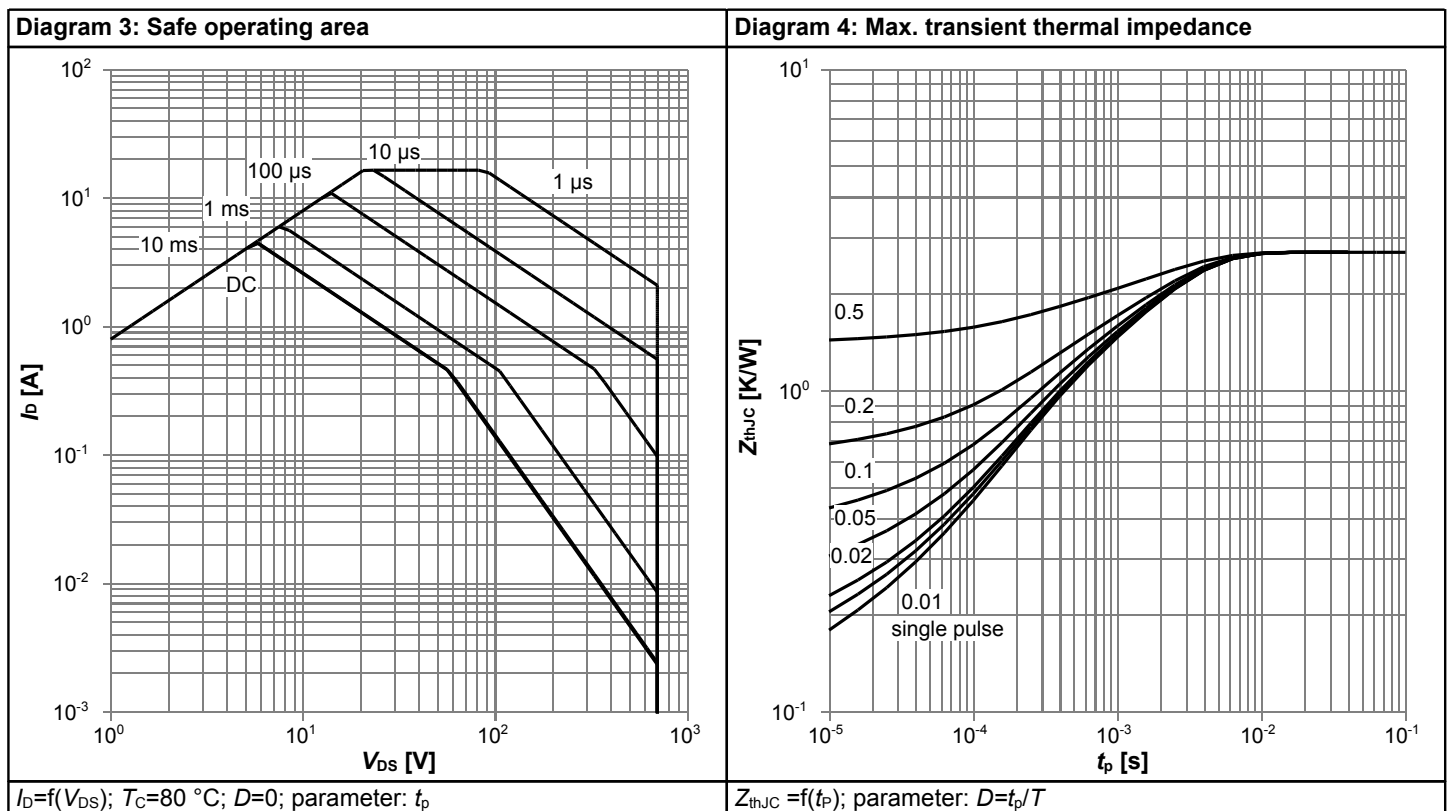
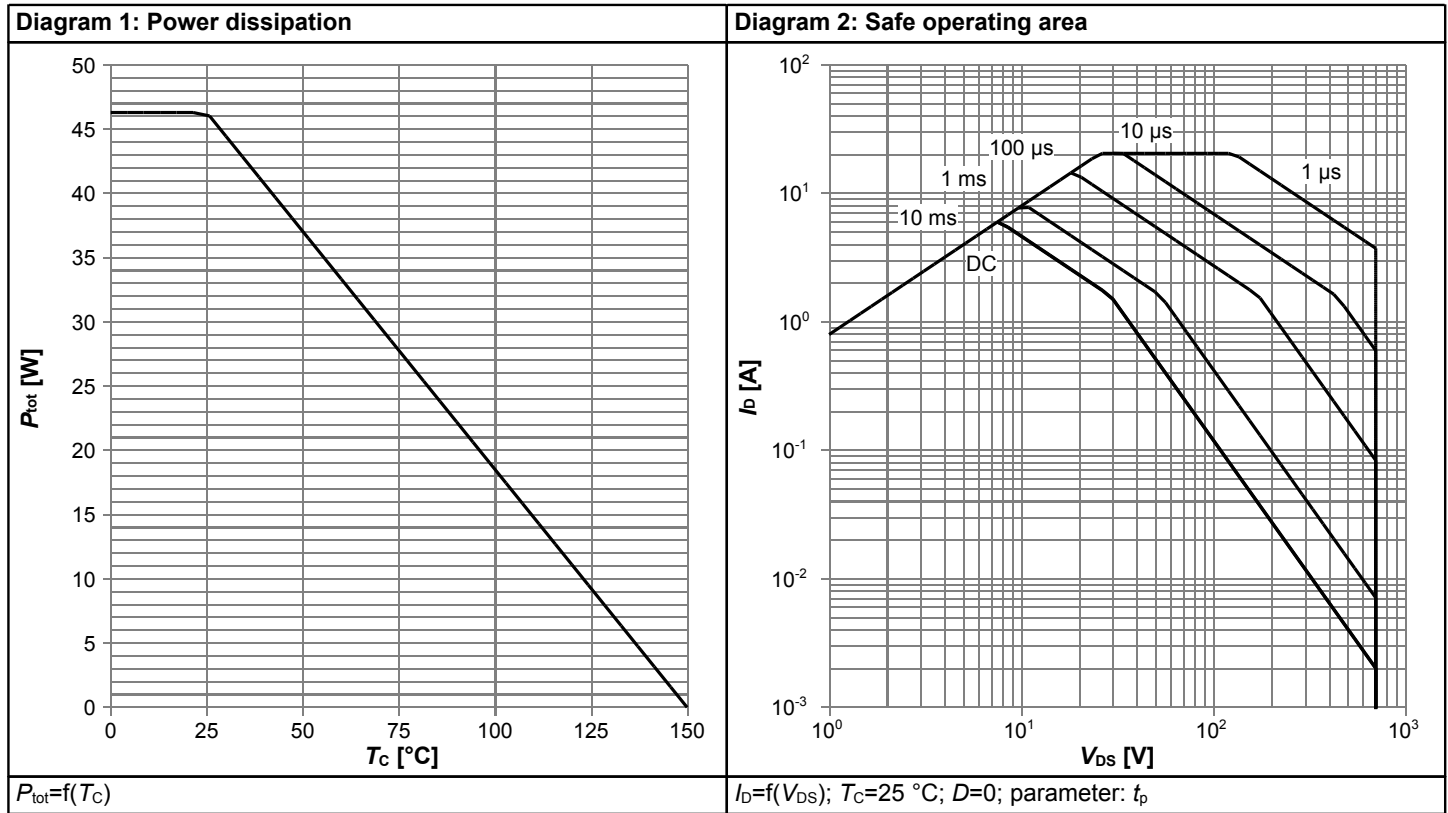
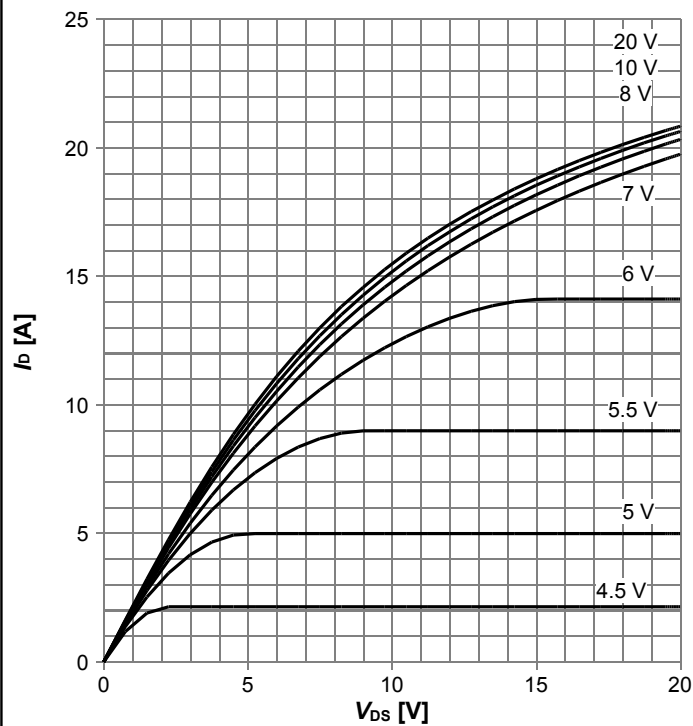
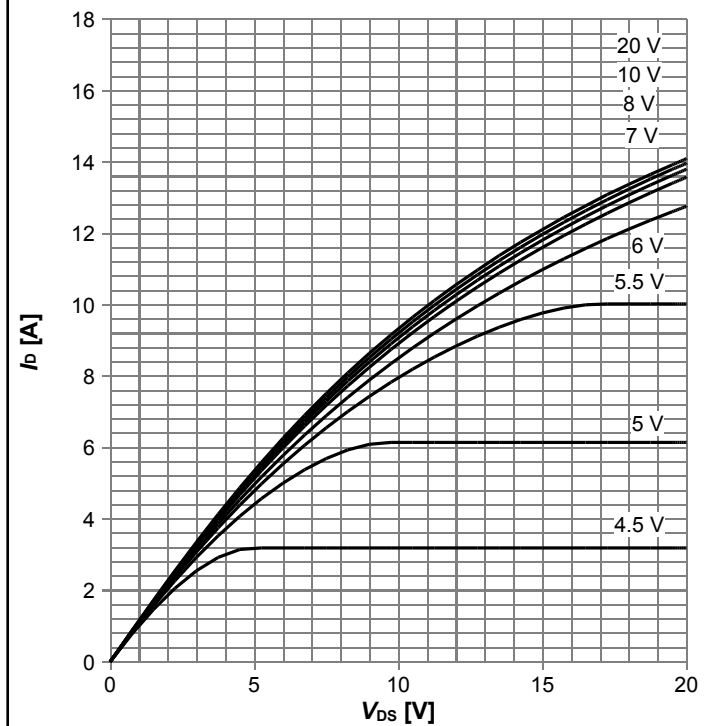


Diagram 5: Typ. output characteristics



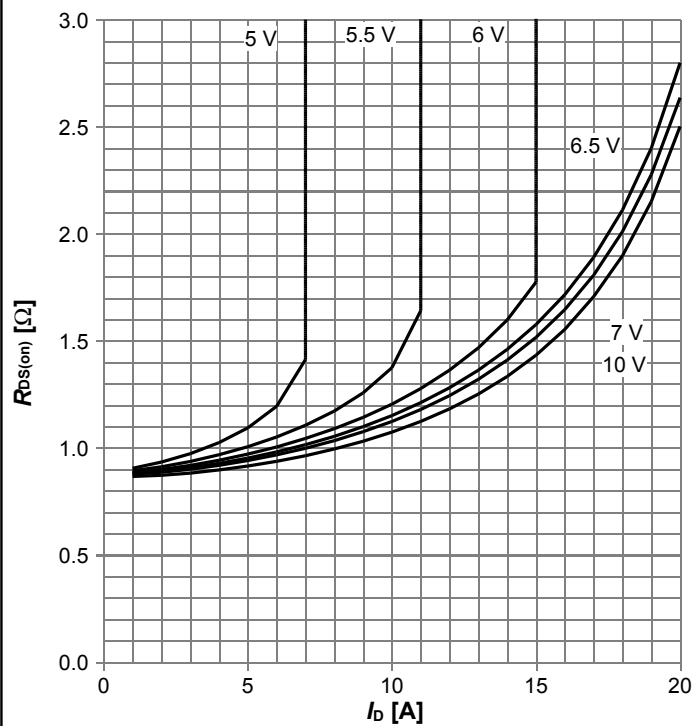
$I_D = f(V_{DS})$ ;  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



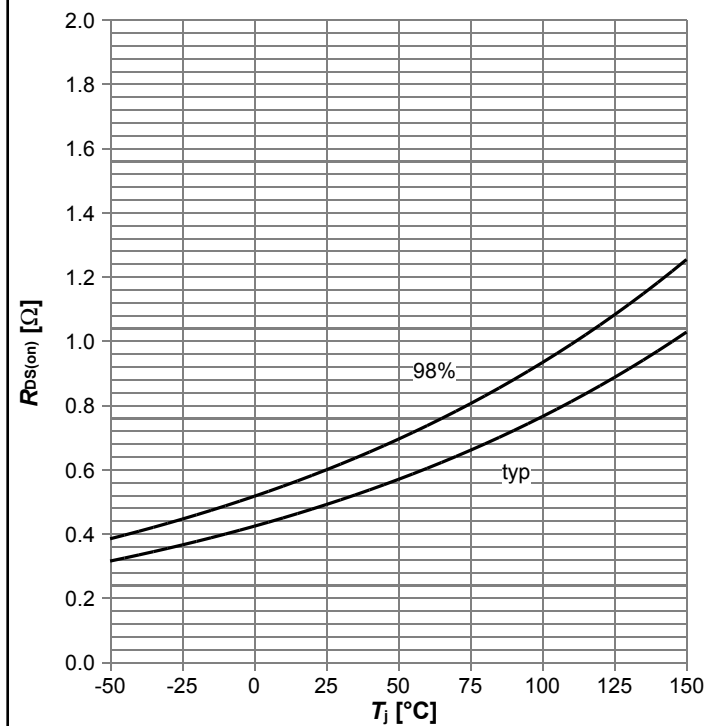
$I_D = f(V_{DS})$ ;  $T_j = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

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



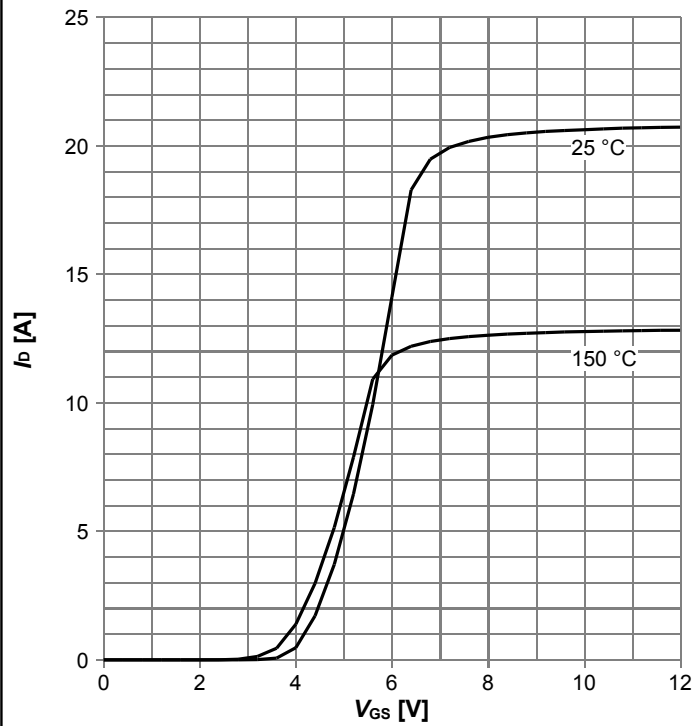
$R_{DS(on)} = f(I_D)$ ;  $T_j = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 8: Drain-source on-state resistance



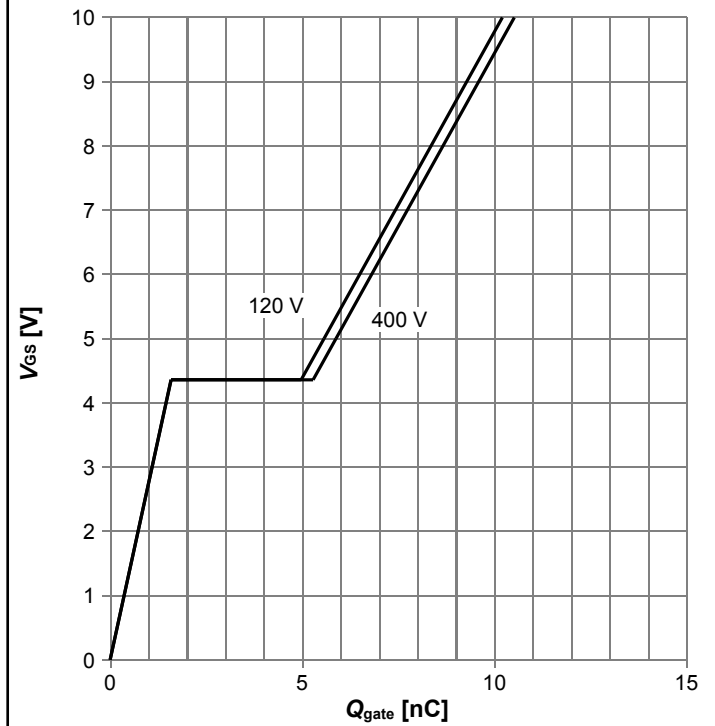
$R_{DS(on)} = f(T_j)$ ;  $I_D = 1.8\text{ A}$ ;  $V_{GS} = 10\text{ V}$

**Diagram 9: Typ. transfer characteristics**



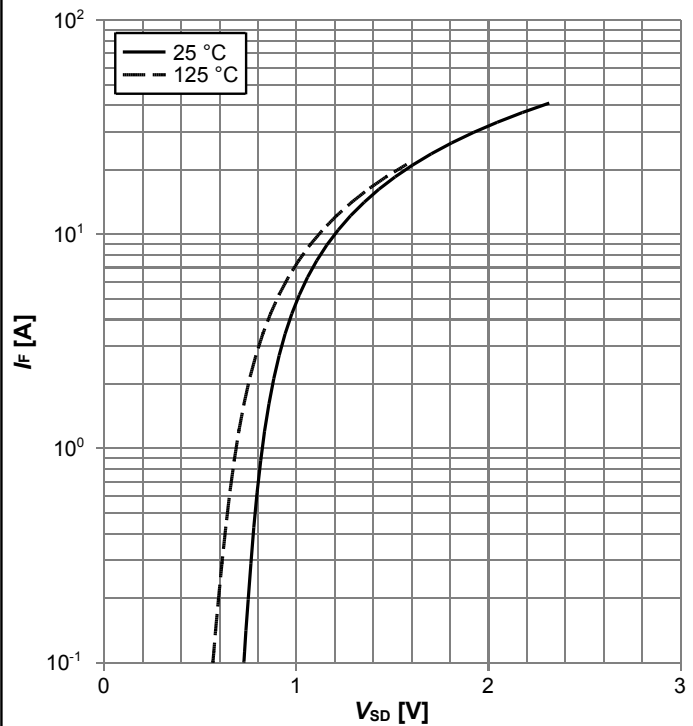
$I_D = f(V_{GS})$ ;  $V_{DS} = 20V$ ; parameter:  $T_j$

**Diagram 10: Typ. gate charge**



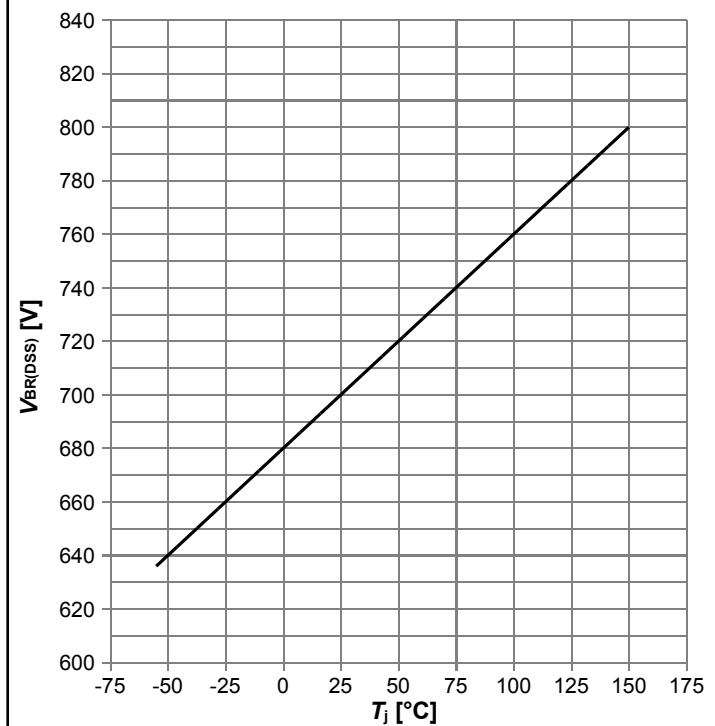
$V_{GS} = f(Q_{gate})$ ;  $I_D = 1.4$  A pulsed; parameter:  $V_{DD}$

**Diagram 11: Forward characteristics of reverse diode**



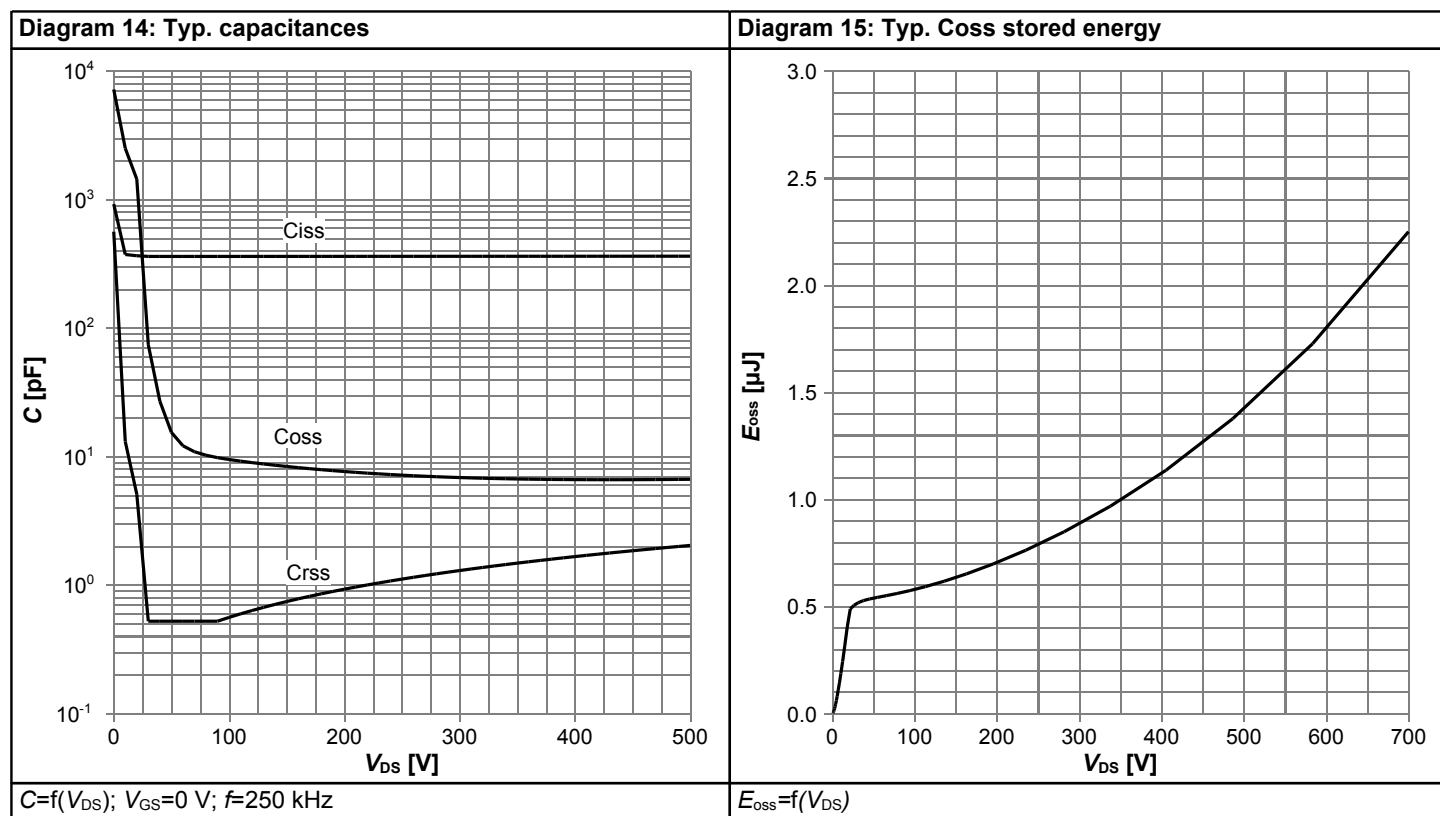
$I_F = f(V_{SD})$ ; parameter:  $T_j$

**Diagram 13: Drain-source breakdown voltage**



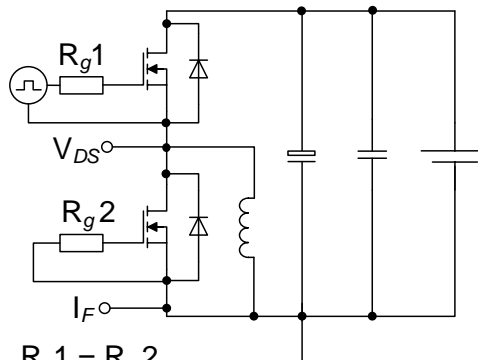
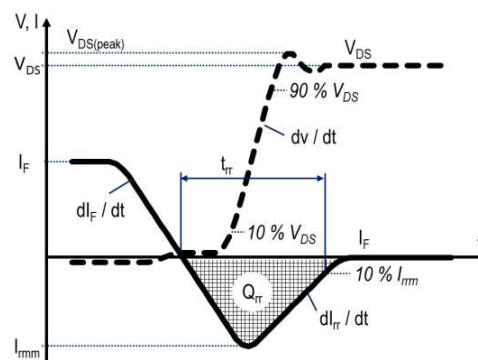
$V_{BR(DSS)} = f(T_j)$ ;  $I_D = 1$  mA



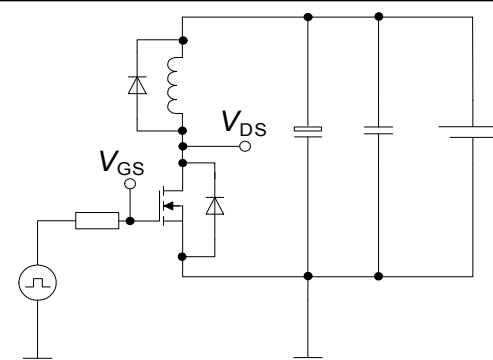
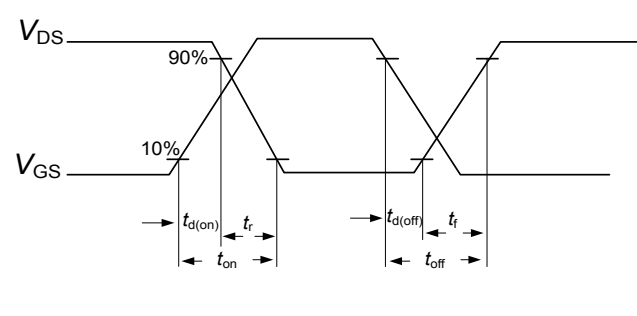


## 5 Test Circuits

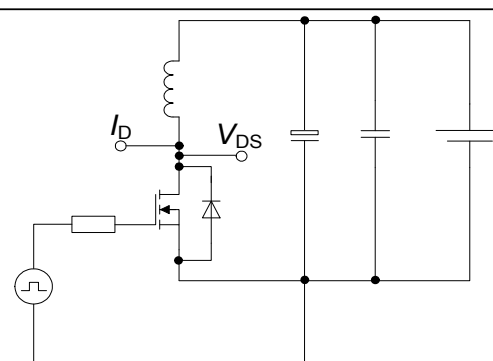
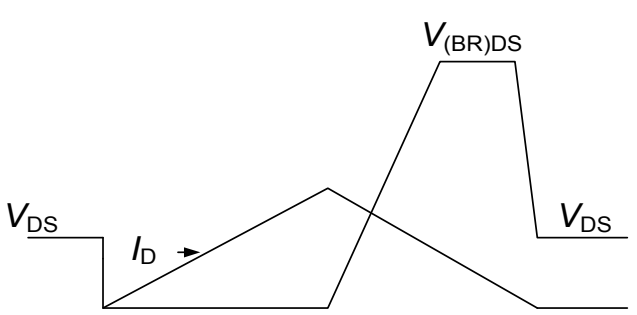
**Table 8 Diode characteristics**

Test circuit for diode characteristics	Diode recovery waveform
 <p><math>R_{g1} = R_{g2}</math></p>	

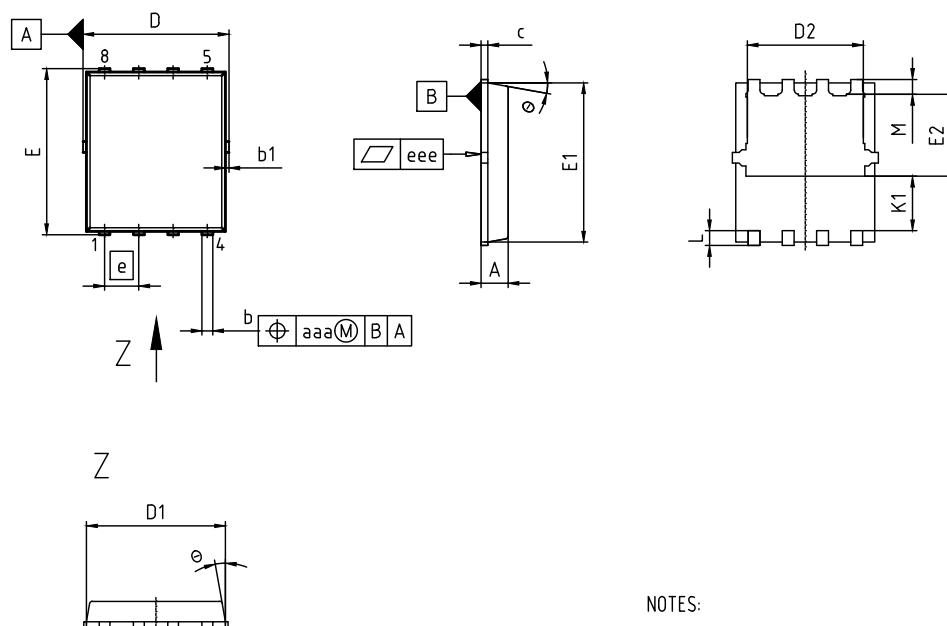
**Table 9 Switching times**

Switching times test circuit for inductive load	Switching times waveform
	

**Table 10 Unclamped inductive load**

Unclamped inductive load test circuit	Unclamped inductive waveform
	

## 6 Package Outlines



### NOTES:

1. INDUSTRIAL QUALITY GRADE
2. ALL DIMENSIONS REFER TO JEDEC STANDARD MO240A NOT INCLUDE MOLD FLASH
3. REMOVAL ON MOLD GATE, INTRUSION 0.1mm;  
PROPRUSION 0.1mm
4. ALL METAL SURFACE ARE PLATED EXCEPT AREA OF CUT

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.90	1.10	0.035	0.043
b	0.34	0.54	0.013	0.021
b1	0.03	0.23	0.001	0.009
c	0.15	0.35	0.006	0.014
D	5.15	5.51	0.203	0.217
D1	4.95	5.35	0.195	0.211
D2	4.20	4.40	0.165	0.173
E	5.95	6.35	0.234	0.250
E1	5.70	6.10	0.224	0.240
E2	2.93	3.13	0.115	0.123
e	1.27		0.050	
N	8		8	
K1	1.92	2.12	0.076	0.083
L	0.45	0.65	0.018	0.026
M	0.45	0.65	0.018	0.026
theta	8.5°	12°	8.5°	12°
aaa	0.25		0.010	
eee	0.08		0.003	

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Figure 1 Outline ThinPAK 5x6 SMD, dimensions in mm/inches - Industrial Grade

## **7 Appendix A**

### **Table 11 Related Links**

- **IFX CoolMOS™ P7 Webpage:** [www.infineon.com](http://www.infineon.com)
- **IFX Design tools:** [www.infineon.com](http://www.infineon.com)

## Revision History

IPLK70R600P7

**Revision: 2018-09-27, Rev. 2.0**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2018-09-27	Release of final version

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