

# MOSFET

## 800V CoolMOS™ P7 Power Transistor

The latest 800V CoolMOS™ P7 series sets a new benchmark in 800V super junction technologies and combines best-in-class performance with state of the art ease-of-use, resulting from Infineon's over 18 years pioneering super junction technology innovation.

### Features

- Best-in-class FOM  $R_{DS(on)} * E_{oss}$ ; reduced  $Q_g$ ,  $C_{iss}$ , and  $C_{oss}$
- Best-in-class DPAK  $R_{DS(on)}$
- Best-in-class  $V_{GS(th)}$  of 3V and smallest  $V_{GS(th)}$  variation of  $\pm 0.5V$
- Integrated Zener Diode ESD protection
- Fully qualified acc. JEDEC for Industrial Applications
- Fully optimized portfolio

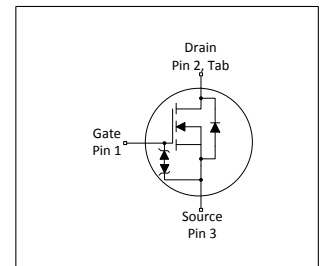
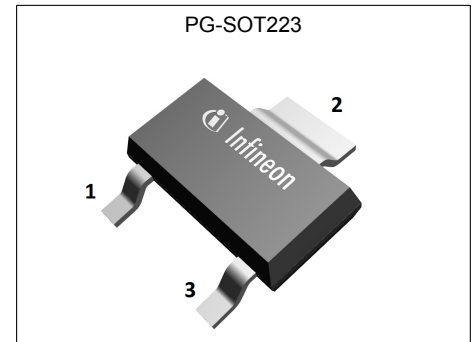
### Benefits

- Best-in-class performance
- Enabling higher power density designs, BOM savings and lower assembly costs
- Easy to drive and to parallel
- Better production yield by reducing ESD related failures
- Less production issues and reduced field returns
- Easy to select right parts for fine tuning of designs

### Potential applications

Recommended for hard and soft switching flyback topologies for LED Lighting, low power Chargers and Adapters, Audio, AUX power and Industrial power. Also suitable for PFC stage in Consumer applications 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     |
|----------------------------|-------|----------|
| $V_{DS} @ T_J=25^{\circ}C$ | 800   | V        |
| $R_{DS(on),max}$           | 1.4   | $\Omega$ |
| $Q_{g,typ}$                | 10    | nC       |
| $I_D$                      | 4     | A        |
| $E_{oss} @ 500V$           | 0.9   | $\mu J$  |
| $V_{GS(th),typ}$           | 3     | V        |
| ESD class (HBM)            | 2     | -        |

| Type / Ordering Code | Package   | Marking | Related Links  |
|----------------------|-----------|---------|----------------|
| IPN80R1K4P7          | PG-SOT223 | 80R1K4  | 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>        | $I_D$          | -          | -    | 4<br>2.7 | A                | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$                     |
| Pulsed drain current <sup>2)</sup>            | $I_{D,pulse}$  | -          | -    | 8.9      | A                | $T_C=25^\circ\text{C}$                                                |
| Avalanche energy, single pulse                | $E_{AS}$       | -          | -    | 8        | mJ               | $I_D=0.6\text{A}$ ; $V_{DD}=50\text{V}$                               |
| Avalanche energy, repetitive                  | $E_{AR}$       | -          | -    | 0.07     | mJ               | $I_D=0.6\text{A}$ ; $V_{DD}=50\text{V}$                               |
| Avalanche current, repetitive                 | $I_{AR}$       | -          | -    | 0.6      | A                | -                                                                     |
| MOSFET dv/dt ruggedness                       | dv/dt          | -          | -    | 100      | V/ns             | $V_{DS}=0$ to 400V                                                    |
| Gate source voltage                           | $V_{GS}$       | -20<br>-30 | -    | 20<br>30 | V                | static;<br>AC ( $f>1\text{ Hz}$ )                                     |
| Power dissipation                             | $P_{tot}$      | -          | -    | 7        | W                | $T_C=25^\circ\text{C}$                                                |
| Operating and storage temperature             | $T_j, T_{stg}$ | -55        | -    | 150      | $^\circ\text{C}$ | -                                                                     |
| Continuous diode forward current              | $I_S$          | -          | -    | 1.4      | A                | $T_C=25^\circ\text{C}$                                                |
| Diode pulse current <sup>2)</sup>             | $I_{S,pulse}$  | -          | -    | 8.9      | A                | $T_C=25^\circ\text{C}$                                                |
| Reverse diode dv/dt <sup>3)</sup>             | dv/dt          | -          | -    | 1        | V/ns             | $V_{DS}=0$ to 400V, $I_{SD}\leq 0.7\text{A}$ , $T_j=25^\circ\text{C}$ |
| Maximum diode commutation speed <sup>3)</sup> | di/dt          | -          | -    | 50       | A/ $\mu\text{s}$ | $V_{DS}=0$ to 400V, $I_{SD}\leq 0.7\text{A}$ , $T_j=25^\circ\text{C}$ |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                                      | Symbol     | Values |      |      | Unit               | Note / Test Condition                                                                                                                                                                          |
|----------------------------------------------------------------|------------|--------|------|------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                |            | Min.   | Typ. | Max. |                    |                                                                                                                                                                                                |
| Thermal resistance, junction - solder point                    | $R_{thJS}$ | -      | -    | 18.7 | $^\circ\text{C/W}$ | -                                                                                                                                                                                              |
| Thermal resistance, junction - ambient                         | $R_{thJA}$ | -      | -    | 160  | $^\circ\text{C/W}$ | Device on PCB, minimal footprint                                                                                                                                                               |
| Thermal resistance, junction - ambient soldered on copper area | $R_{thJA}$ | -      | -    | 75   | $^\circ\text{C/W}$ | Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm <sup>2</sup> (one layer 70 $\mu\text{m}$ thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling. |
| Soldering temperature, wave- & reflow soldering allowed        | $T_{sold}$ | -      | -    | 260  | $^\circ\text{C}$   | reflow MSL1                                                                                                                                                                                    |

<sup>1)</sup> DPAK equivalent. Limited by  $T_{j,max}$ . Maximum duty cycle  $D=0.5$

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

<sup>3)</sup>  $V_{DClamp}=400\text{V}$ ;  $V_{DS,peak}<V_{(BR)DSS}$ ; identical low side and high side switch with identical  $R_G$ ;  $t_{cond}<2\mu\text{s}$

### 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                | $V_{(BR)DSS}$ | 800    | -    | -    | V        | $V_{GS}=0V$ , $I_D=1mA$                                                                           |
| Gate threshold voltage                        | $V_{GS(th)}$  | 2.5    | 3    | 3.5  | V        | $V_{DS}=V_{GS}$ , $I_D=0.07mA$                                                                    |
| Zero gate voltage drain current               | $I_{DSS}$     | -      | -    | 1    | $\mu A$  | $V_{DS}=800V$ , $V_{GS}=0V$ , $T_j=25^\circ C$<br>$V_{DS}=800V$ , $V_{GS}=0V$ , $T_j=150^\circ C$ |
| Gate-source leakage current incl. zener diode | $I_{GSS}$     | -      | -    | 1    | $\mu A$  | $V_{GS}=20V$ , $V_{DS}=0V$                                                                        |
| Drain-source on-state resistance              | $R_{DS(on)}$  | -      | 1.2  | 1.4  | $\Omega$ | $V_{GS}=10V$ , $I_D=1.4A$ , $T_j=25^\circ C$<br>$V_{GS}=10V$ , $I_D=1.4A$ , $T_j=150^\circ C$     |
| Gate resistance                               | $R_G$         | -      | 1.5  | -    | $\Omega$ | $f=250kHz$ , open drain                                                                           |

**Table 5 Dynamic characteristics**

| Parameter                                                  | Symbol       | Values |      |      | Unit | Note / Test Condition                                         |
|------------------------------------------------------------|--------------|--------|------|------|------|---------------------------------------------------------------|
|                                                            |              | Min.   | Typ. | Max. |      |                                                               |
| Input capacitance                                          | $C_{iss}$    | -      | 250  | -    | pF   | $V_{GS}=0V$ , $V_{DS}=500V$ , $f=250kHz$                      |
| Output capacitance                                         | $C_{oss}$    | -      | 6.5  | -    | pF   | $V_{GS}=0V$ , $V_{DS}=500V$ , $f=250kHz$                      |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 8    | -    | pF   | $V_{GS}=0V$ , $V_{DS}=0$ to $500V$                            |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 97   | -    | pF   | $I_D=constant$ , $V_{GS}=0V$ , $V_{DS}=0$ to $500V$           |
| Turn-on delay time                                         | $t_{d(on)}$  | -      | 10   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ ,<br>$R_G=22\Omega$ |
| Rise time                                                  | $t_r$        | -      | 8    | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ ,<br>$R_G=22\Omega$ |
| Turn-off delay time                                        | $t_{d(off)}$ | -      | 40   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ ,<br>$R_G=22\Omega$ |
| Fall time                                                  | $t_f$        | -      | 20   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=1.4A$ ,<br>$R_G=22\Omega$ |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                            |
|-----------------------|---------------|--------|------|------|------|--------------------------------------------------|
|                       |               | Min.   | Typ. | Max. |      |                                                  |
| Gate to source charge | $Q_{gs}$      | -      | 1    | -    | nC   | $V_{DD}=640V$ , $I_D=1.4A$ , $V_{GS}=0$ to $10V$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 5    | -    | nC   | $V_{DD}=640V$ , $I_D=1.4A$ , $V_{GS}=0$ to $10V$ |
| Gate charge total     | $Q_g$         | -      | 10   | -    | nC   | $V_{DD}=640V$ , $I_D=1.4A$ , $V_{GS}=0$ to $10V$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 4.5  | -    | V    | $V_{DD}=640V$ , $I_D=1.4A$ , $V_{GS}=0$ 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 500V

<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 500V

**Table 7 Reverse diode characteristics**

| Parameter                     | Symbol    | Values |      |      | Unit    | Note / Test Condition                         |
|-------------------------------|-----------|--------|------|------|---------|-----------------------------------------------|
|                               |           | Min.   | Typ. | Max. |         |                                               |
| Diode forward voltage         | $V_{SD}$  | -      | 0.9  | -    | V       | $V_{GS}=0V$ , $I_F=1.4A$ , $T_f=25^{\circ}C$  |
| Reverse recovery time         | $t_{rr}$  | -      | 800  | -    | ns      | $V_R=400V$ , $I_F=0.7A$ , $di_F/dt=50A/\mu s$ |
| Reverse recovery charge       | $Q_{rr}$  | -      | 5    | -    | $\mu C$ | $V_R=400V$ , $I_F=0.7A$ , $di_F/dt=50A/\mu s$ |
| Peak reverse recovery current | $I_{rrm}$ | -      | 9    | -    | A       | $V_R=400V$ , $I_F=0.7A$ , $di_F/dt=50A/\mu s$ |

## 4 Electrical characteristics diagrams

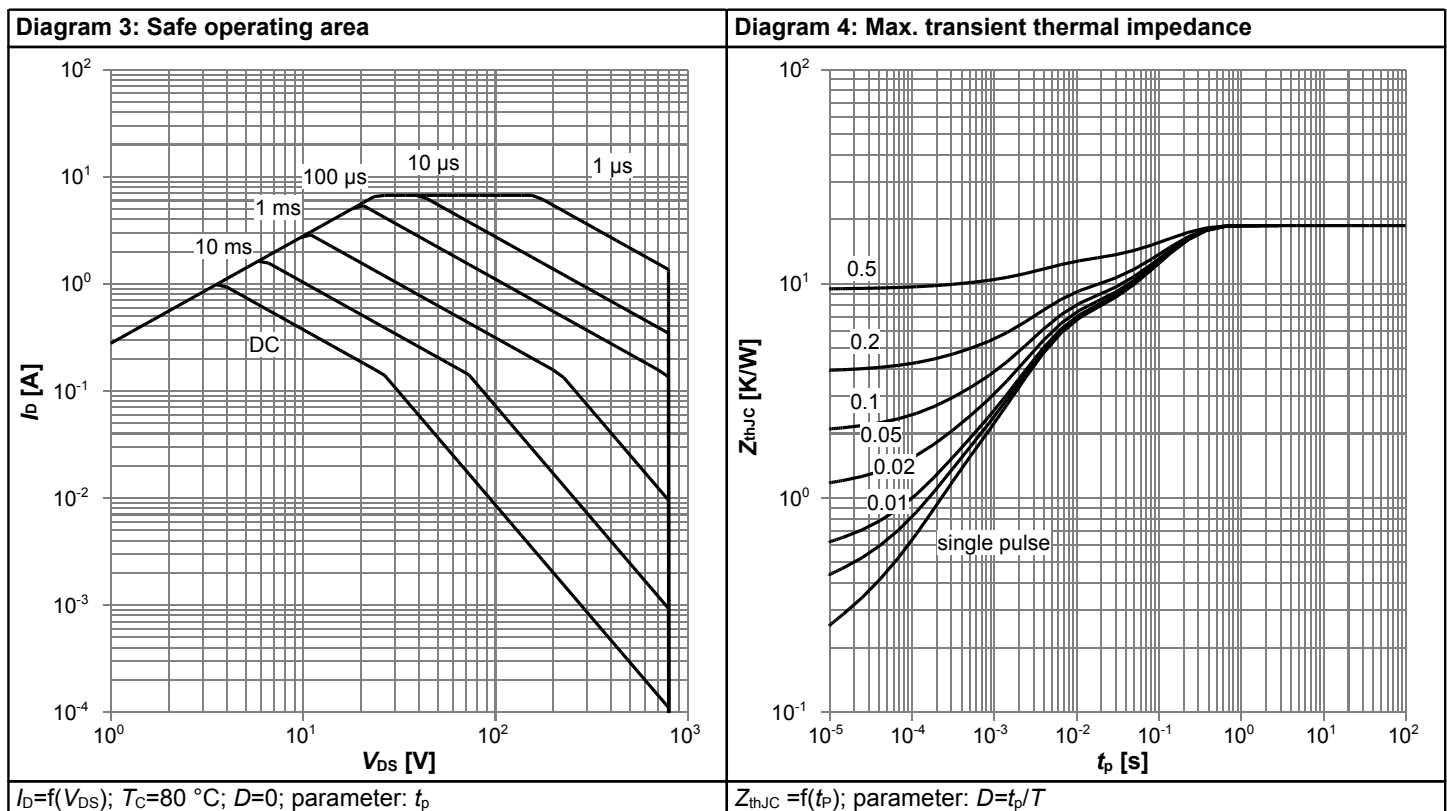
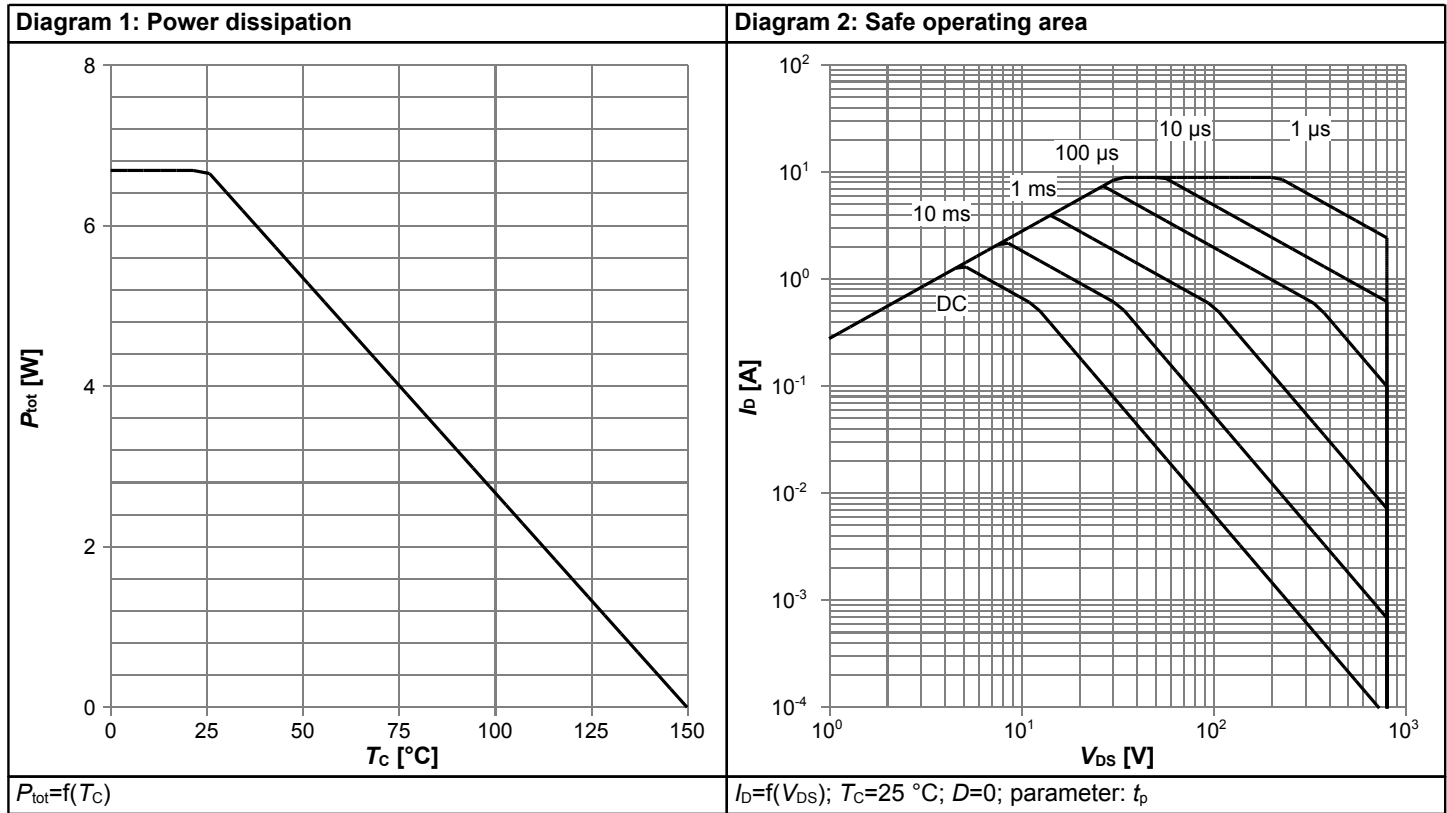
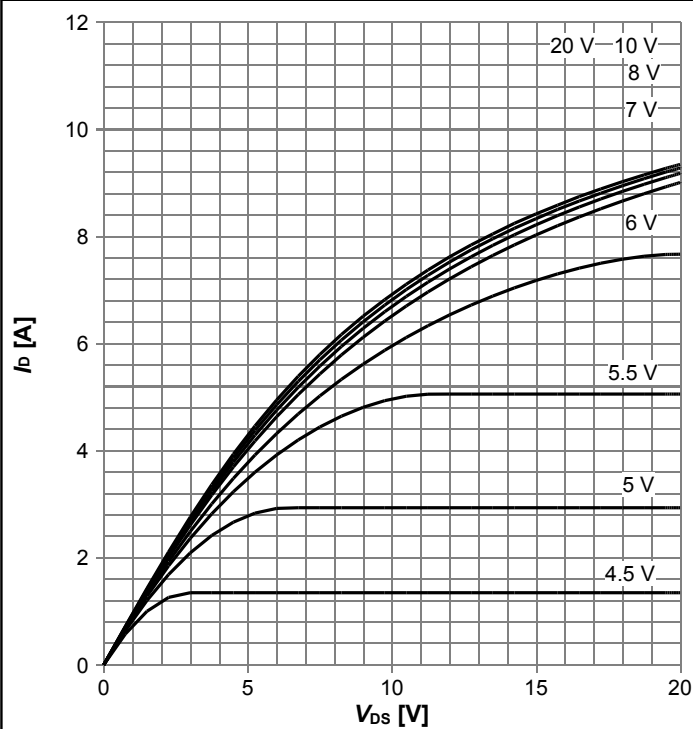
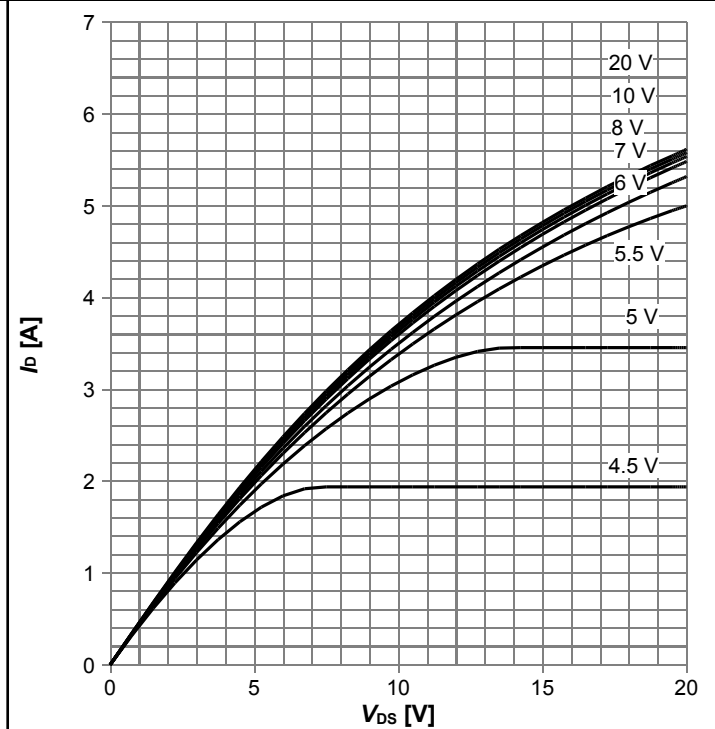


Diagram 5: Typ. output characteristics



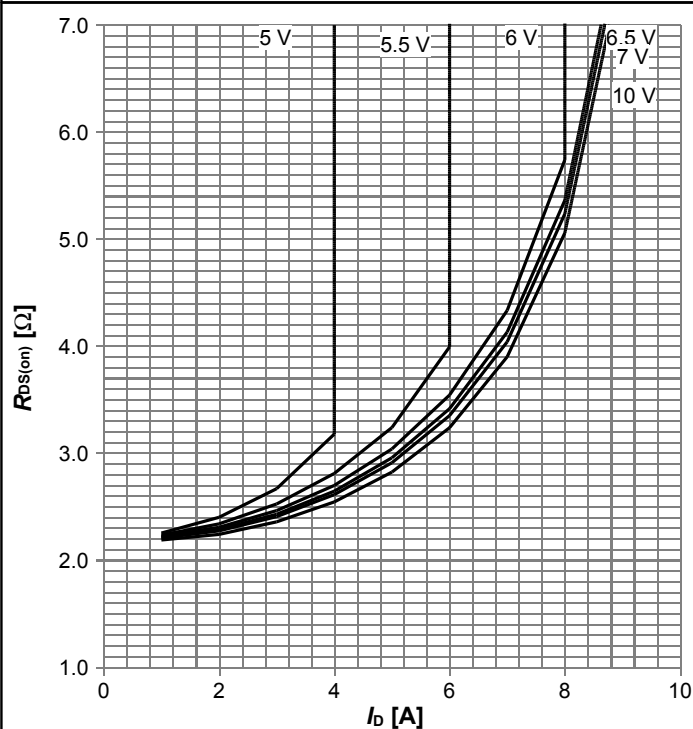
$I_D = f(V_{DS})$ ;  $T_j = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



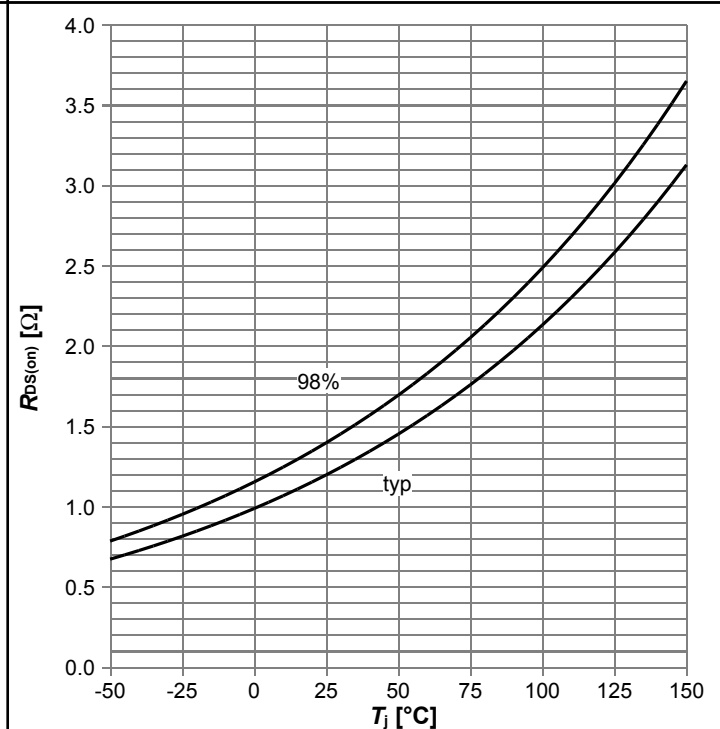
$I_D = f(V_{DS})$ ;  $T_j = 125\text{ °C}$ ; parameter:  $V_{GS}$

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



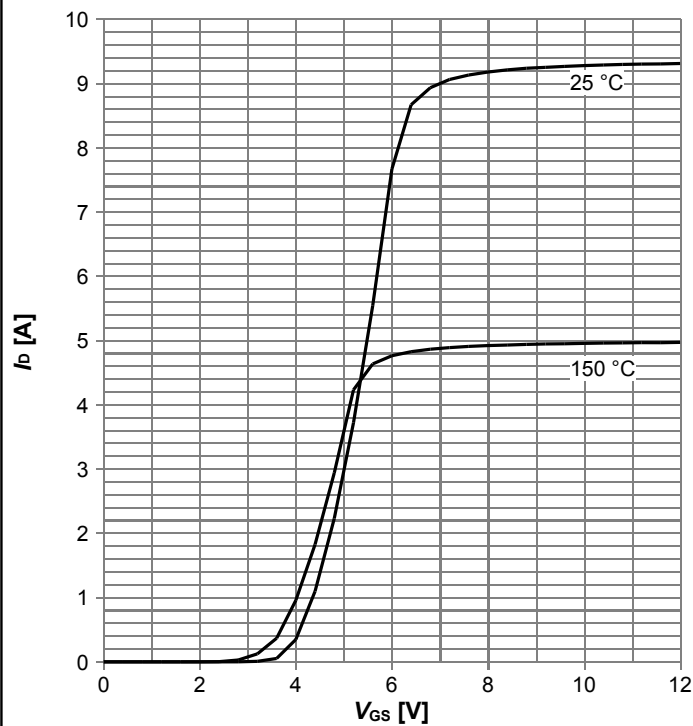
$R_{DS(on)} = f(I_D)$ ;  $T_j = 125\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 8: Drain-source on-state resistance



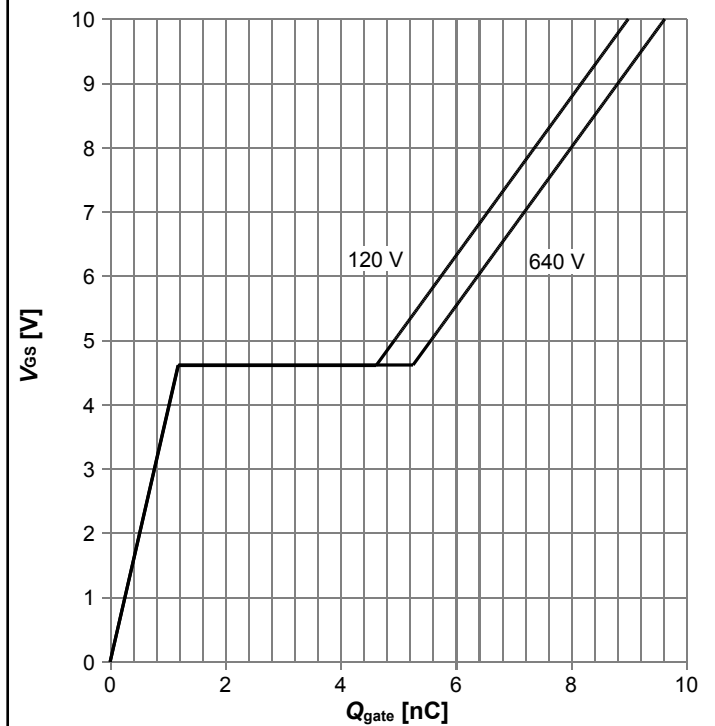
$R_{DS(on)} = f(T_j)$ ;  $I_D = 1.4\text{ A}$ ;  $V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics



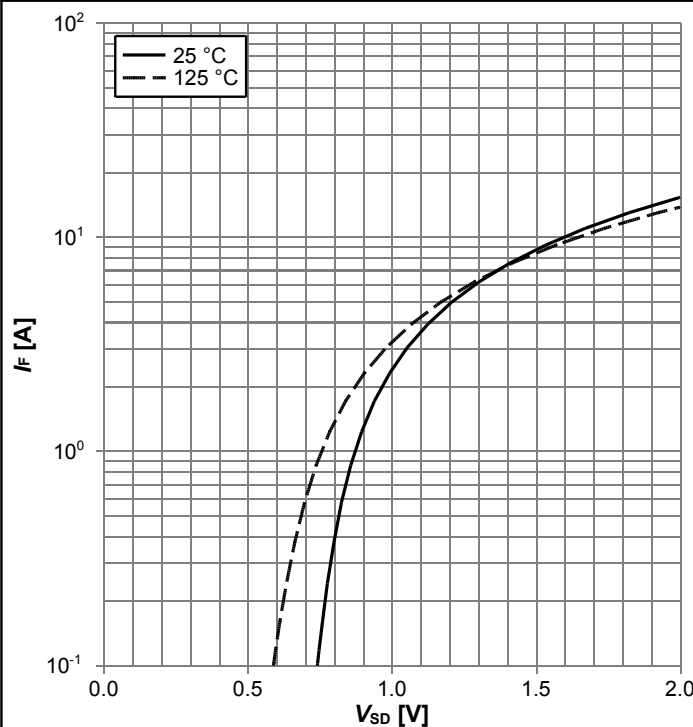
$I_D = f(V_{GS})$ ;  $V_{DS} = 20V$ ; parameter:  $T_j$

Diagram 10: Typ. gate charge



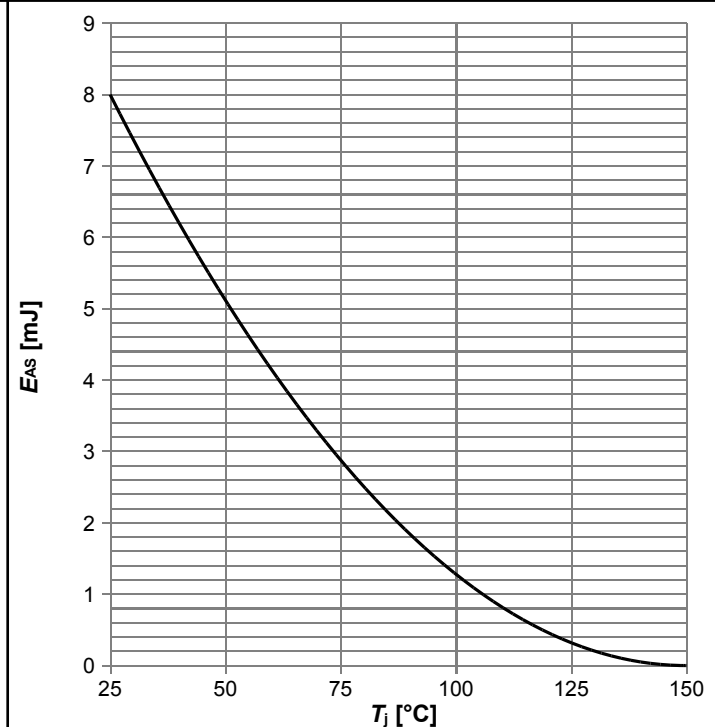
$V_{GS} = f(Q_{gate})$ ;  $I_D = 1.4$  A pulsed; parameter:  $V_{DD}$

Diagram 11: Forward characteristics of reverse diode



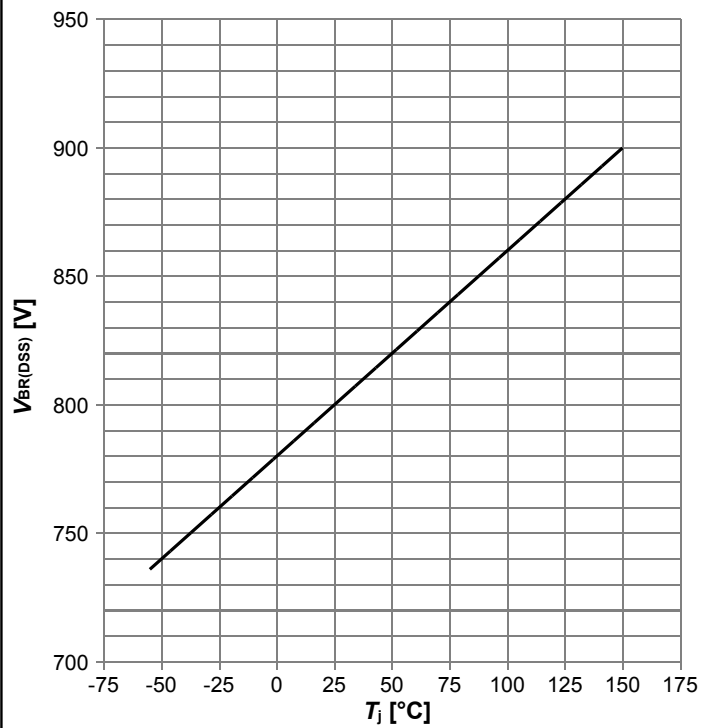
$I_F = f(V_{SD})$ ; parameter:  $T_j$

Diagram 12: Avalanche energy



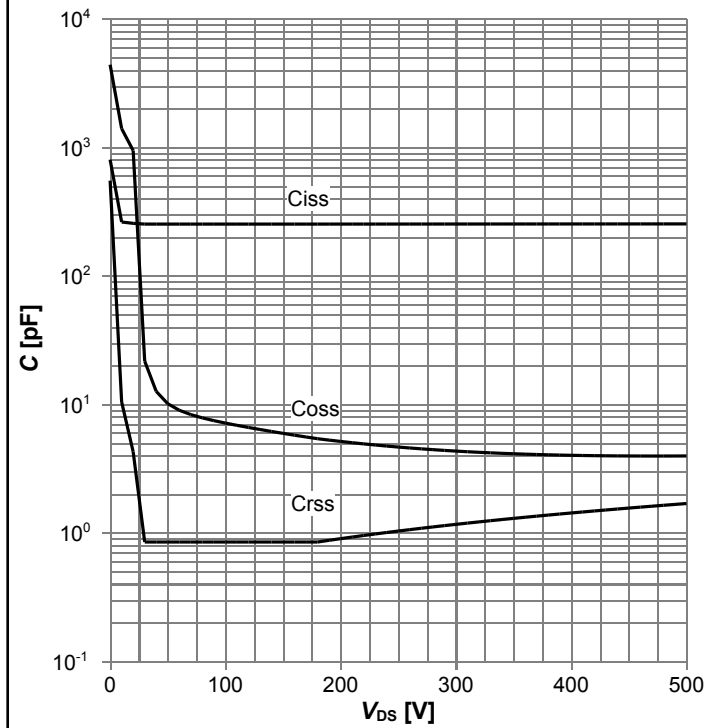
$E_{AS} = f(T_j)$ ;  $I_D = 0.6$  A;  $V_{DD} = 50$  V

Diagram 13: Drain-source breakdown voltage



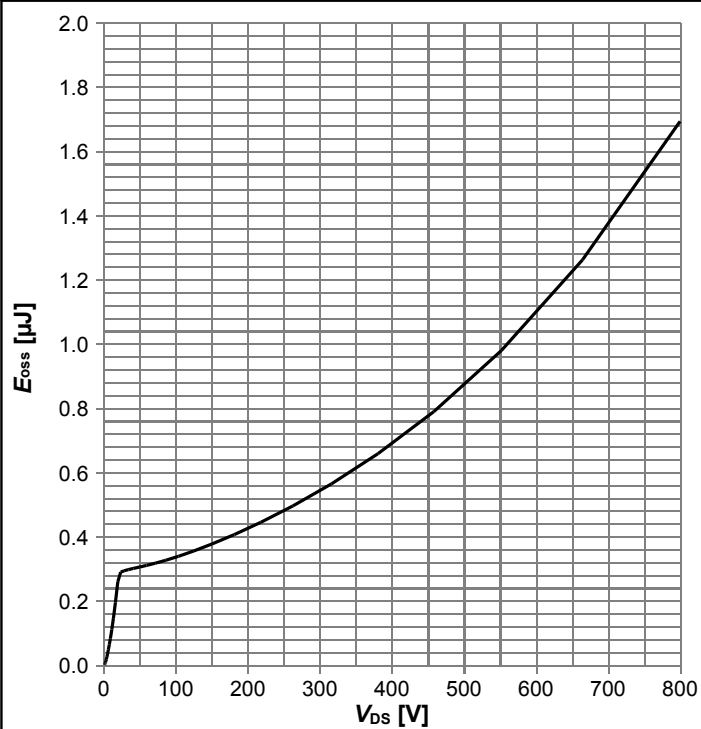
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

Diagram 14: Typ. capacitances



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

Diagram 15: Typ. Coss stored energy



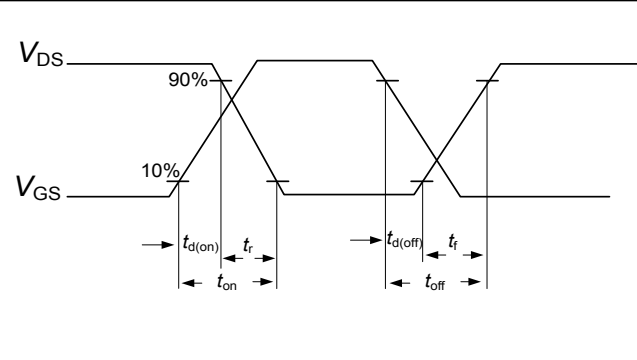
$E_{oss} = f(V_{DS})$

## 5 Test Circuits

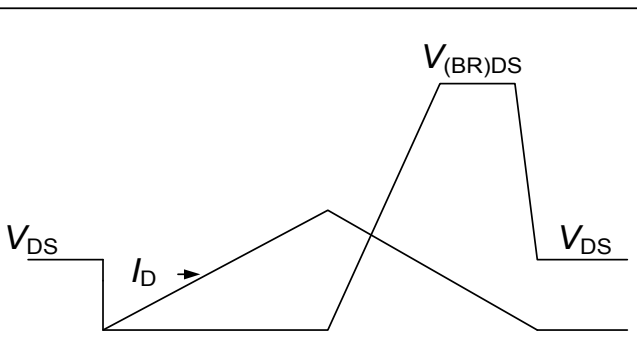
**Table 8 Diode characteristics**

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

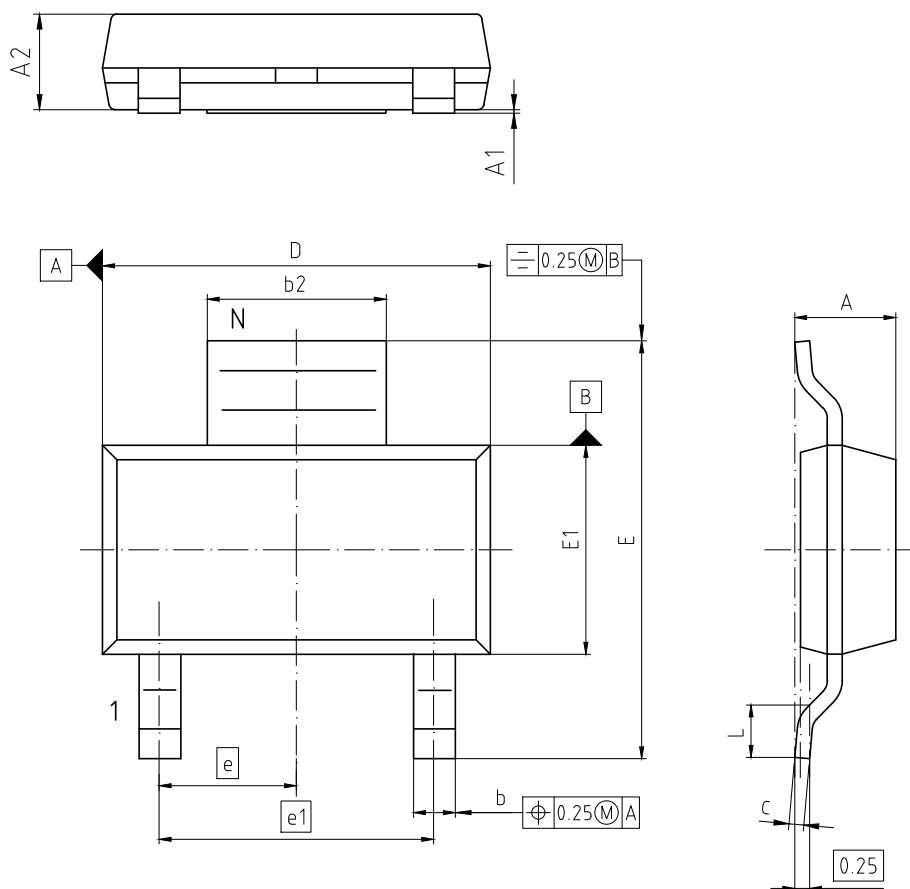
**Table 9 Switching times**

| 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



| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 1.52        | 1.80 |
| A1  | -           | 0.10 |
| A2  | 1.50        | 1.70 |
| b   | 0.60        | 0.80 |
| b2  | 2.95        | 3.10 |
| c   | 0.24        | 0.32 |
| D   | 6.30        | 6.70 |
| E   | 6.70        | 7.30 |
| E1  | 3.30        | 3.70 |
| e   | 2.3 BASIC   |      |
| e1  | 4.6 BASIC   |      |
| L   | 0.75        | 1.10 |
| N   | 3           |      |
| O   | 0°          | 10°  |

NOTES:

1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-261

|                             |
|-----------------------------|
| DOCUMENT NO.<br>Z8B00180553 |
| SCALE<br>0 2.5 5mm          |
| EUROPEAN PROJECTION<br>     |
| ISSUE DATE<br>24-02-2016    |
| REVISION<br>01              |

Figure 1 Outline PG-SOT223, dimensions in mm - Industrial Grade

## **7 Appendix A**

### **Table 11 Related Links**

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

## Revision History

IPN80R1K4P7

**Revision: 2018-02-09, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2017-06-23 | Release of final version                     |
| 2.1      | 2018-02-09 | Corrected front page text                    |

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