

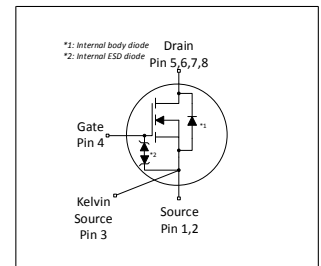
# MOSFET

## 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             |
| $R_{DS(on),max}$                | 0.9   | $\Omega$      |
| $Q_{g,typ}$                     | 6.8   | nC            |
| $I_{D,pulse}$                   | 12.8  | A             |
| $E_{oss} @ 400V$                | 0.9   | $\mu\text{J}$ |
| $V_{(GS)th,typ}$                | 3     | V             |
| ESD class (HBM)                 | 1C    |               |

| Type / Ordering Code | Package         | Marking  | Related Links  |
|----------------------|-----------------|----------|----------------|
| IPLK70R900P7         | ThinPAK 5x6 SMD | 70R900P7 | see Appendix A |

**Table of Contents**

Description ..... 1

Maximum ratings ..... 3

Thermal characteristics ..... 3

Electrical characteristics ..... 4

Electrical characteristics diagrams ..... 6

Test Circuits ..... 10

Package Outlines ..... 11

Appendix A ..... 12

Revision History ..... 13

Trademarks ..... 13

Disclaimer ..... 13

## 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>                                       | $I_D$          | -          | -    | 5.7<br>3.5 | A                | $T_C = 20^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$                         |
| Pulsed drain current <sup>2)</sup>                                           | $I_{D,pulse}$  | -          | -    | 12.8       | A                | $T_C = 25^\circ\text{C}$                                                      |
| Application (Flyback) relevant avalanche current, single pulse <sup>3)</sup> | $I_{AS}$       | -          | 3.6  | -          | A                | measured with standard leakage inductance of transformer of 5μH               |
| MOSFET dv/dt ruggedness                                                      | dv/dt          | -          | -    | 100        | V/ns             | $V_{DS} = 0 \dots 400\text{V}$                                                |
| Gate source voltage                                                          | $V_{GS}$       | -16<br>-30 | -    | 16<br>30   | V                | static;<br>AC ( $f > 1\text{ Hz}$ )                                           |
| Power dissipation                                                            | $P_{tot}$      | -          | -    | 32.1       | W                | $T_C = 25^\circ\text{C}$                                                      |
| Operating and storage temperature                                            | $T_j, T_{stg}$ | -55        | -    | 150        | $^\circ\text{C}$ | -                                                                             |
| Continuous diode forward current                                             | $I_S$          | -          | -    | 5.4        | A                | $T_C = 25^\circ\text{C}$                                                      |
| Diode pulse current <sup>2)</sup>                                            | $I_{S,pulse}$  | -          | -    | 12.8       | 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/μs             | $V_{DS} = 0 \dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j = 25^\circ\text{C}$ |
| 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                            | $R_{thJC}$ | -      | -    | 3.9  | $^\circ\text{C/W}$ | -                                                                                                                                                                     |
| 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 40mm*40mm*1.5 epoxy PCB FR4 with 6cm <sup>2</sup> (one layer 70μm 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        | $V_{DS}=V_{GS}$ , $I_D=0.06mA$                                                                    |
| Zero gate voltage drain current               | $I_{DSS}$     | -      | -            | 1         | $\mu A$  | $V_{DS}=700V$ , $V_{GS}=0V$ , $T_j=25^\circ C$<br>$V_{DS}=700V$ , $V_{GS}=0V$ , $T_j=150^\circ C$ |
| Gate-source leakage current incl. Zener diode | $I_{GSS}$     | -      | -            | 1         | $\mu A$  | $V_{GS}=20V$ , $V_{DS}=0V$                                                                        |
| Drain-source on-state resistance              | $R_{DS(on)}$  | -      | 0.74<br>1.53 | 0.90<br>- | $\Omega$ | $V_{GS}=10V$ , $I_D=1.1A$ , $T_j=25^\circ C$<br>$V_{GS}=10V$ , $I_D=1.1A$ , $T_j=150^\circ C$     |
| Gate resistance                               | $R_G$         | -      | 1.6          | -         | $\Omega$ | $f=1\text{ MHz}$ , open drain                                                                     |

**Table 5 Dynamic characteristics**

| Parameter                                                  | Symbol       | Values |      |      | Unit | Note / Test Condition                                          |
|------------------------------------------------------------|--------------|--------|------|------|------|----------------------------------------------------------------|
|                                                            |              | Min.   | Typ. | Max. |      |                                                                |
| Input capacitance                                          | $C_{iss}$    | -      | 211  | -    | pF   | $V_{GS}=0V$ , $V_{DS}=400V$ , $f=250kHz$                       |
| Output capacitance                                         | $C_{oss}$    | -      | 5    | -    | pF   | $V_{GS}=0V$ , $V_{DS}=400V$ , $f=250kHz$                       |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 13   | -    | pF   | $V_{GS}=0V$ , $V_{DS}=0...400V$                                |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 177  | -    | pF   | $I_D=\text{constant}$ , $V_{GS}=0V$ , $V_{DS}=0...400V$        |
| Turn-on delay time                                         | $t_{d(on)}$  | -      | 12   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=0.9A$ ,<br>$R_G=5.3\Omega$ |
| Rise time                                                  | $t_r$        | -      | 4.7  | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=0.9A$ ,<br>$R_G=5.3\Omega$ |
| Turn-off delay time                                        | $t_{d(off)}$ | -      | 58   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=0.9A$ ,<br>$R_G=5.3\Omega$ |
| Fall time                                                  | $t_f$        | -      | 31   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=0.9A$ ,<br>$R_G=5.3\Omega$ |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                          |
|-----------------------|---------------|--------|------|------|------|------------------------------------------------|
|                       |               | Min.   | Typ. | Max. |      |                                                |
| Gate to source charge | $Q_{gs}$      | -      | 0.9  | -    | nC   | $V_{DD}=400V$ , $I_D=0.9A$ , $V_{GS}=0$ to 10V |
| Gate to drain charge  | $Q_{gd}$      | -      | 2.6  | -    | nC   | $V_{DD}=400V$ , $I_D=0.9A$ , $V_{GS}=0$ to 10V |
| Gate charge total     | $Q_g$         | -      | 6.8  | -    | nC   | $V_{DD}=400V$ , $I_D=0.9A$ , $V_{GS}=0$ to 10V |
| Gate plateau voltage  | $V_{plateau}$ | -      | 4.4  | -    | V    | $V_{DD}=400V$ , $I_D=0.9A$ , $V_{GS}=0$ 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       | $V_{GS}=0V$ , $I_F=1.4A$ , $T_J=25^{\circ}C$  |
| Reverse recovery time         | $t_{rr}$  | -      | 298  | -    | ns      | $V_R=400V$ , $I_F=0.9A$ , $di_F/dt=50A/\mu s$ |
| Reverse recovery charge       | $Q_{rr}$  | -      | 0.7  | -    | $\mu C$ | $V_R=400V$ , $I_F=0.9A$ , $di_F/dt=50A/\mu s$ |
| Peak reverse recovery current | $I_{rrm}$ | -      | 7    | -    | A       | $V_R=400V$ , $I_F=0.9A$ , $di_F/dt=50A/\mu s$ |

## 4 Electrical characteristics diagrams

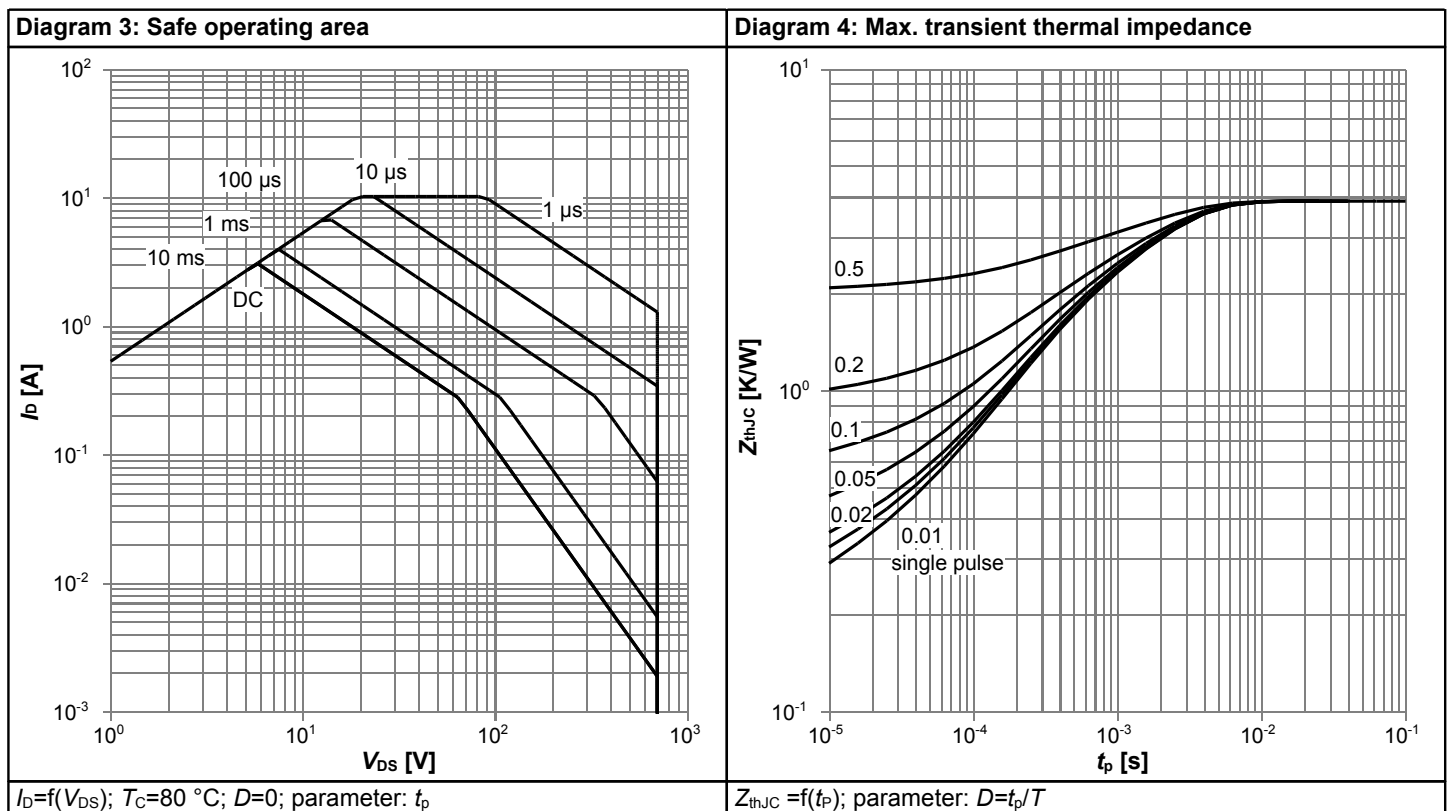
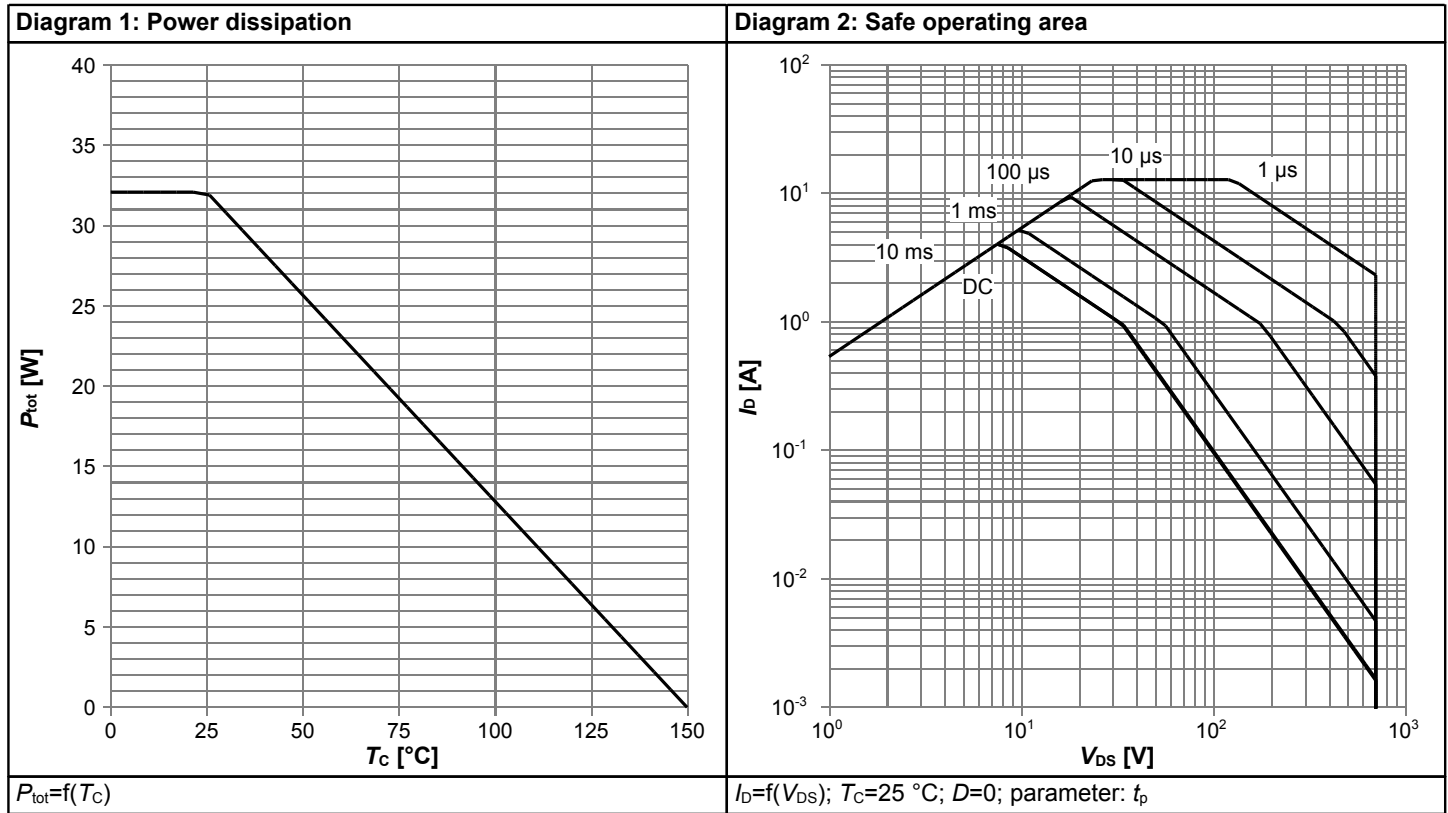
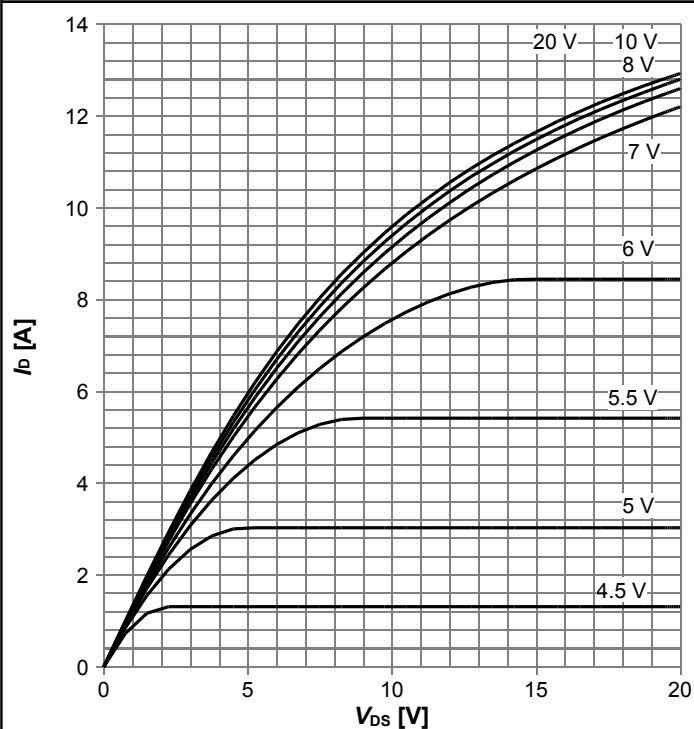
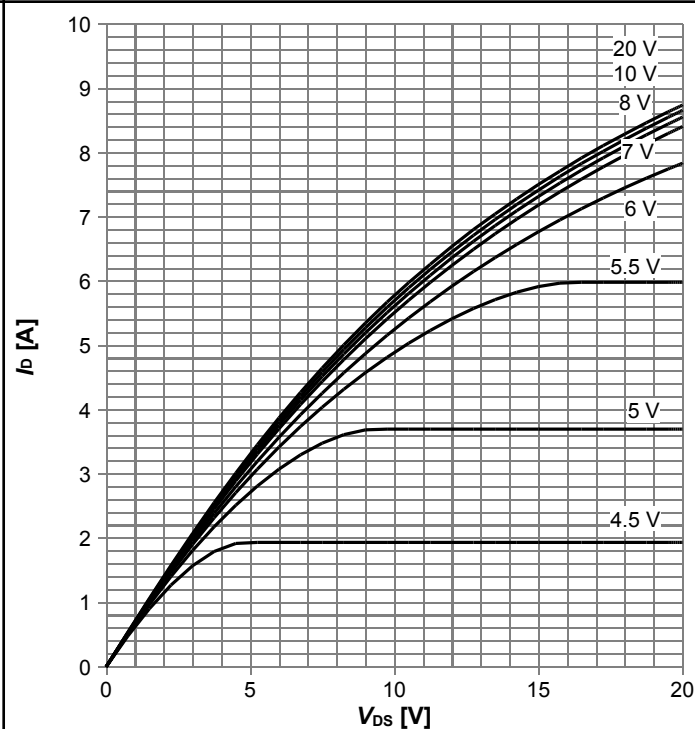


Diagram 5: Typ. output characteristics



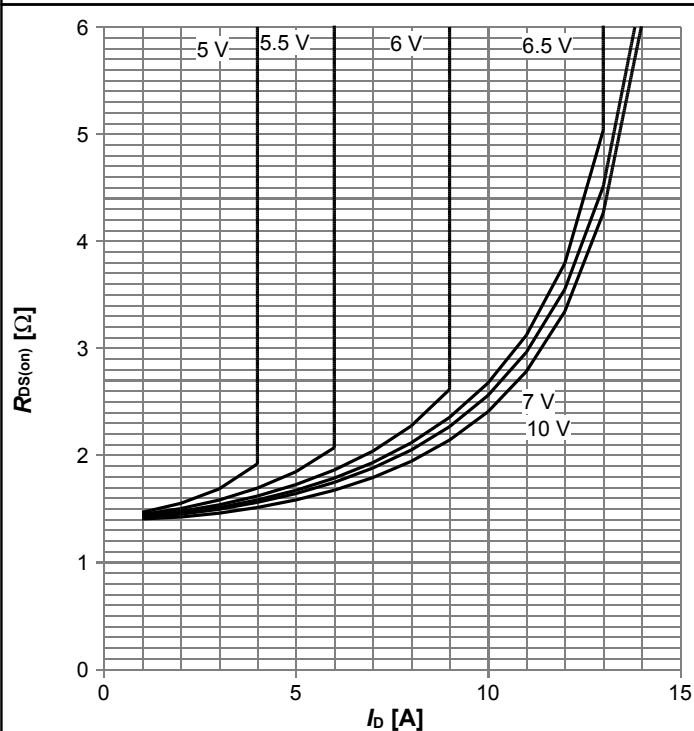
$I_D = f(V_{DS})$ ;  $T_J = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



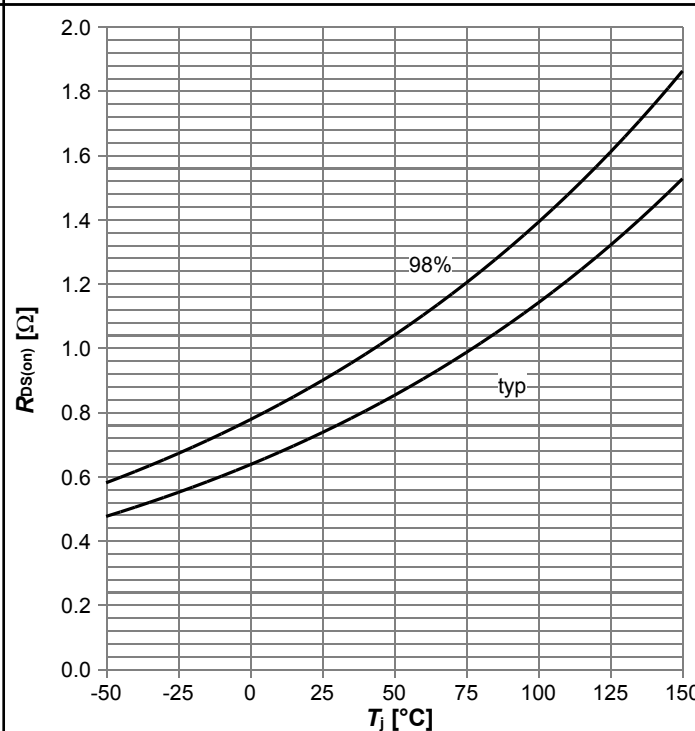
$I_D = f(V_{DS})$ ;  $T_J = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

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



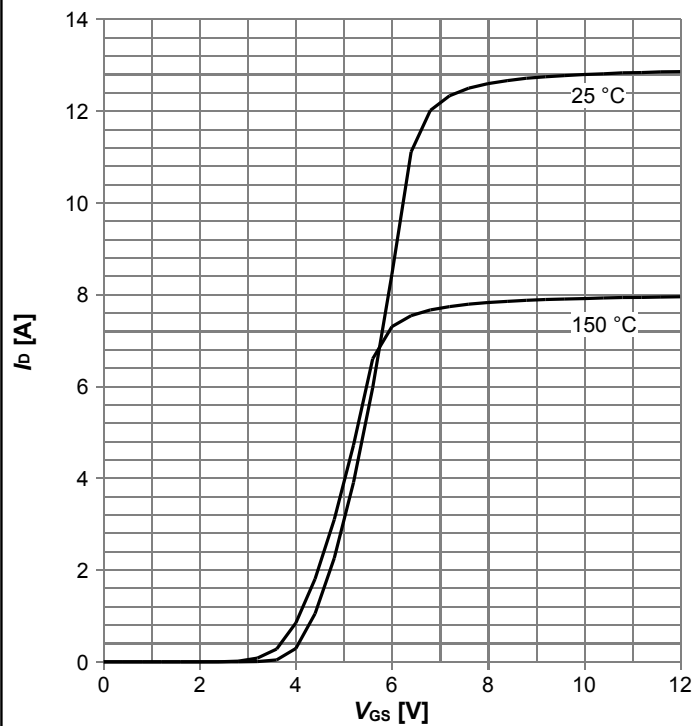
$R_{DS(on)} = f(I_D)$ ;  $T_J = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 8: Drain-source on-state resistance



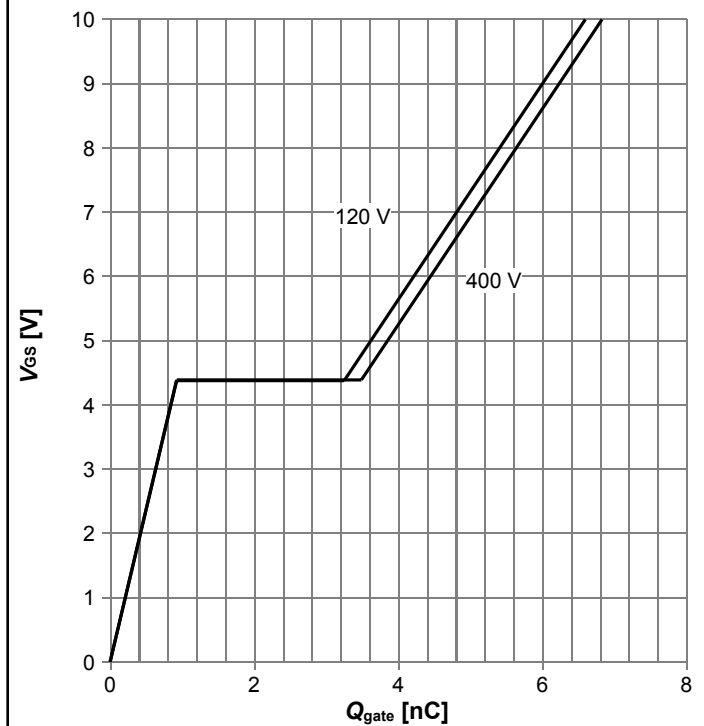
$R_{DS(on)} = f(T_J)$ ;  $I_D = 1.1\text{ A}$ ;  $V_{GS} = 10\text{ V}$

**Diagram 9: Typ. transfer characteristics**



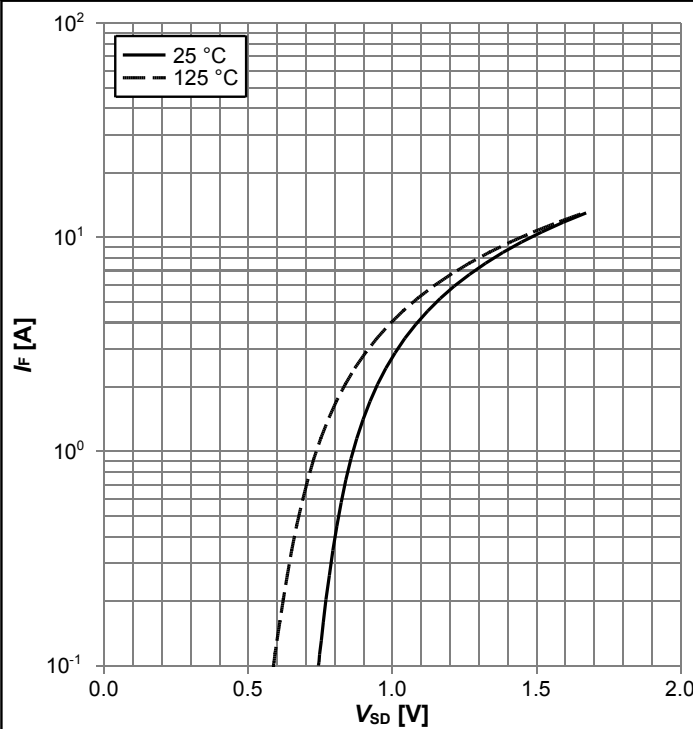
$I_D = f(V_{GS})$ ;  $V_{DS} = 20V$ ; parameter:  $T_j$

**Diagram 10: Typ. gate charge**



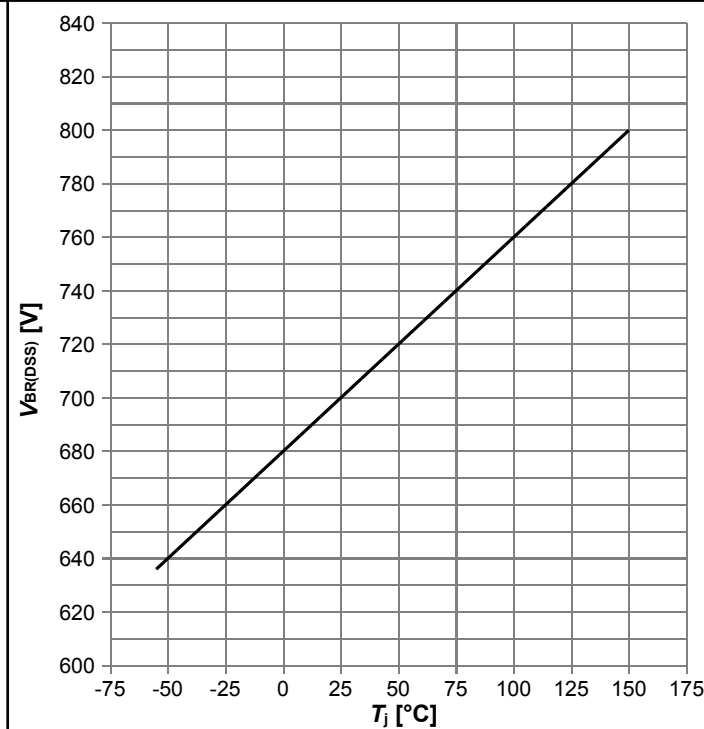
$V_{GS} = f(Q_{gate})$ ;  $I_D = 0.9$  A pulsed; parameter:  $V_{DD}$

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

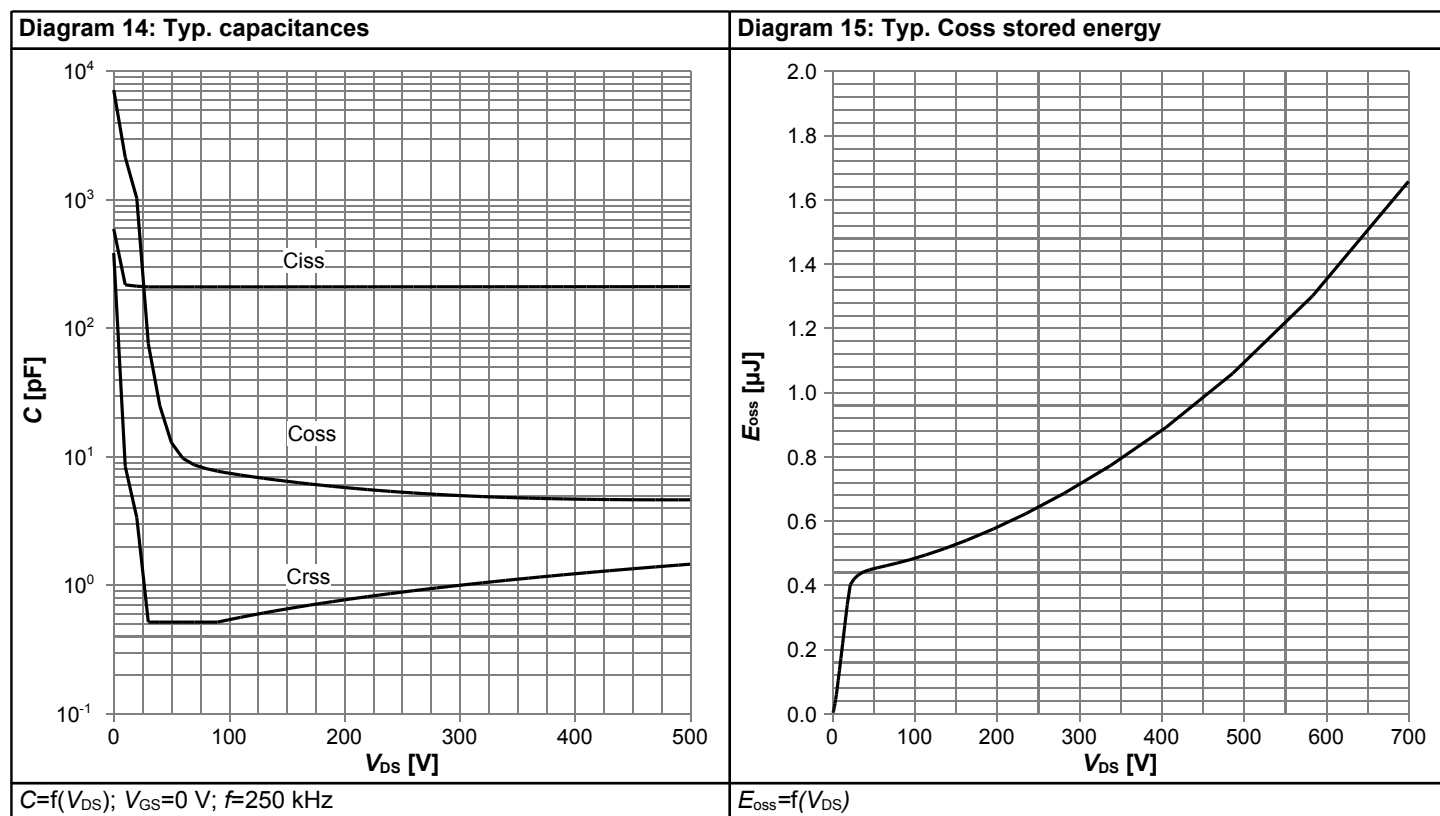


$I_F = f(V_{SD})$ ; parameter:  $T_j$

**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> |  |

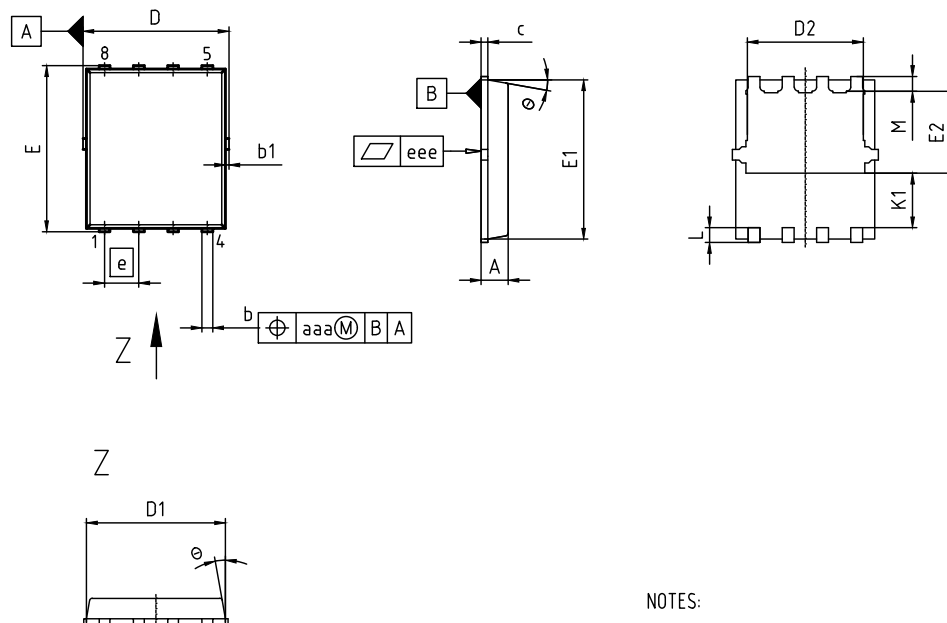
**Table 9 Switching times**

| 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  |       |

|                                    |
|------------------------------------|
| <b>DOCUMENT NO.</b><br>Z8B00181453 |
| <b>SCALE</b><br>0 2.5 5mm          |
| <b>EUROPEAN PROJECTION</b><br>     |
| <b>ISSUE DATE</b><br>13-05-2016    |
| <b>REVISION</b><br>01              |

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

IPLK70R900P7

**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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