

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## CoolMOS™ CE

800V CoolMOS™ CE Power Transistor  
IPA80R1K0CE

## Data Sheet

Rev. 2.1  
Final

## 1 Description

CoolMOS™ CE is a revolutionary technology for high voltage power MOSFETs. The high voltage capability combines safety with performance and ruggedness to allow stable designs at highest efficiency level. CoolMOS™ 800V CE comes with selected package choice offering the benefit of reduced system costs and higher power density designs.

### Features

- High voltage technology
- Extreme dv/dt rated
- High peak current capability
- Low gate charge
- Low effective capacitances
- Pb-free plating, RoHS Compliant, Halogen free mold compound
- Qualified for consumer grade applications

### Applications

LED Lighting for retrofit applications in QR Flyback topology

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

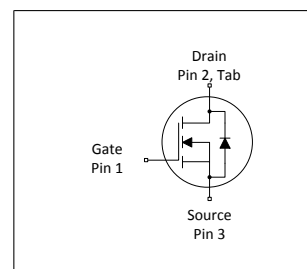


**Table 1 Key Performance Parameters**

| Parameter                  | Value | Unit |
|----------------------------|-------|------|
| $V_{DS} @ T_J=25^{\circ}C$ | 800   | V    |
| $R_{DS(on),max}$           | 950   | mΩ   |
| $Q_{g,typ}$                | 31    | nC   |
| $I_{D,pulse}$              | 18    | A    |
| $E_{oss}@400V$             | 2.4   | μJ   |
| Body diode di/dt           | 400   | A/μs |

| Type / Ordering Code | Package           | Marking | Related Links  |
|----------------------|-------------------|---------|----------------|
| IPA80R1K0CE          | PG-TO 220 FullPAK | 8R1K0CE | see Appendix A |

**Table of Contents**

|                                           |    |
|-------------------------------------------|----|
| Description .....                         | 2  |
| Maximum ratings .....                     | 4  |
| Thermal characteristics .....             | 5  |
| Electrical characteristics .....          | 6  |
| Electrical characteristics diagrams ..... | 8  |
| Test Circuits .....                       | 12 |
| Package Outlines .....                    | 13 |
| Appendix A .....                          | 14 |
| Revision History .....                    | 15 |
| Disclaimer .....                          | 15 |

## 2 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>3.6 | A                | $T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$                                 |
| Pulsed drain current <sup>2)</sup>        | $I_{D,pulse}$ | -      | -    | 18         | A                | $T_C=25^\circ\text{C}$                                                                |
| Avalanche energy, single pulse            | $E_{AS}$      | -      | -    | 230        | mJ               | $I_D=1.6\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                |
| Avalanche energy, repetitive              | $E_{AR}$      | -      | -    | 0.20       | mJ               | $I_D=1.6\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                |
| Avalanche current, repetitive             | $I_{AR}$      | -      | -    | 1.60       | A                | -                                                                                     |
| MOSFET dv/dt ruggedness                   | dv/dt         | -      | -    | 50         | V/ns             | $V_{DS}=0\dots640\text{V}$                                                            |
| 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                         | $P_{tot}$     | -      | -    | 32         | 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                           | -             | -      | -    | 50         | Ncm              | M2.5 screws                                                                           |
| Continuous diode forward current          | $I_S$         | -      | -    | 5.7        | A                | $T_C=25^\circ\text{C}$                                                                |
| Diode pulse current <sup>2)</sup>         | $I_{S,pulse}$ | -      | -    | 18         | A                | $T_C=25^\circ\text{C}$                                                                |
| Reverse diode dv/dt <sup>3)</sup>         | dv/dt         | -      | -    | 4          | V/ns             | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq I_S$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Maximum diode commutation speed           | di/dt         | -      | -    | 400        | A/ $\mu\text{s}$ | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq I_S$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Insulation withstand voltage for TO-220FP | $V_{ISO}$     | -      | -    | 2500       | V                | $V_{rms}$ , $T_C=25^\circ\text{C}$ , $t=1\text{min}$                                  |

<sup>1)</sup> Limited by  $T_{j,max} < 150^\circ\text{C}$ .

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

<sup>3)</sup> Identical low side and high side switch with identical  $R_G$

### 3 Thermal characteristics

**Table 3 Thermal characteristics TO-220 FullPAK**

| Parameter                                                  | Symbol     | Values |      |      | Unit | Note / Test Condition               |
|------------------------------------------------------------|------------|--------|------|------|------|-------------------------------------|
|                                                            |            | Min.   | Typ. | Max. |      |                                     |
| Thermal resistance, junction - case                        | $R_{thJC}$ | -      | -    | 3.9  | °C/W | -                                   |
| Thermal resistance, junction - ambient                     | $R_{thJA}$ | -      | -    | 80   | °C/W | leaded                              |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sld}$  | -      | -    | 260  | °C   | 1.6mm (0.063 in.) from case for 10s |

## 4 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        | $V_{GS}=0V$ , $I_D=0.25mA$                                                                                  |
| Gate threshold voltage           | $V_{(GS)th}$  | 2.1    | 3.0  | 3.9  | V        | $V_{DS}=V_{GS}$ , $I_D=0.25mA$                                                                              |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -    | 10   | $\mu A$  | $V_{DS}=800$ , $V_{GS}=0V$ , $T_j=25^\circ\text{C}$<br>$V_{DS}=800$ , $V_{GS}=0V$ , $T_j=150^\circ\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -    | 100  | nA       | $V_{GS}=20V$ , $V_{DS}=0V$                                                                                  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.83 | 0.95 | $\Omega$ | $V_{GS}=10V$ , $I_D=3.6A$ , $T_j=25^\circ\text{C}$<br>$V_{GS}=10V$ , $I_D=3.6A$ , $T_j=150^\circ\text{C}$   |
| Gate resistance                  | $R_G$         | -      | 1.2  | -    | $\Omega$ | $f=1MHz$ , open drain                                                                                       |

**Table 5 Dynamic characteristics**

| Parameter                                                  | Symbol       | Values |      |      | Unit | Note / Test Condition                                                    |
|------------------------------------------------------------|--------------|--------|------|------|------|--------------------------------------------------------------------------|
|                                                            |              | Min.   | Typ. | Max. |      |                                                                          |
| Input capacitance                                          | $C_{iss}$    | -      | 785  | -    | pF   | $V_{GS}=0V$ , $V_{DS}=100V$ , $f=1MHz$                                   |
| Output capacitance                                         | $C_{oss}$    | -      | 33   | -    | pF   | $V_{GS}=0V$ , $V_{DS}=100V$ , $f=1MHz$                                   |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 26   | -    | pF   | $V_{GS}=0V$ , $V_{DS}=0...480V$                                          |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 69   | -    | pF   | $I_D=\text{constant}$ , $V_{GS}=0V$ , $V_{DS}=0...480V$                  |
| Turn-on delay time                                         | $t_{d(on)}$  | -      | 25   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=10V$ , $I_D=5.7A$ , $R_G=15\Omega$ ; see table 9 |
| Rise time                                                  | $t_r$        | -      | 15   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=10V$ , $I_D=5.7A$ , $R_G=15\Omega$ ; see table 9 |
| Turn-off delay time                                        | $t_{d(off)}$ | -      | 72   | -    | ns   | $V_{DD}=400V$ , $V_{GS}=10V$ , $I_D=5.7A$ , $R_G=15\Omega$ ; see table 9 |
| Fall time                                                  | $t_f$        | -      | 8    | -    | ns   | $V_{DD}=400V$ , $V_{GS}=10V$ , $I_D=5.7A$ , $R_G=15\Omega$ ; see table 9 |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                            |
|-----------------------|---------------|--------|------|------|------|--------------------------------------------------|
|                       |               | Min.   | Typ. | Max. |      |                                                  |
| Gate to source charge | $Q_{gs}$      | -      | 4    | -    | nC   | $V_{DD}=640V$ , $I_D=5.7A$ , $V_{GS}=0$ to $10V$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 15   | -    | nC   | $V_{DD}=640V$ , $I_D=5.7A$ , $V_{GS}=0$ to $10V$ |
| Gate charge total     | $Q_g$         | -      | 31   | -    | nC   | $V_{DD}=640V$ , $I_D=5.7A$ , $V_{GS}=0$ to $10V$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 5.5  | -    | V    | $V_{DD}=640V$ , $I_D=5.7A$ , $V_{GS}=0$ 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 480V

<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 480V

**Table 7 Reverse diode characteristics**

| Parameter                     | Symbol    | Values |      |      | Unit    | Note / Test Condition                                        |
|-------------------------------|-----------|--------|------|------|---------|--------------------------------------------------------------|
|                               |           | Min.   | Typ. | Max. |         |                                                              |
| Diode forward voltage         | $V_{SD}$  | -      | 1    | -    | V       | $V_{GS}=0V$ , $I_F=5.7A$ , $T_j=25^{\circ}C$                 |
| Reverse recovery time         | $t_{rr}$  | -      | 520  | -    | ns      | $V_R=400V$ , $I_F=5.7A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Reverse recovery charge       | $Q_{rr}$  | -      | 5    | -    | $\mu C$ | $V_R=400V$ , $I_F=5.7A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | -      | 18   | -    | A       | $V_R=400V$ , $I_F=5.7A$ , $di_F/dt=100A/\mu s$ ; see table 8 |

## 5 Electrical characteristics diagrams

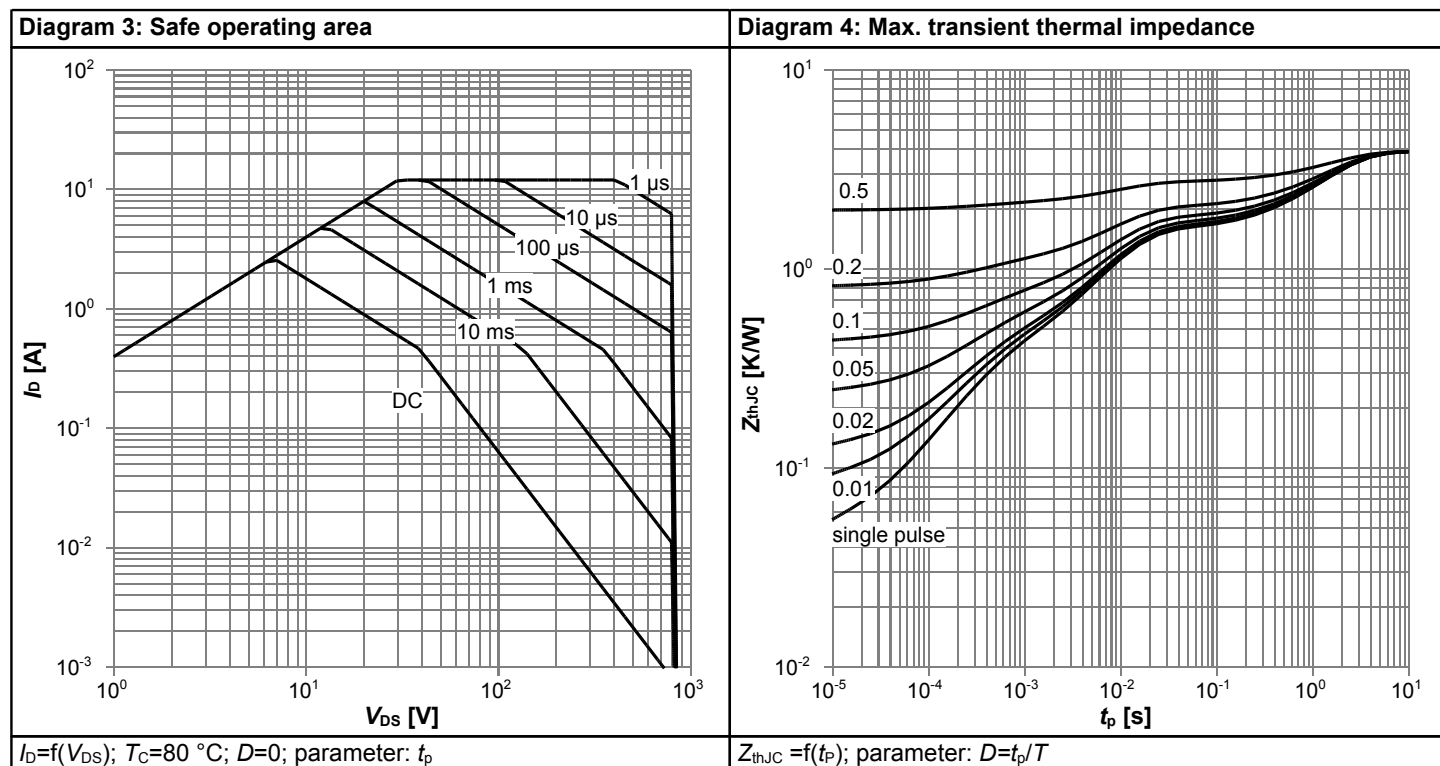
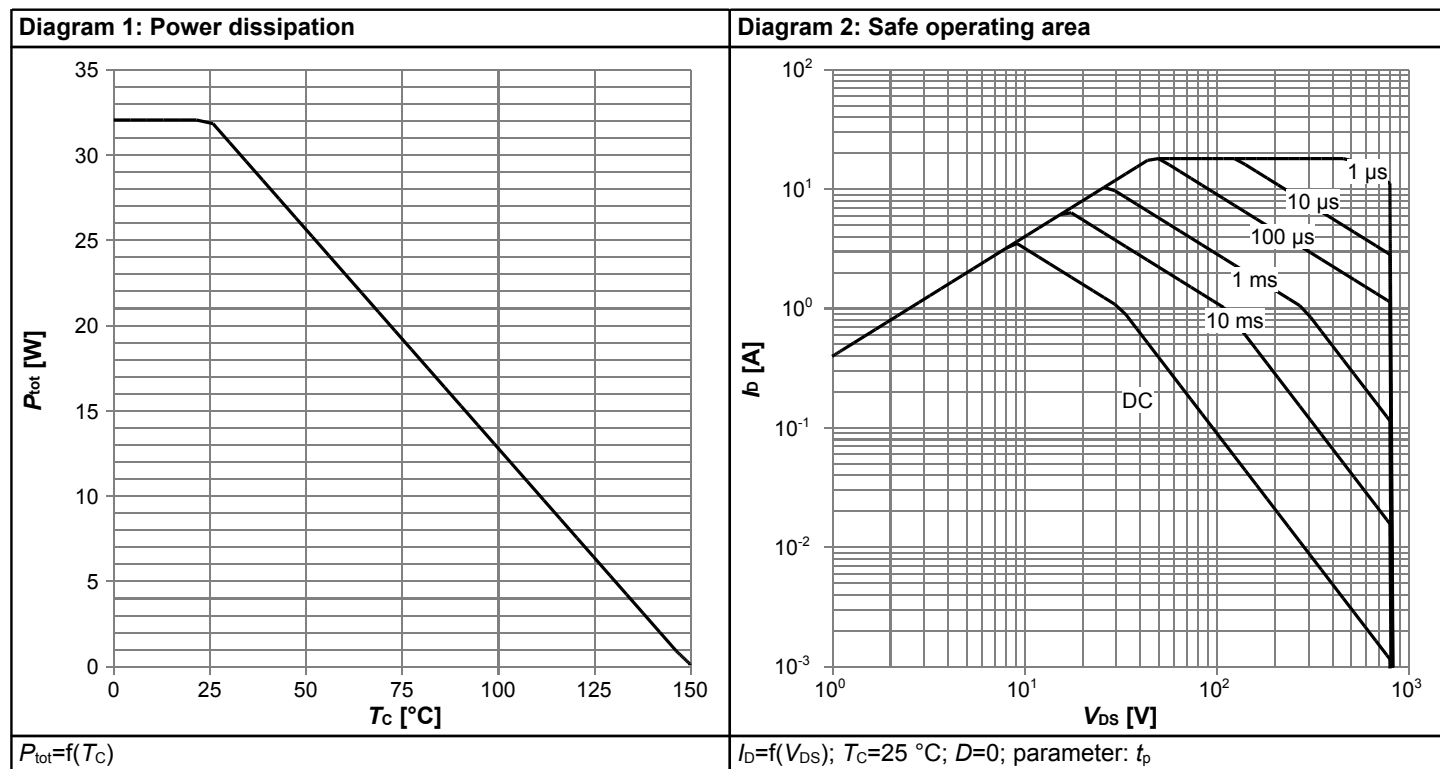


Diagram 5: Typ. output characteristics

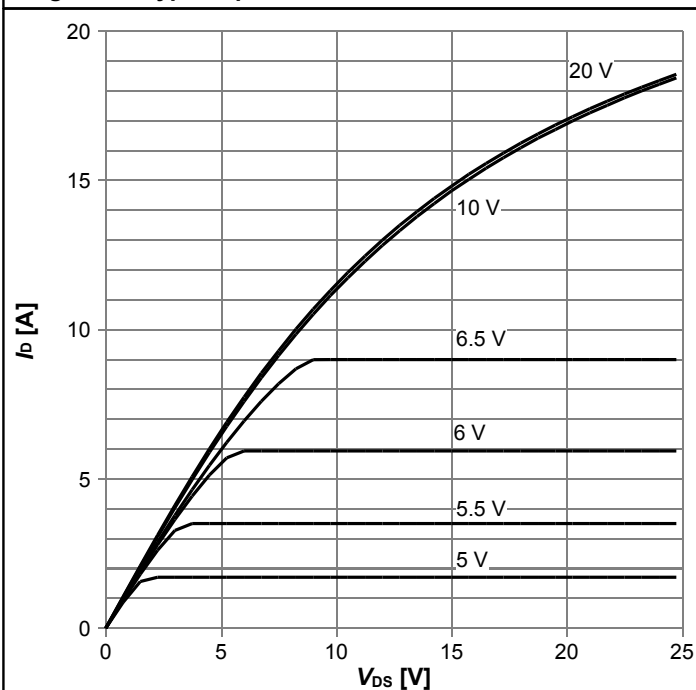

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; t_p = 10\text{ }\mu\text{s}; \text{parameter: } V_{GS}$ 

Diagram 6: Typ. output characteristics

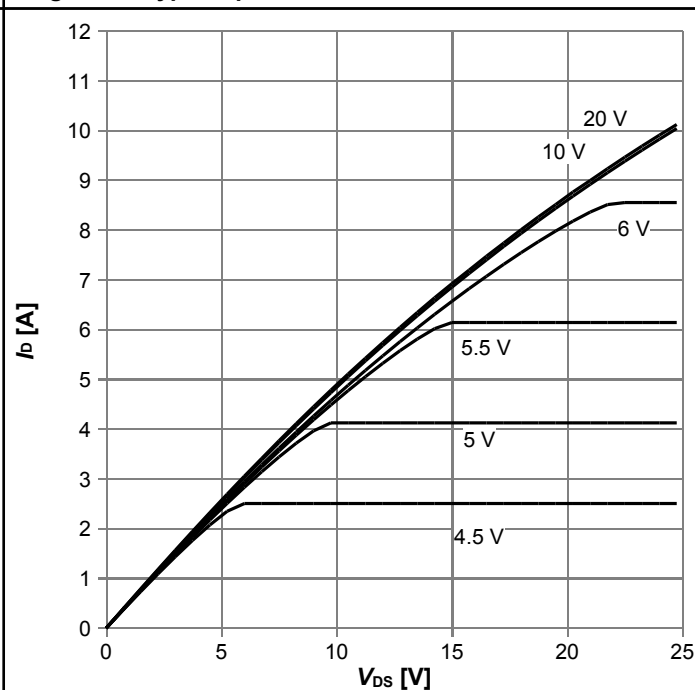

 $I_D = f(V_{DS}); T_J = 150^\circ\text{C}; t_p = 10\text{ }\mu\text{s}; \text{parameter: } V_{GS}$ 

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

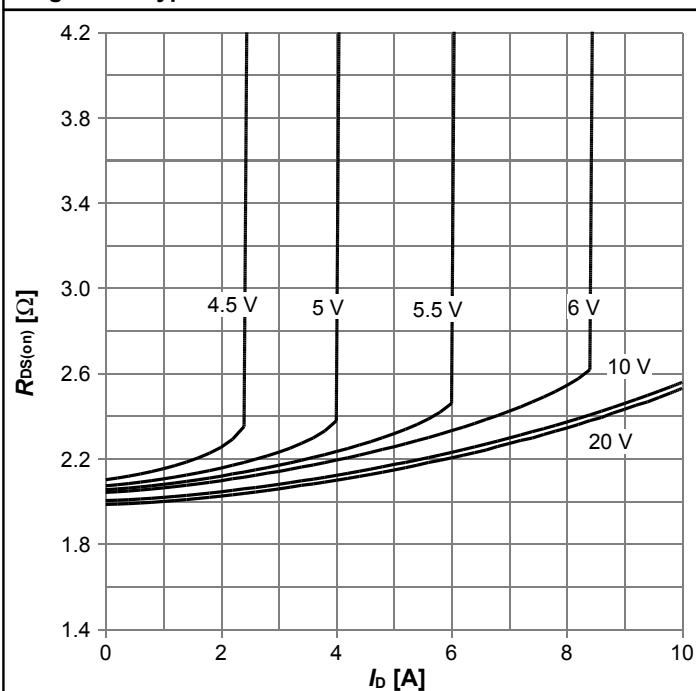

 $R_{DS(on)} = f(I_D); T_J = 150^\circ\text{C}; \text{parameter: } V_{GS}$ 

Diagram 8: Drain-source on-state resistance

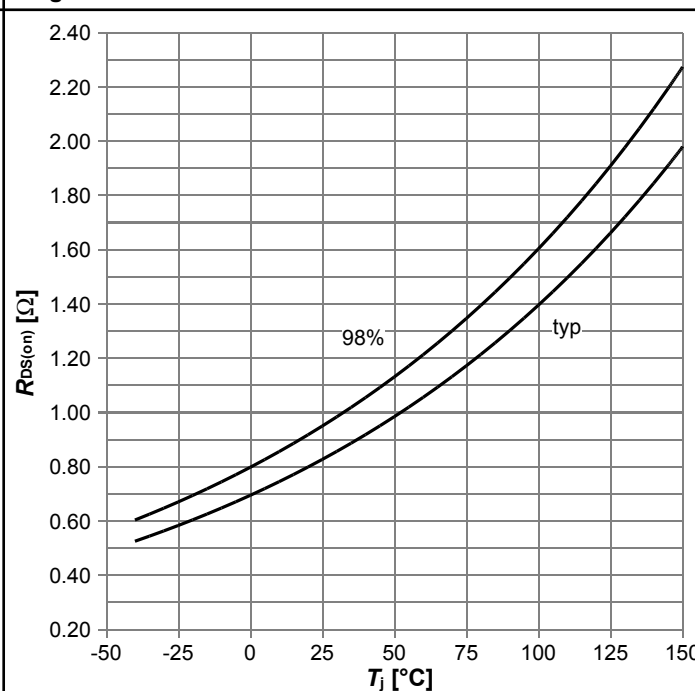

 $R_{DS(on)} = f(T_J); I_D = 3.6\text{ A}; V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics

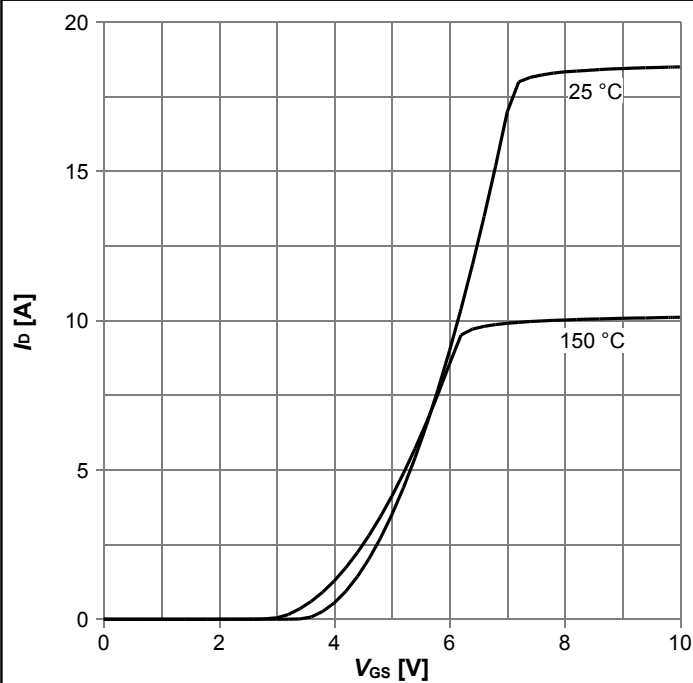

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}; t_p = 10 \mu s; \text{parameter: } T_j$ 

Diagram 10: Typ. gate charge

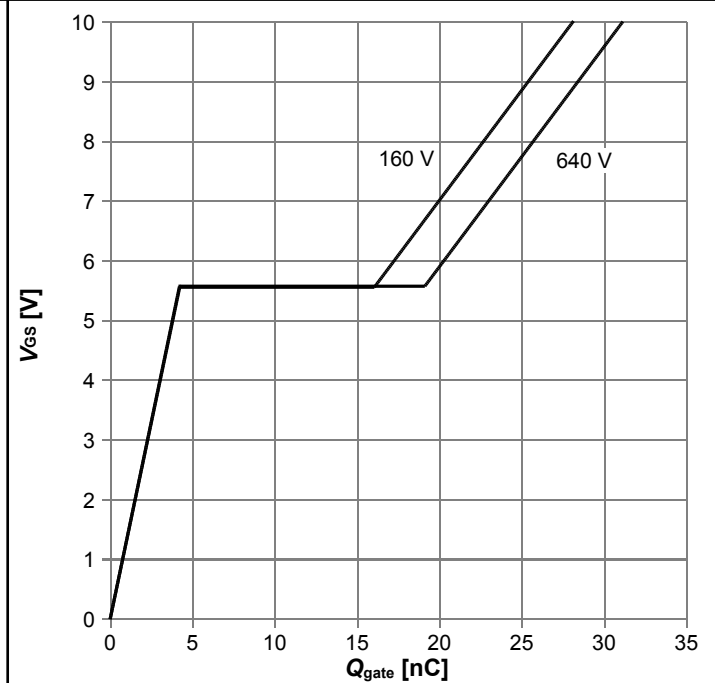

 $V_{GS} = f(Q_{gate}); I_D = 5.7 \text{ A pulsed}; \text{parameter: } V_{DD}$ 

Diagram 11: Forward characteristics of reverse diode

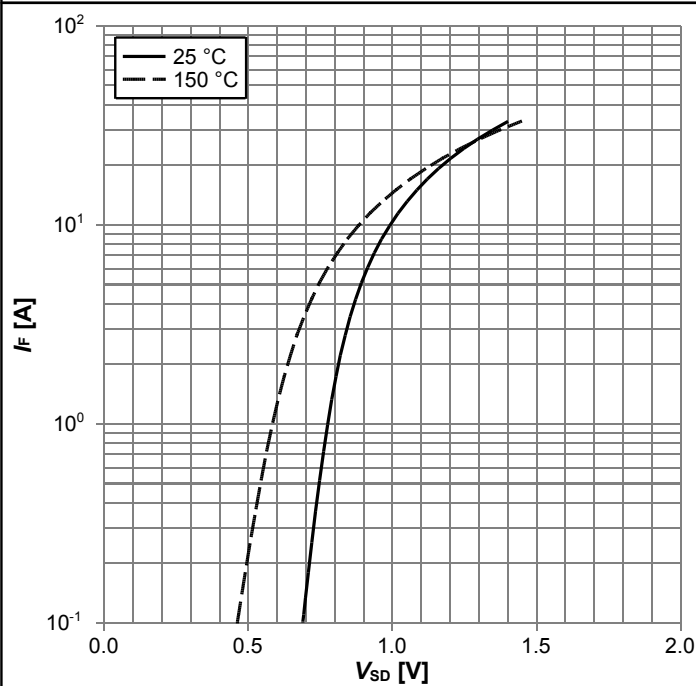

 $I_F = f(V_{SD}); t_p = 10 \mu s; \text{parameter: } T_j$ 

Diagram 12: Avalanche energy

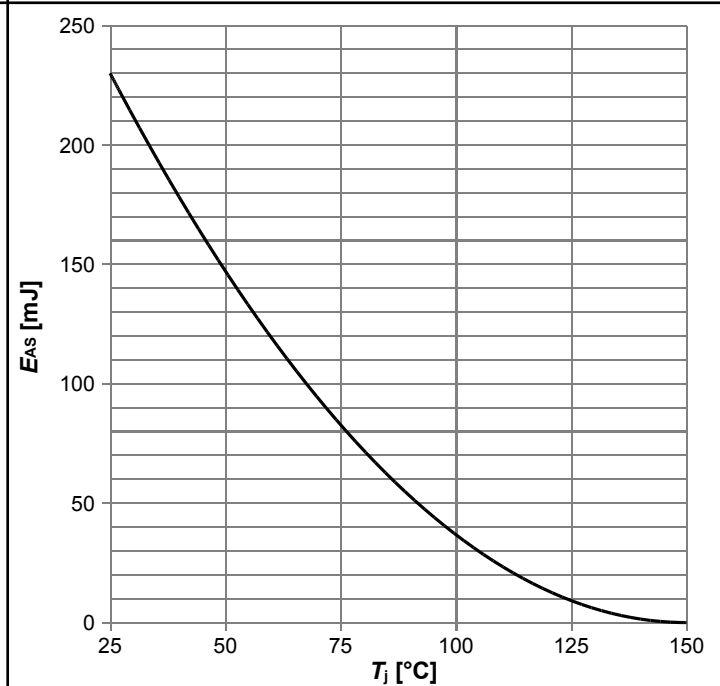
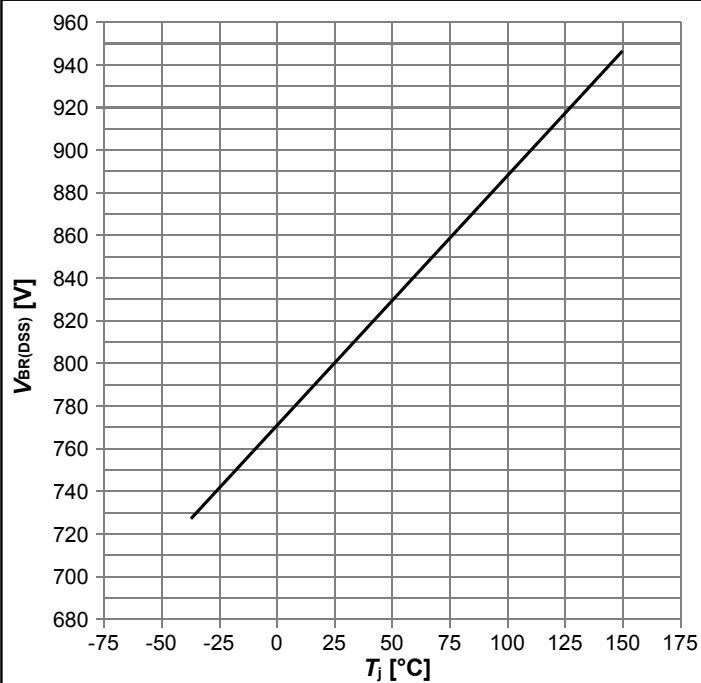
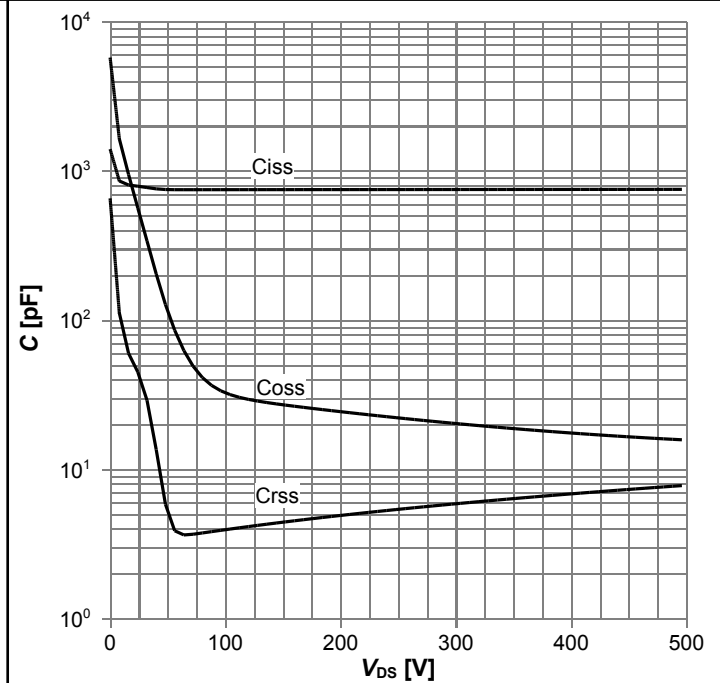

 $E_{AS} = f(T_j); I_D = 1.6 \text{ A}; V_{DD} = 50 \text{ V}$

Diagram 13: Drain-source breakdown voltage



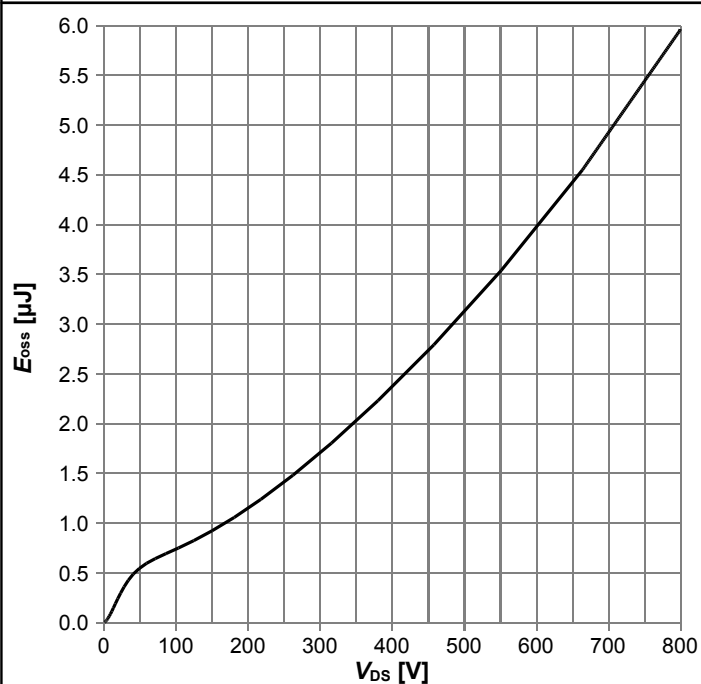
$$V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$$

Diagram 14: Typ. capacitances



$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

Diagram 15: Typ. Coss stored energy



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

## 6 Test Circuits

**Table 8 Diode characteristics**

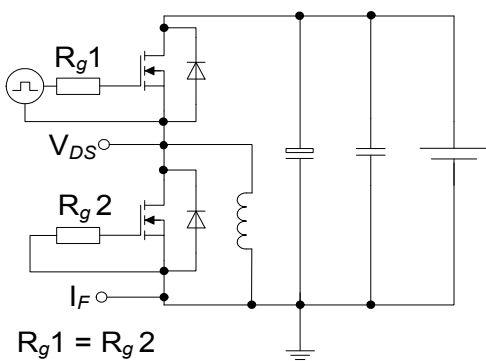
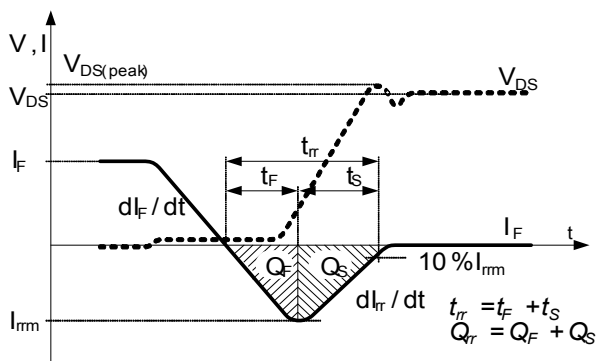
| Test circuit for diode characteristics                                                                                | Diode recovery waveform                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><math>R_{g1} = R_{g2}</math></p> |  <p> <math>t_{rr} = t_F + t_S</math><br/> <math>Q_{rr} = Q_F + Q_S</math> </p> |

**Table 9 Switching times**

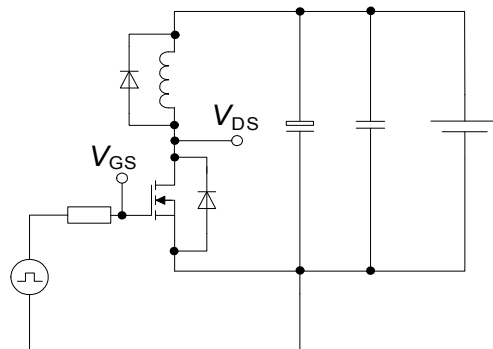
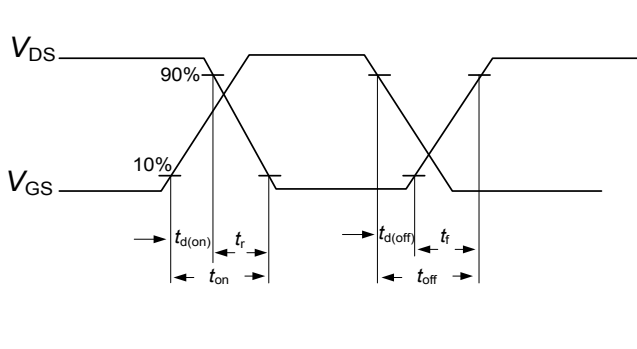
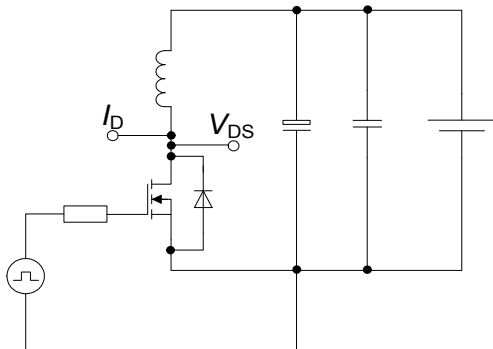
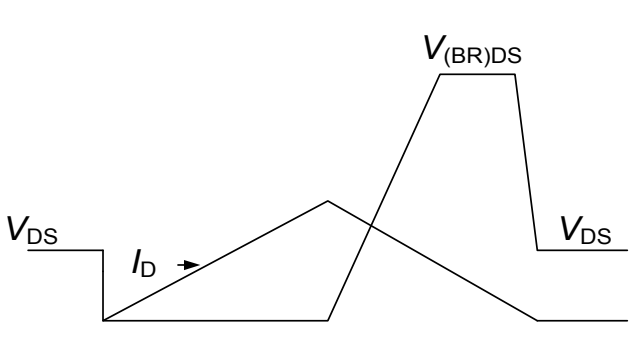
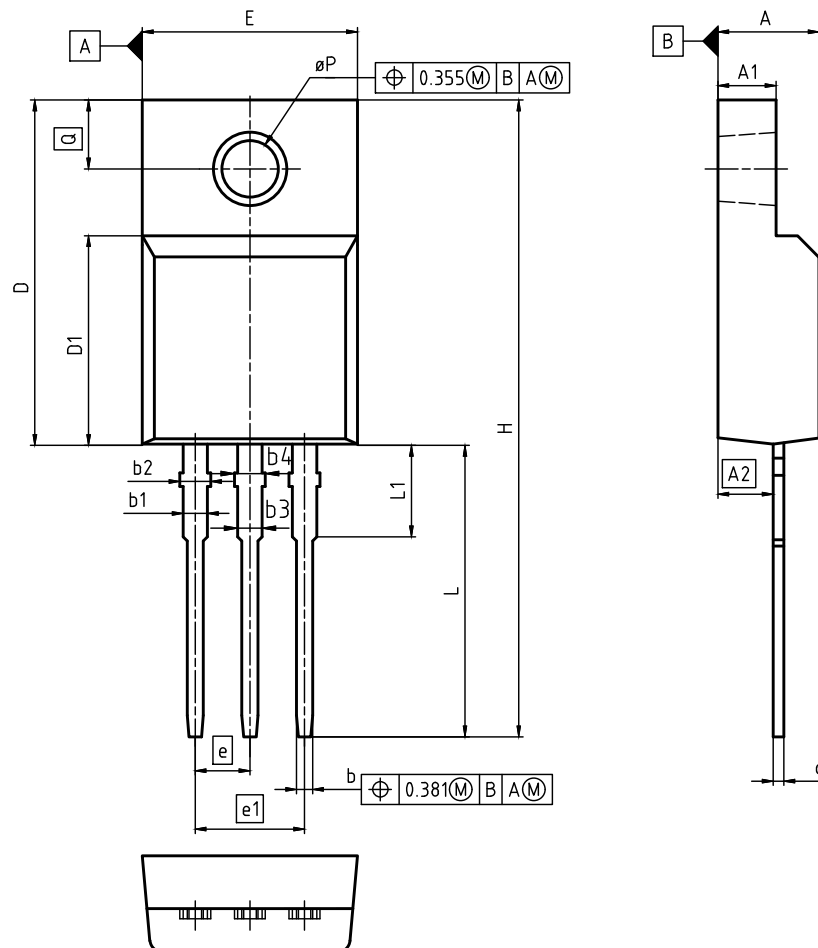
| Switching times test circuit for inductive load                                     | Switching times waveform                                                             |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

**Table 10 Unclamped inductive load**

| Unclamped inductive load test circuit                                               | Unclamped inductive waveform                                                         |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

## 7 Package Outlines



| DIM | MILLIMETERS |       | INCHES      |       |
|-----|-------------|-------|-------------|-------|
|     | MIN         | MAX   | MIN         | MAX   |
| A   | 4.50        | 4.90  | 0.177       | 0.193 |
| A1  | 2.34        | 2.85  | 0.092       | 0.112 |
| A2  | 2.42        | 2.86  | 0.095       | 0.113 |
| b   | 0.65        | 0.90  | 0.026       | 0.035 |
| b1  | 0.95        | 1.38  | 0.037       | 0.054 |
| b2  | 0.95        | 1.51  | 0.037       | 0.059 |
| b3  | 0.65        | 1.38  | 0.026       | 0.054 |
| b4  | 0.65        | 1.51  | 0.026       | 0.059 |
| c   | 0.40        | 0.63  | 0.016       | 0.025 |
| D   | 15.67       | 16.15 | 0.617       | 0.636 |
| D1  | 8.97        | 9.83  | 0.353       | 0.387 |
| E   | 10.00       | 10.65 | 0.394       | 0.419 |
| e   | 2.54 (BSC)  |       | 0.100 (BSC) |       |
| e1  | 5.08        |       | 0.200       |       |
| N   | 3           |       | 3           |       |
| H   | 28.70       | 29.75 | 1.130       | 1.171 |
| L   | 12.78       | 13.75 | 0.503       | 0.541 |
| L1  | 2.83        | 3.45  | 0.111       | 0.136 |
| øP  | 2.95        | 3.38  | 0.116       | 0.133 |
| Q   | 3.15        | 3.50  | 0.124       | 0.138 |

Dimensions do not include mold flash, protrusions or gate burrs

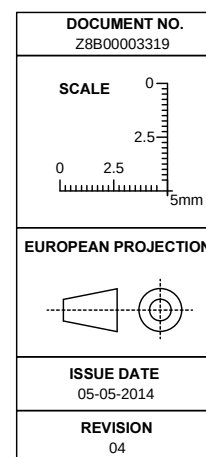


Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm/inches

## 8 Appendix A

Table 11 Related Links

- IFX CoolMOS™ CE Webpage: [www.infineon.com](http://www.infineon.com)
- IFX CoolMOS™ CE application note: [www.infineon.com](http://www.infineon.com)
- IFX CoolMOS™ CE simulation model: [www.infineon.com](http://www.infineon.com)
- IFX Design tools: [www.infineon.com](http://www.infineon.com)

## Revision History

IPA80R1K0CE

Revision: 2015-06-23, Rev. 2.1

### Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2014-09-25 | Release of final version                     |
| 2.1      | 2015-06-23 | Continuous current Id update                 |

### We Listen to Your Comments

Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to: [erratum@infineon.com](mailto:erratum@infineon.com)

### Published by

Infineon Technologies AG  
81726 München, Germany  
© 2015 Infineon Technologies AG  
All Rights Reserved.

### Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

### Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com) ).

### Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.



**Стандарт  
Электрон  
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331