

# 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.

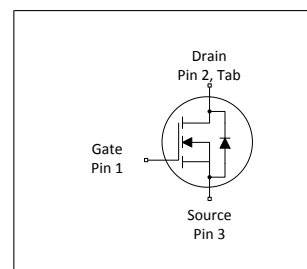
### Features

- 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 |

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## 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<br>2.19 | 0.95<br>- | $\Omega$ | $V_{GS}=10V$ , $I_D=3.6A$ , $T_j=25^\circ\text{C}$<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

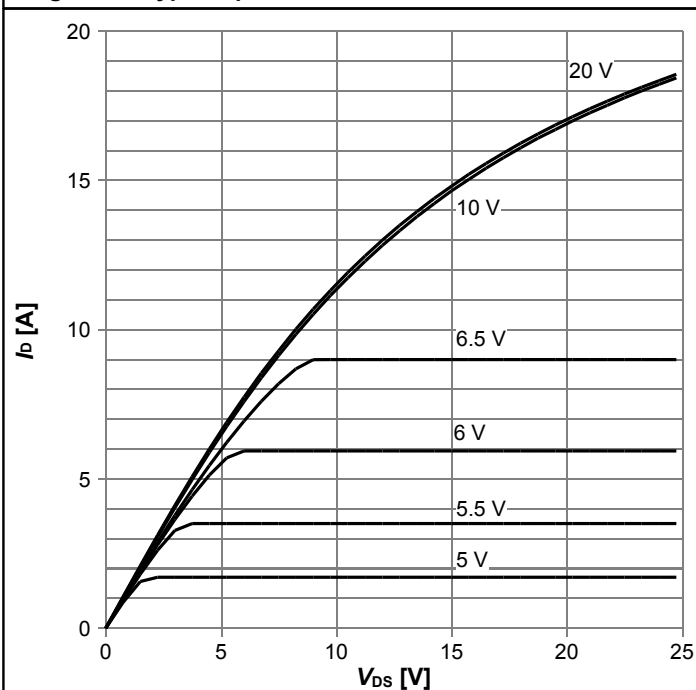

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; t_p = 10\text{ }\mu\text{s}; \text{parameter: } V_{GS}$ 

Diagram 6: Typ. output characteristics

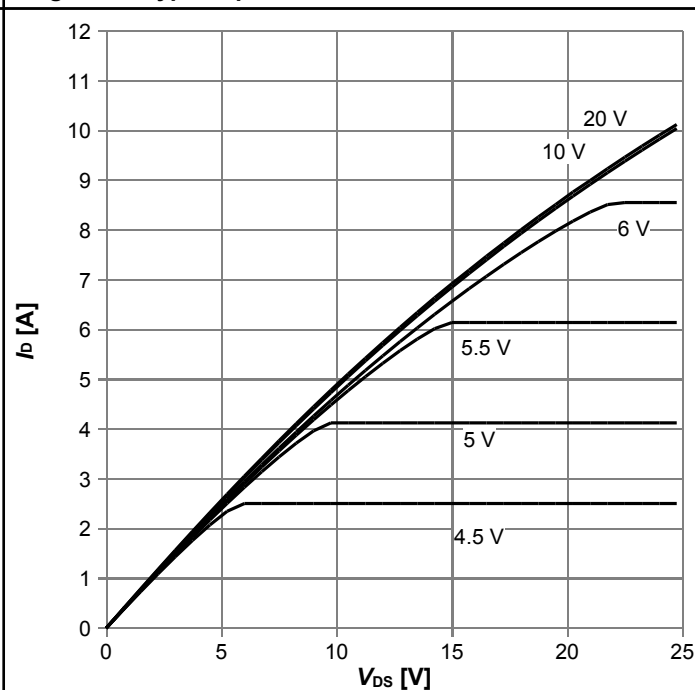

 $I_D = f(V_{DS}); T_J = 150^\circ\text{C}; t_p = 10\text{ }\mu\text{s}; \text{parameter: } V_{GS}$ 

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

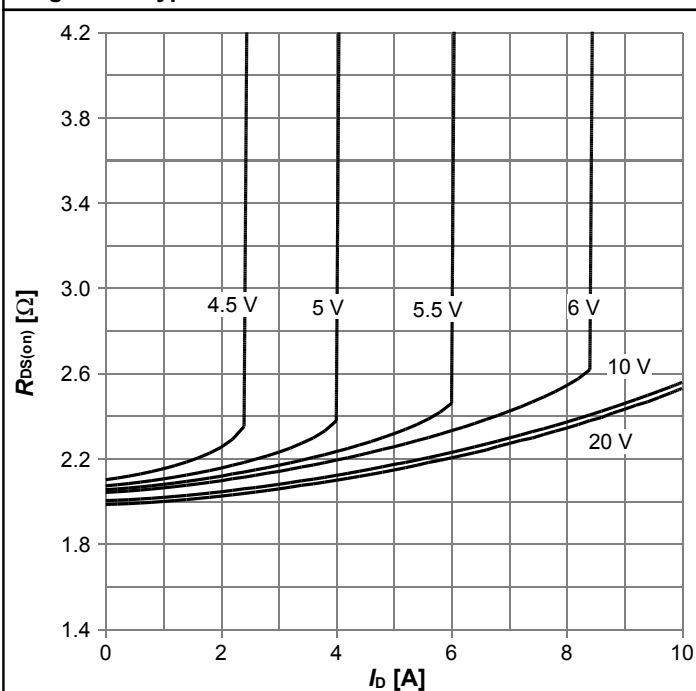

 $R_{DS(on)} = f(I_D); T_J = 150^\circ\text{C}; \text{parameter: } V_{GS}$ 

Diagram 8: Drain-source on-state resistance

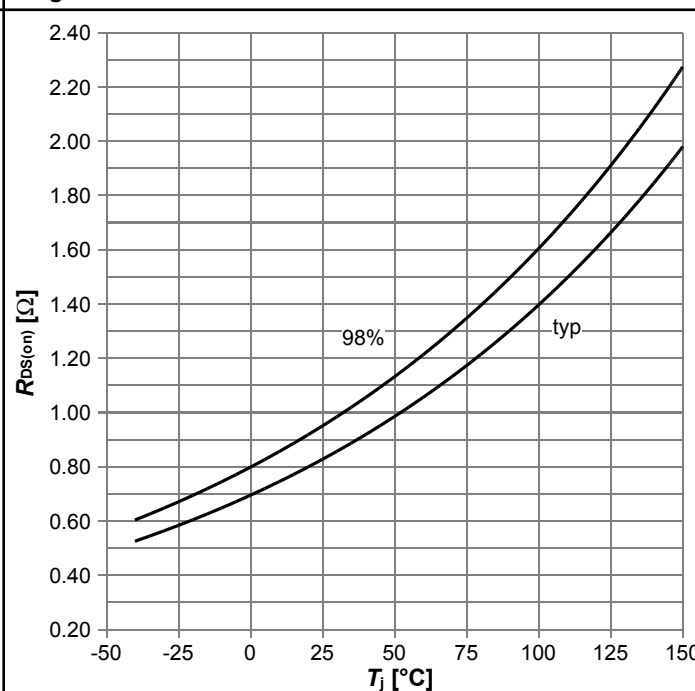

 $R_{DS(on)} = f(T_J); I_D = 3.6\text{ A}; V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics

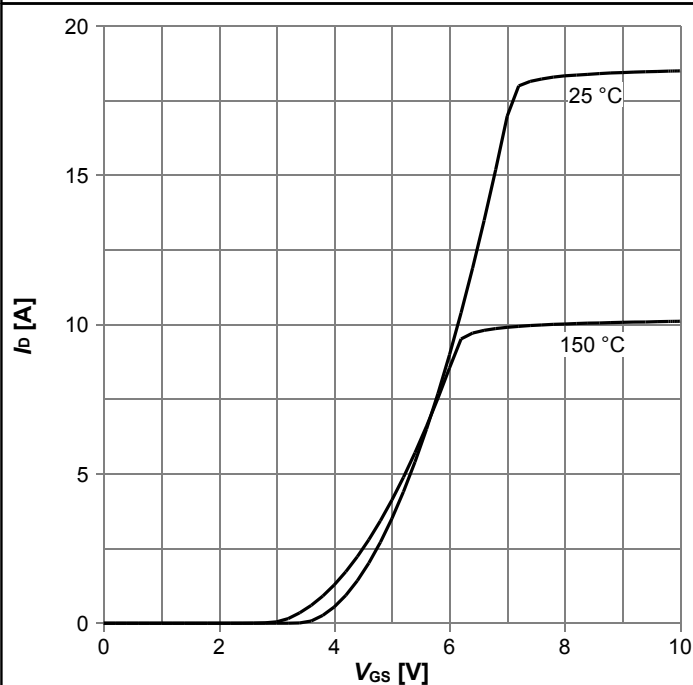

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}; t_p = 10 \mu s; \text{parameter: } T_j$ 

Diagram 10: Typ. gate charge

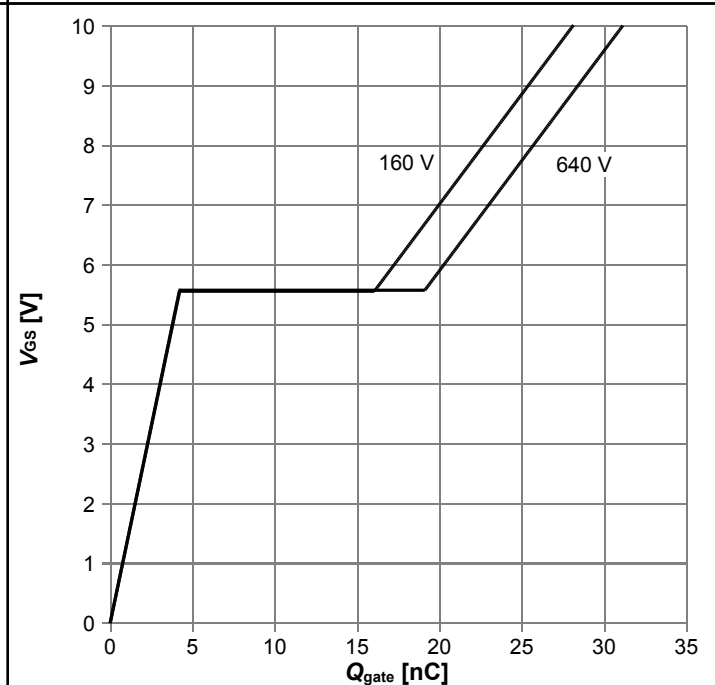

 $V_{GS} = f(Q_{gate}); I_D = 5.7 \text{ A pulsed}; \text{parameter: } V_{DD}$ 

Diagram 11: Forward characteristics of reverse diode

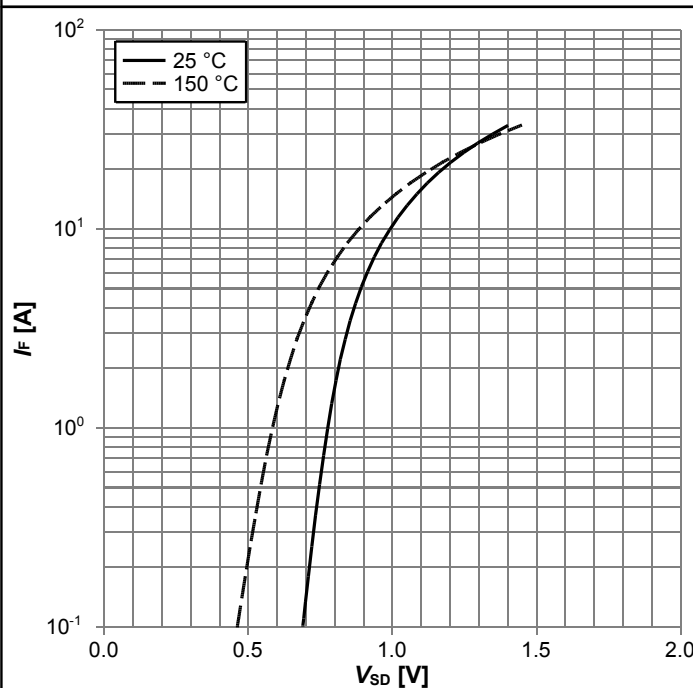

 $I_F = f(V_{SD}); t_p = 10 \mu s; \text{parameter: } T_j$ 

Diagram 12: Avalanche energy

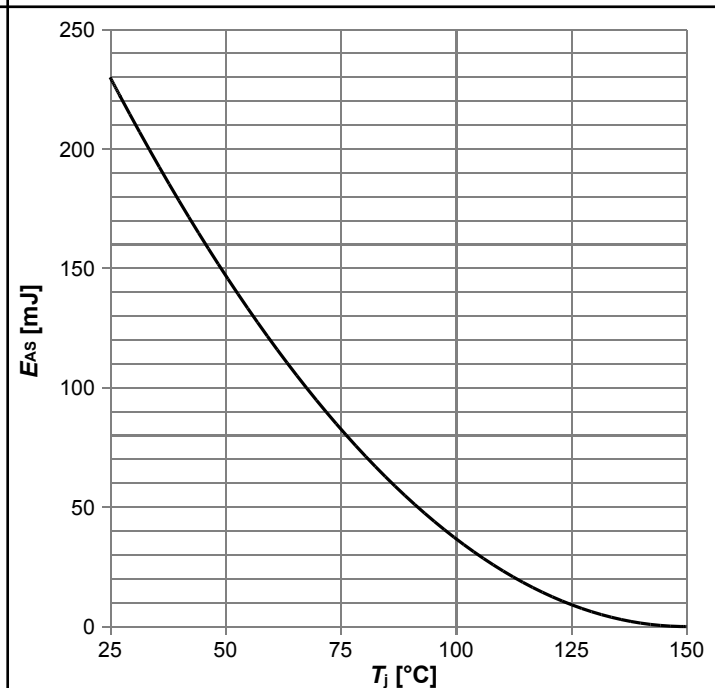
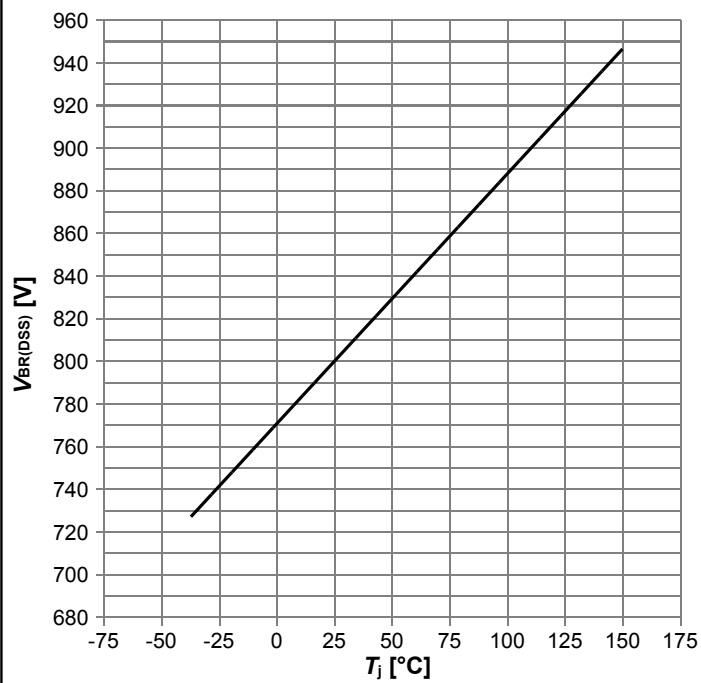
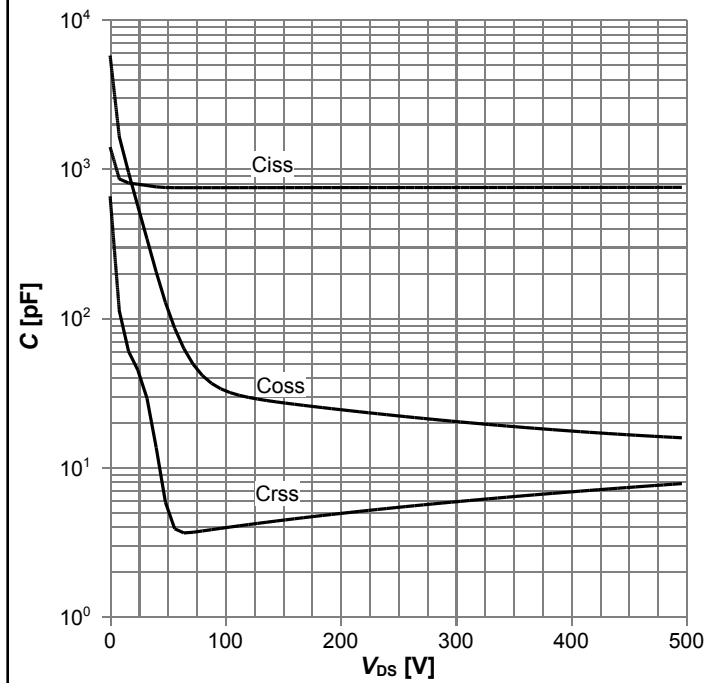

 $E_{AS} = f(T_j); I_D = 1.6 \text{ A}; V_{DD} = 50 \text{ V}$

Diagram 13: Drain-source breakdown voltage



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

Diagram 14: Typ. capacitances



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

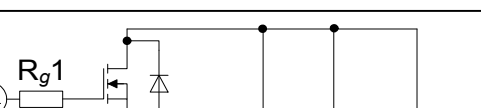
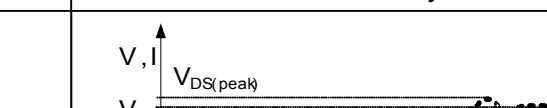
Diagram 15: Typ. Coss stored energy



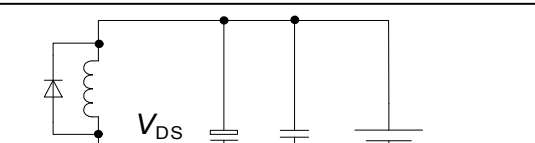
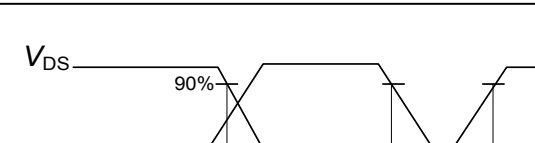
$$E_{oss} = f(V_{DS})$$

## 6 Test Circuits

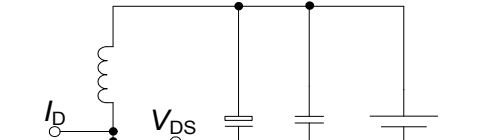
### Table 8 Diode characteristics

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

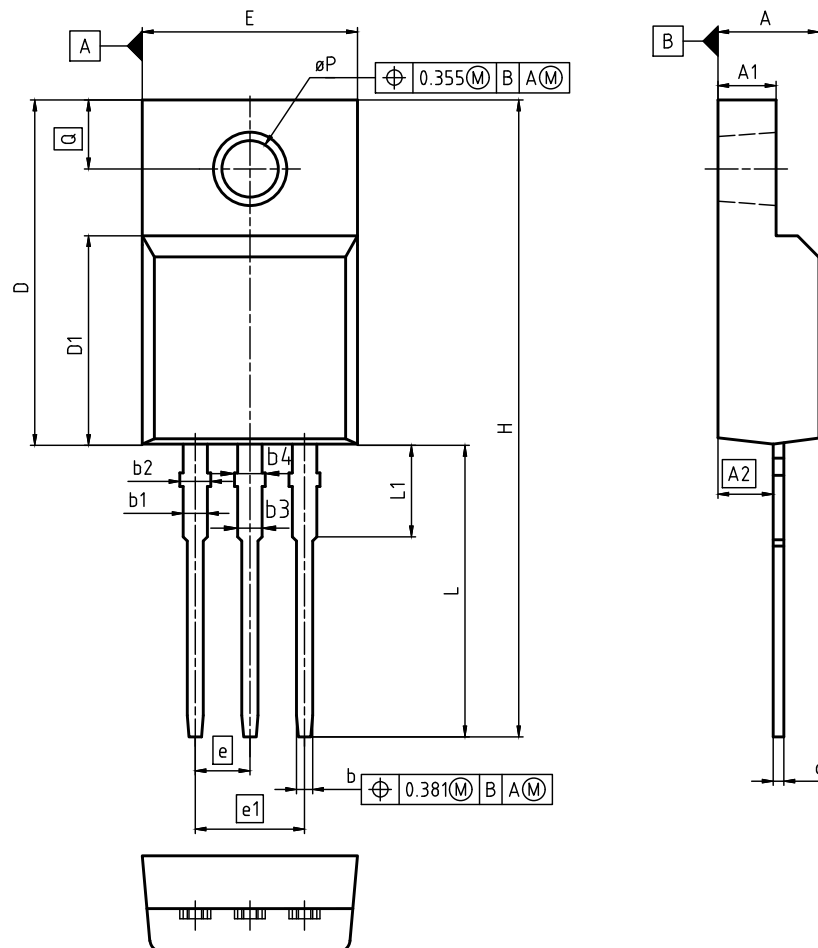
### Table 9 Switching times

| 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

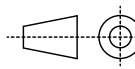
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| <b>DOCUMENT NO.</b><br>Z8B00003319                                                                                  |
| <b>SCALE</b><br>0 2.5 5mm                                                                                           |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>05-05-2014                                                                                     |
| <b>REVISION</b><br>04                                                                                               |

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                 |

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**Стандарт  
Электрон  
Связь**

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

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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.

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