# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

# CoolMOS™ CE

500V CoolMOS™ CE Power Transistor
IPA50R800CE

## Data Sheet

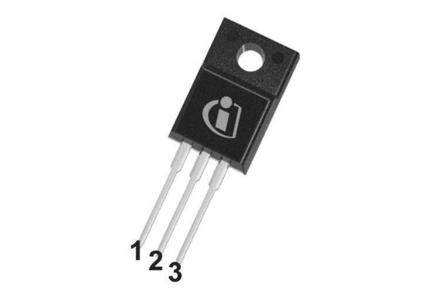
Rev. 2.0
Final

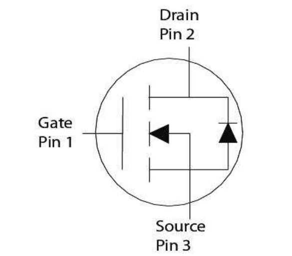
Industrial & Multimarket

## 1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE series combines the experience of the leading SJ MOSFET supplier with high class innovation while representing a cost appealing alternative compared to standard MOSFETs in target applications. The resulting devices provide all benefits of a fast switching SJ MOSFET while not sacrificing ease of use. Extremely low switching and conduction losses make switching applications even more efficient, more compact, lighter and cooler.

TO-220 FP




### Features

- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)

### Applications

PFC stages, hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, LCD & PDP TV and Lighting.

### Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 550 | V |
| $R_{DS(on),max}$ | 0.8 | Ω |
| $Q_{g.typ}$ | 12.4 | nC |
| $I_{D,pulse}$ | 15.5 | A |
| $E_{oss}$@400V | 1.46 | µJ |
| Body diode di/dt | 500 | A/µs |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPA50R800CE | PG-TO 220 FullPAK | 5R800CE | see Appendix A |

## Table of Contents

## 2 Maximum ratings

at $T_j$ = 25°C, unless otherwise specified

### Table 2 Maximum ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current[1] | $I_D$ | -<br>- | -<br>- | 5<br>3.2 | A | $T_C$ = 25°C<br>$T_C$ = 100°C |
| Pulsed drain current[2] | $I_{D,pulse}$ | - | - | 15.5 | A | $T_C$=25°C |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 83 | mJ | $I_D$ =1.9A; $V_{DD}$ = 50V |
| Avalanche energy, repetitive | $E_{AR}$ | - | - | 0.13 | mJ | $I_D$ =1.9A; $V_{DD}$ = 50V |
| Avalanche current, repetitive | $I_{AR}$ | - | - | 1.9 | A | - |
| MOSFET dv/dt ruggedness | dv/dt | - | - | 50 | V/ns | $V_{DS}$ =0...400V |
| Gate source voltage | $V_{GS}$ | -20<br>-30 | -<br>- | 20<br>30 | V | static;<br>AC (f>1 Hz) |
| Power dissipation (FullPAK) TO-220FP | $P_{tot}$ | - | - | 26 | W | $T_C$=25°C |
| Operating and storage temperature | $T_j$, $T_{stg}$ | -55 | - | 150 | °C | - |
| Mounting torque (FullPAK) TO-220FP | - | - | - | 50 | Ncm | M2.5 screws |
| Continuous diode forward current | $I_S$ | - | - | 4.4 | A | $T_C$=25°C |
| Diode pulse current[2] | $I_{S,pulse}$ | - | - | 15.5 | A | $T_C$ = 25°C |
| Reverse diode dv/dt[3] | dv/dt | - | - | 15 | V/ns | $V_{DS}$ =0...400V, $I_{SD}$<=$I_S$, $T_j$=25°C, $t_{cond}$<2$\mu$s |
| Maximum diode commutation speed[3] | $di_f/dt$ | - | - | 500 | A/$\mu$s | $V_{DS}$ =0...400V, $I_{SD}$<=$I_S$, $T_j$=25°C, $t_{cond}$<2$\mu$s |
| Insulation withstand voltage for TO-220 FullPAK | $V_{ISO}$ | - | - | 2500 | V | $V_{rms}$, $T_C$=25°C, $t$=1min |

## 3 Thermal characteristics

### Table 3 Thermal characteristics (FullPAK) TO-220FP

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 4.73 | °C/W | - |
| Thermal resistance, junction - ambient | $R_{thJA}$ | - | - | 80 | °C/W | leaded |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ | - | - | 260 | °C | 1.6mm (0.063 in.) from case for 10s |

[1] Limited by $T_{j\,max}$. Maximum duty cycle D=0.75
[2] Pulse width $t_p$ limited by $T_{j,max}$
[3] $V_{DClink}$=400V; $V_{DS,peak}$< $V_{(BR)DSS}$; identical low side and high side switch with identical $R_G$

# 4 Electrical characteristics

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 500 | - | - | V | $V_{GS}$=0V, $I_D$=1mA |
| Gate threshold voltage | $V_{(GS)th}$ | 2.50 | 3 | 3.50 | V | $V_{DS}$= $V_{GS}$, $I_D$=0.13mA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | -<br>10 | 1<br>- | μA | $V_{DS}$=500V, $V_{GS}$=0V, $T_j$=25°C<br>$V_{DS}$=500V, $V_{GS}$=0V, $T_j$=150°C |
| Gate-source leakage curent | $I_{GSS}$ | - | - | 100 | nA | $V_{GS}$=20V, $V_{DS}$=0V |
| Drain-source on-state resistance | $R_{DS(on)}$ | -<br>- | 0.72<br>1.89 | 0.80<br>- | Ω | $V_{GS}$=13V, $I_D$=1.5A, $T_j$=25°C<br>$V_{GS}$=13V, $I_D$=1.5A, $T_j$=150°C |
| Gate resistance | $R_G$ | - | 3 | - | Ω | $f$=1 MHz, open drain |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 280 | - | pF | $V_{GS}$=0V, $V_{DS}$=100V, $f$=1MHz |
| Output capacitance | $C_{oss}$ | - | 23 | - | pF | $V_{GS}$=0V, $V_{DS}$=100V, $f$=1MHz |
| Effective output capacitance, energy related[1] | $C_{o(er)}$ | - | 18 | - | pF | $V_{GS}$=0V, $V_{DS}$=0...400V |
| Effective output capacitance, time related[2] | $C_{o(tr)}$ | - | 67 | - | pF | $I_D$=constant, $V_{GS}$=0V, $V_{DS}$=0...400V |
| Turn-on delay time | $t_{d(on)}$ | - | 6.2 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=1.9A, $R_G$=5.3Ω |
| Rise time | $t_r$ | - | 5.5 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=1.9A, $R_G$=5.3Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 26 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=1.9A, $R_G$=5.3Ω |
| Fall time | $t_f$ | - | 15.9 | - | ns | $V_{DD}$=400V, $V_{GS}$=13 V, $I_D$=1.9A, $R_G$=5.3Ω |

## Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 1.5 | - | nC | $V_{DD}$=400V, $I_D$=1.9A, $V_{GS}$=0 to 10V |
| Gate to drain charge | $Q_{gd}$ | - | 6.8 | - | nC | $V_{DD}$=400V, $I_D$=1.9A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 12.4 | - | nC | $V_{DD}$=400V, $I_D$=1.9A, $V_{GS}$=0 to 10V |
| Gate plateau voltage | $V_{plateau}$ | - | 5.3 | - | V | $V_{DD}$=400V, $I_D$=1.9A, $V_{GS}$=0 to 10V |

[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$

[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$

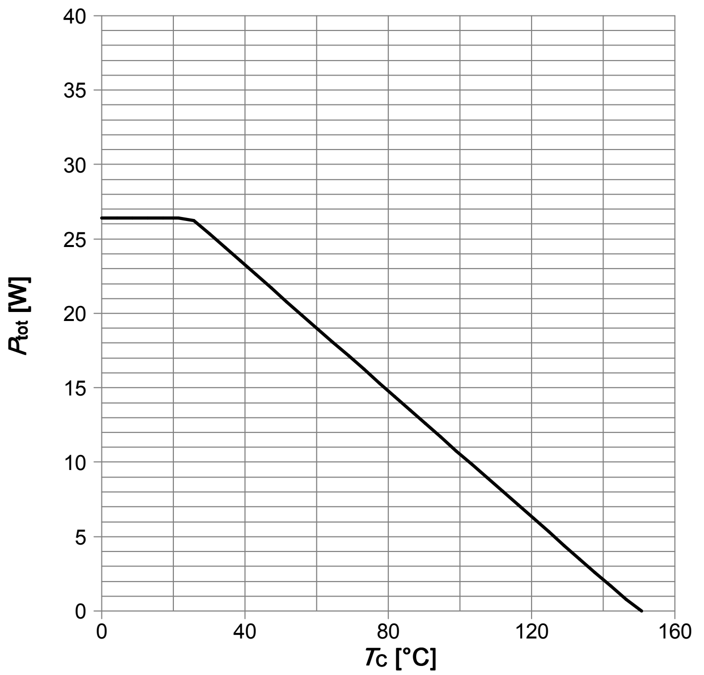
**Table 7 Reverse diode characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode forward voltage | $V_{SD}$ | - | 0.83 | - | V | $V_{GS}$=0V, $I_F$=1.9A, $T_j$=25°C |
| Reverse recovery time | $t_{rr}$ | - | 158 | - | ns | $V_R$=400V, $I_F$=1.9A, $di_F/dt$=100A/µs |
| Reverse recovery charge | $Q_{rr}$ | - | 0.84 | - | µC | $V_R$=400V, $I_F$=1.9A, $di_F/dt$=100A/µs |
| Peak reverse recovery current | $I_{rrm}$ | - | 9.6 | - | A | $V_R$=400V, $I_F$=1.9A, $di_F/dt$=100A/µs |

# 5 Electrical characteristics diagrams

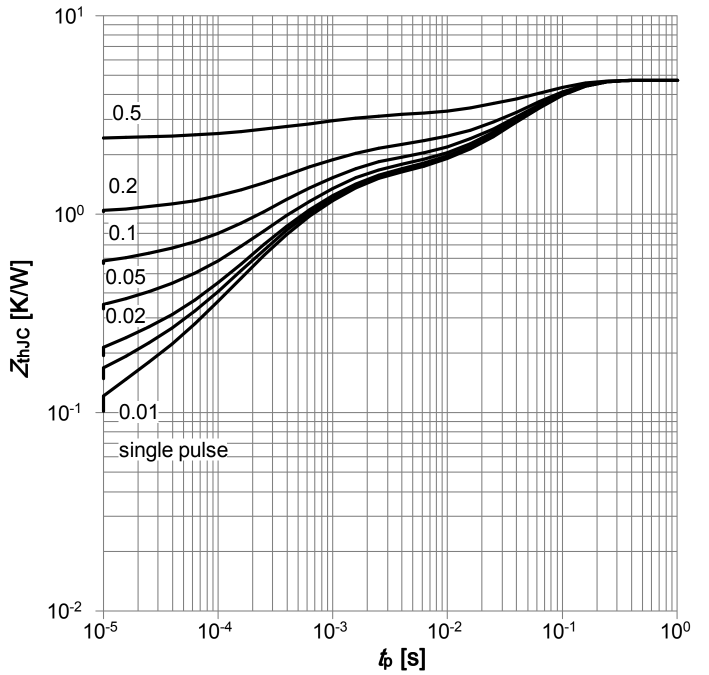
## Table 8

**Power dissipation (FullPAK)**




$P_{tot}$=f($T_C$)

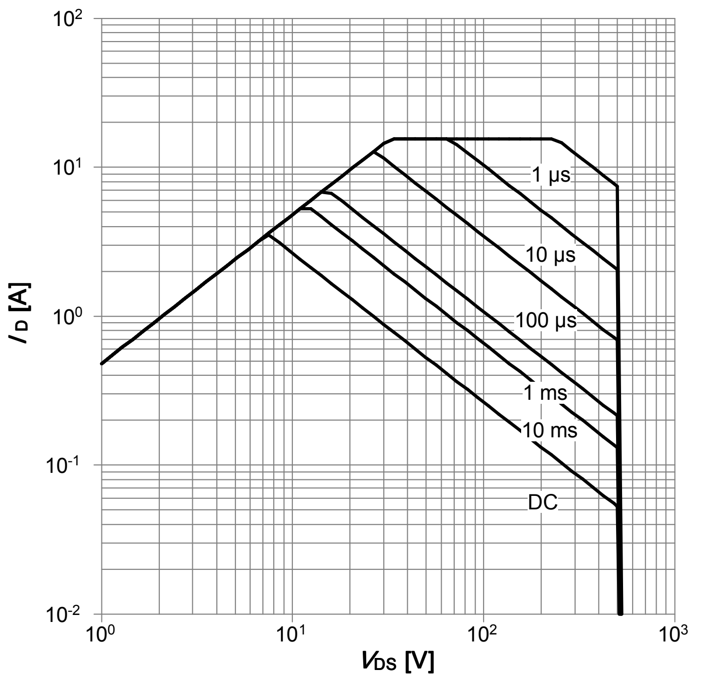
**Max. transient thermal impedance (FullPAK)**




$Z_{thJC}$ =f($t_P$); parameter: $D$=$t_p$/$T$

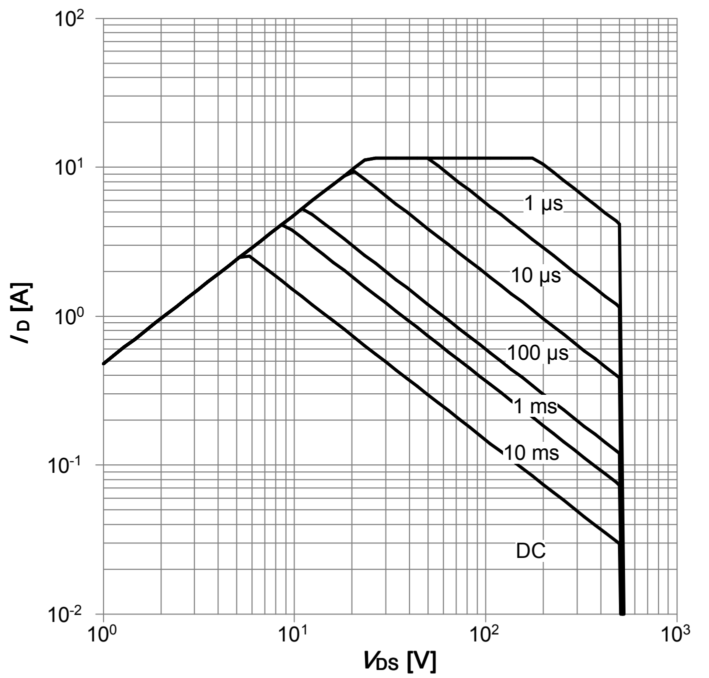
## Table 9

**Safe operating area (FullPAK) Tj=25°C**



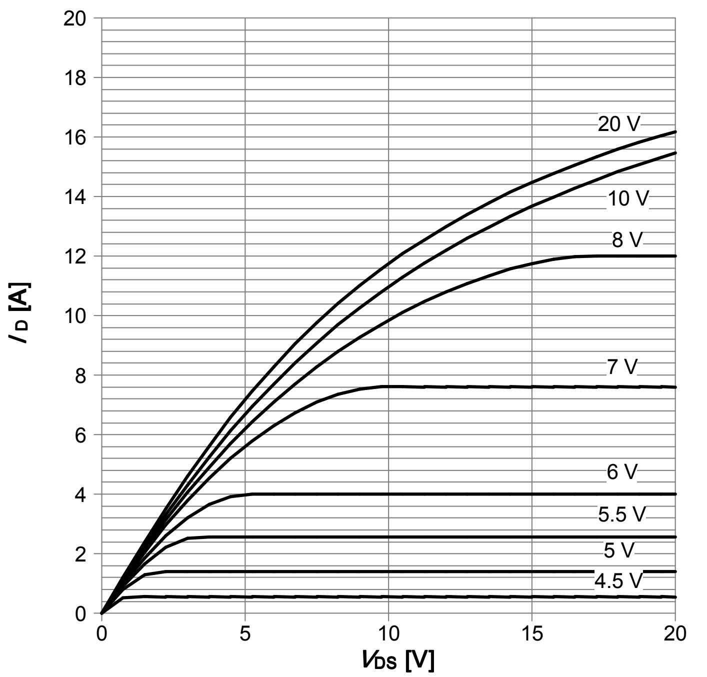
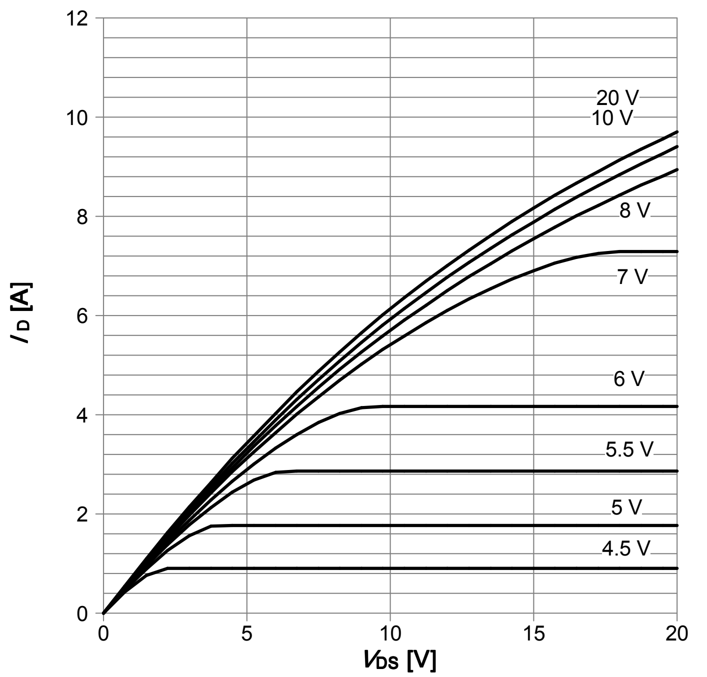

$I_D$=f($V_{DS}$); $T_C$=25 °C; $D$=0; parameter: $t_p$

**Safe operating area (FullPAK) Tj=80°C**

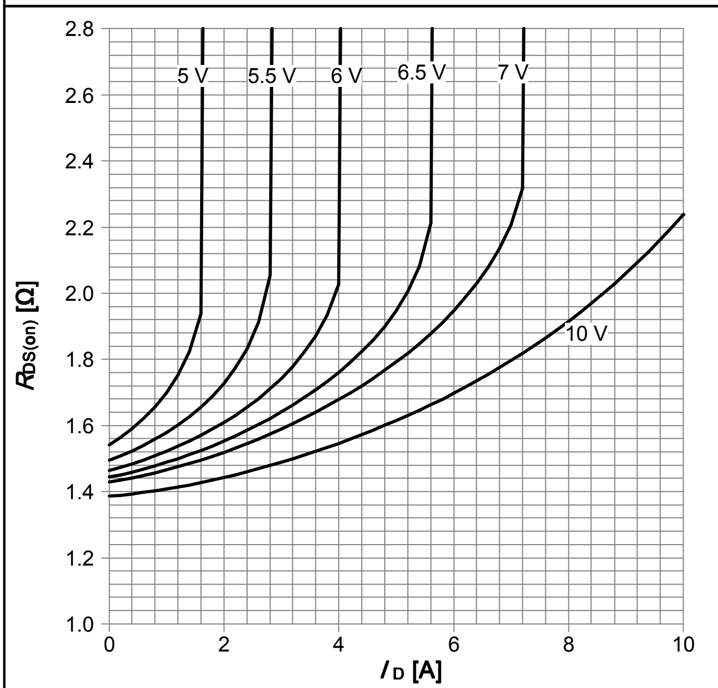
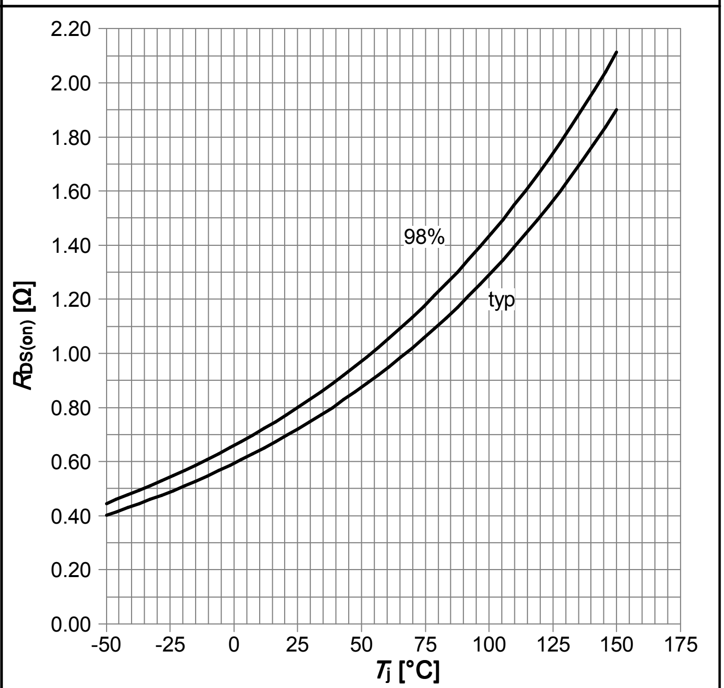



$I_D$=f($V_{DS}$); $T_C$=80 °C; $D$=0; parameter: $t_p$

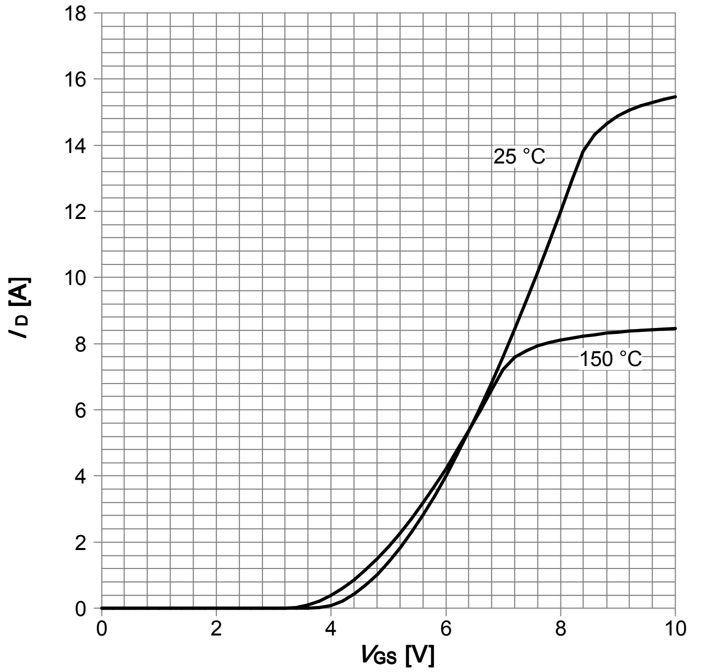
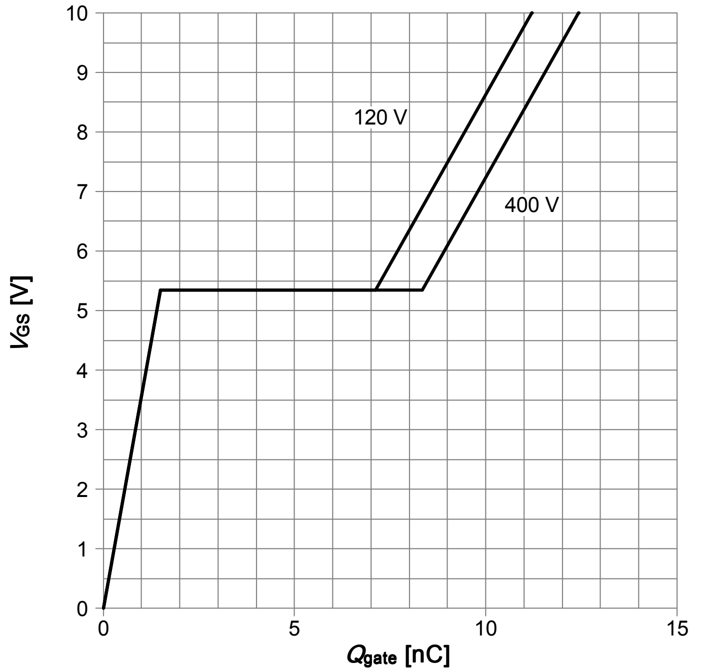
## Table 10

| Typ. output characteristics Tj=25°C | Typ. output characteristics Tj=125°C |
|---|---|
|  |  |
| $I_D$=f($V_{DS}$); $T_j$=25 °C; parameter: $V_{GS}$ | $I_D$=f($V_{DS}$); $T_j$=125 °C; parameter: $V_{GS}$ |

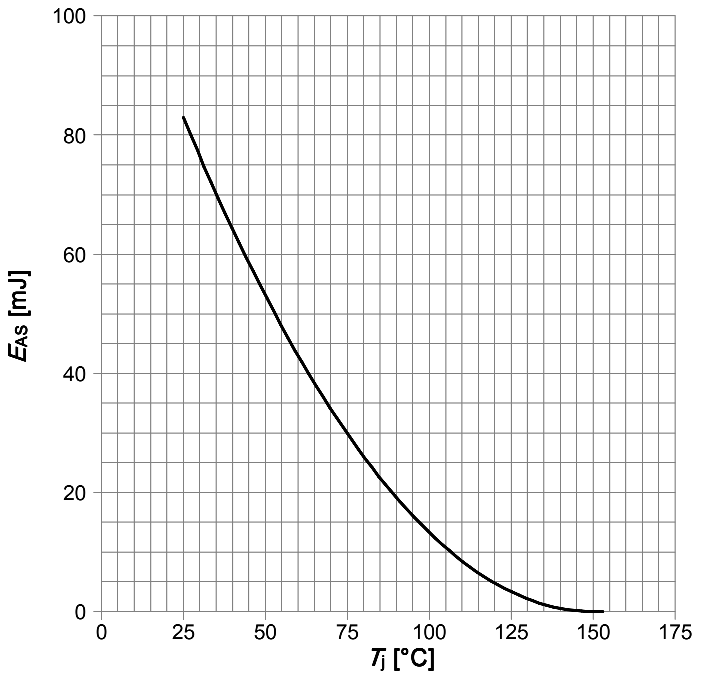
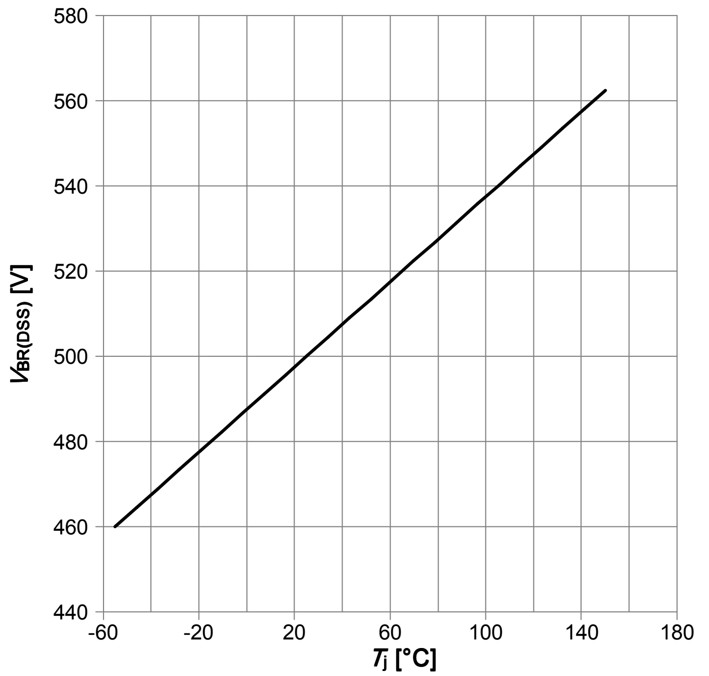
## Table 11

| Typ. drain-source on-state resistance | Drain-source on-state resistance |
|---|---|
|  |  |
| $R_{DS(on)}$=f($I_D$); $T_j$=125 °C; parameter: $V_{GS}$ | $R_{DS(on)}$=f($T_j$); $I_D$=1.5 A; $V_{GS}$=13 V |

### Table 12

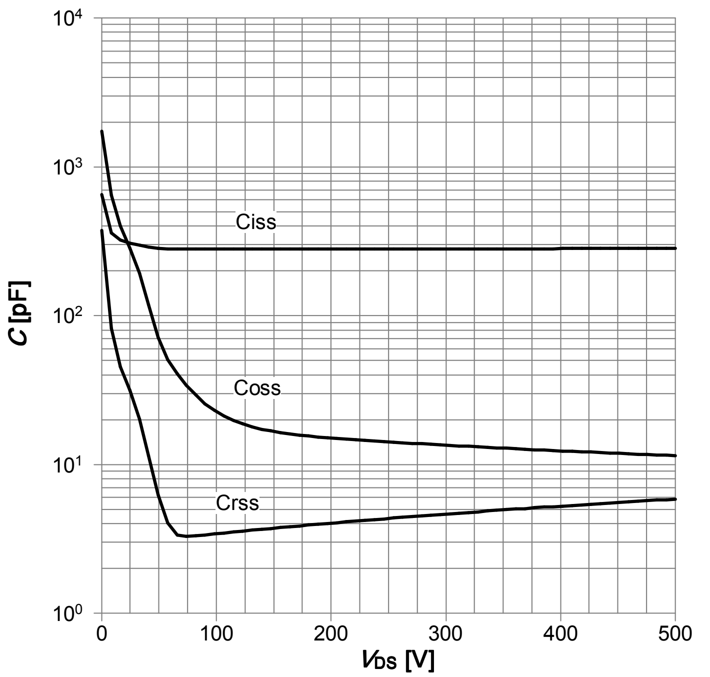
| Typ. transfer characteristics | Typ. gate charge |
|---|---|
|  |  |
| $I_D$=f($V_{GS}$); $V_{DS}$=20V; parameter: $T_j$ | $V_{GS}$=f($Q_{gate}$); $I_D$=1.9 A pulsed; parameter: $V_{DD}$ |

### Table 13

| Avalanche energy | Drain-source breakdown voltage |
|---|---|
|  |  |
| $E_{AS}$=f($T_j$); $I_D$=1.9 A; $V_{DD}$=50 V | $V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA |

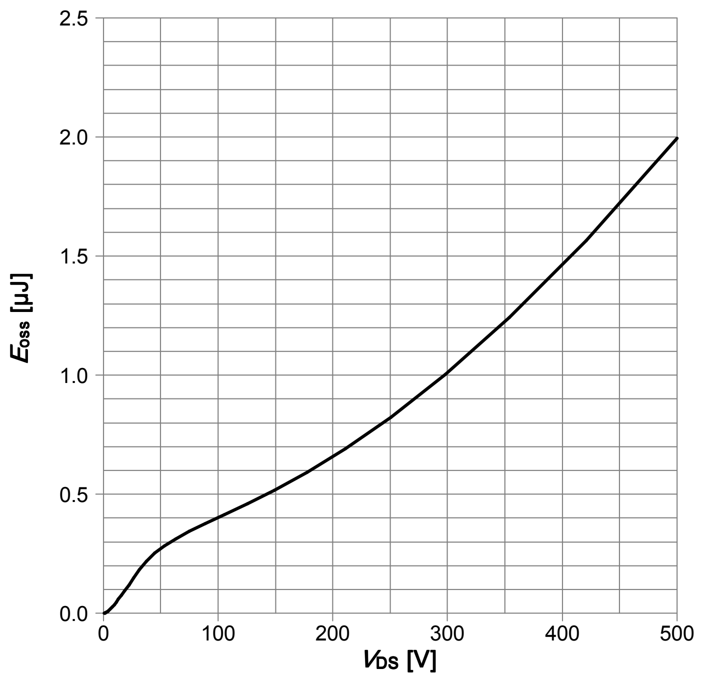
## Table 14

**Typ. capacitances**




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

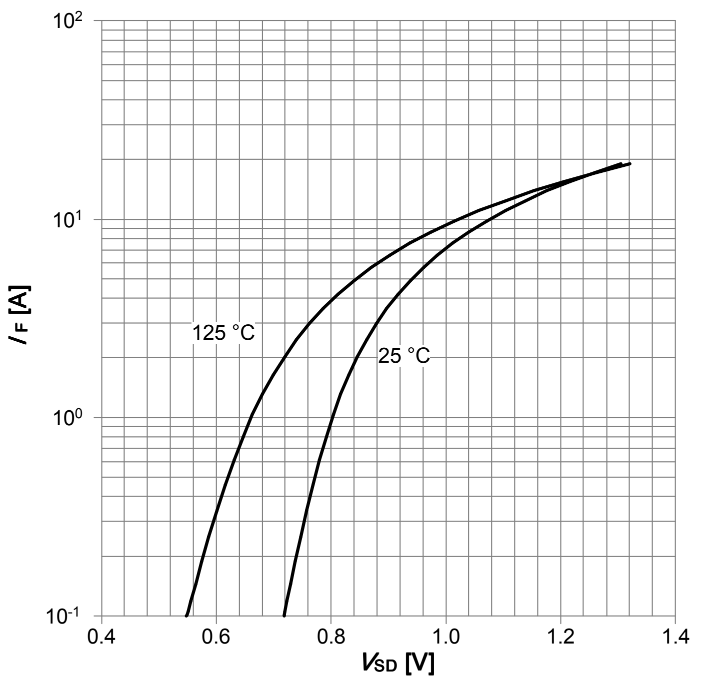
**Typ. Coss stored energy**




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

## Table 15

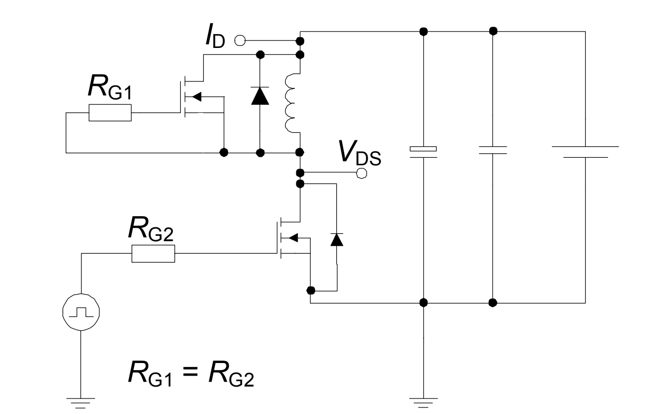
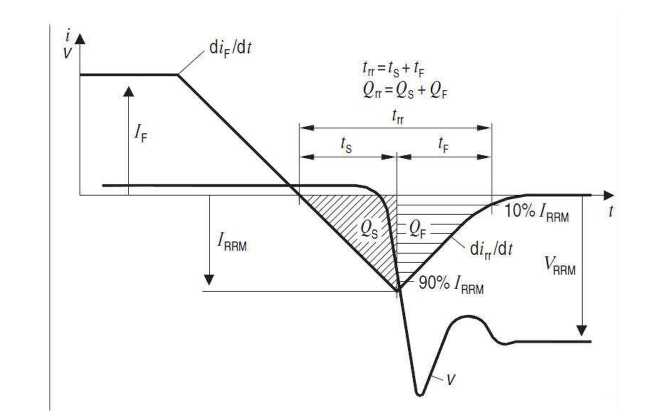
**Forward characteristics of reverse diode**



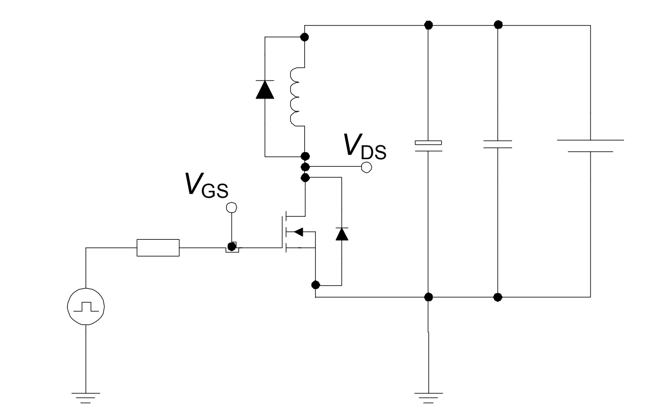
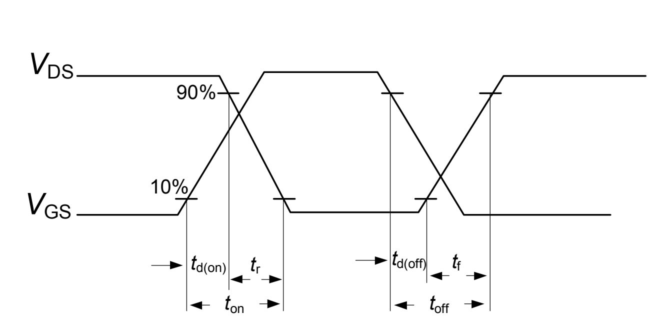

$I_F$=f($V_{SD}$); parameter: $T_j$

# 6 Test Circuits

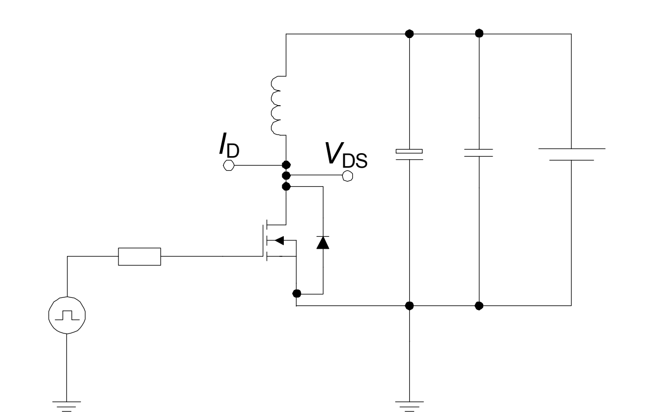
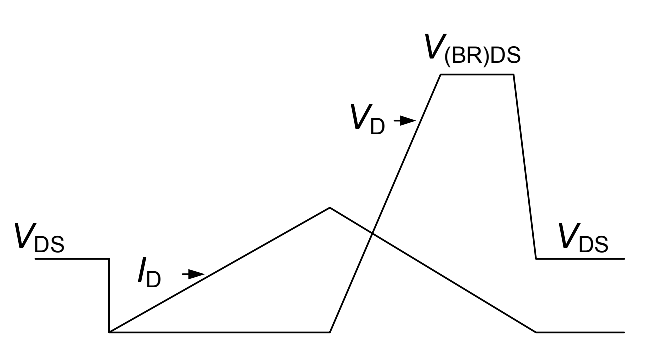
## Table 16 Diode characteristics

| Test circuit for diode characteristics | Diode recovery waveform |
| --- | --- |
|  |  |

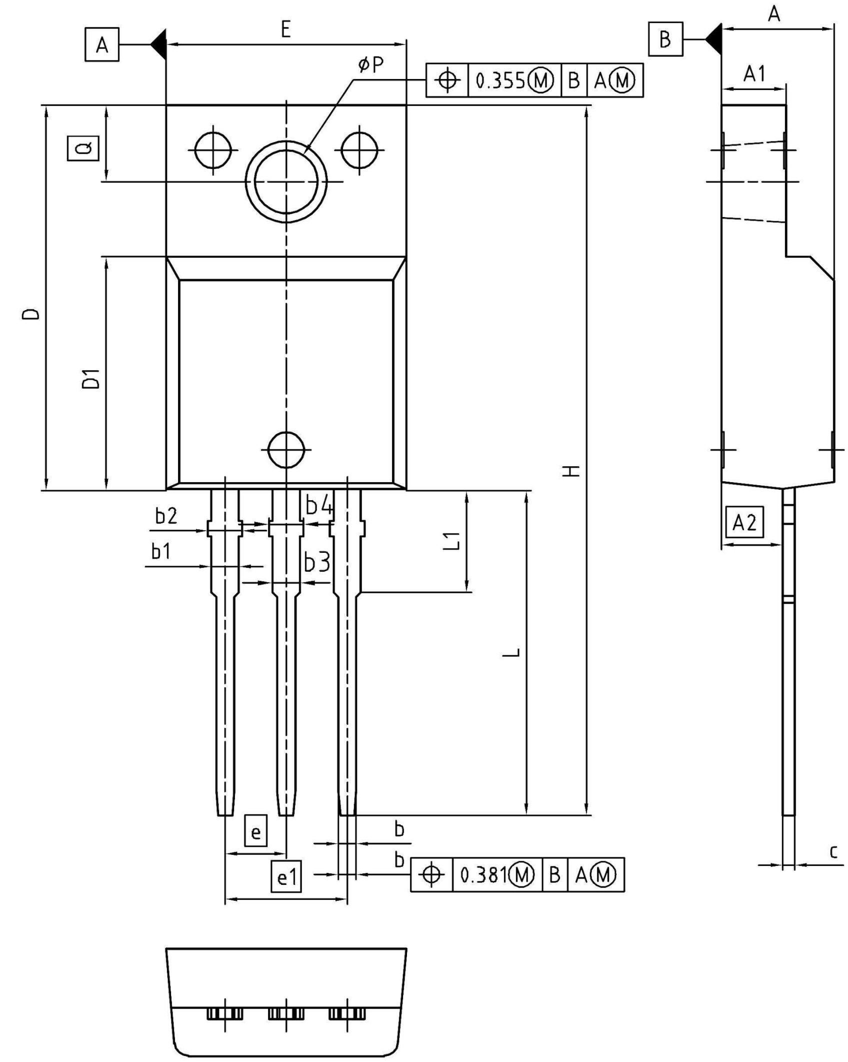
## Table 17 Switching times

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

## Table 18 Unclamped inductive

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

# 7 Package Outlines

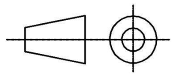



| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.55 | 4.85 | 0.179 | 0.191 |
| A1 | 2.55 | 2.85 | 0.100 | 0.112 |
| A2 | 2.42 | 2.72 | 0.095 | 0.107 |
| b | 0.65 | 0.85 | 0.026 | 0.033 |
| b1 | 0.95 | 1.33 | 0.037 | 0.052 |
| b2 | 0.95 | 1.51 | 0.037 | 0.059 |
| b3 | 0.65 | 1.33 | 0.026 | 0.052 |
| b4 | 0.65 | 1.51 | 0.026 | 0.059 |
| c | 0.40 | 0.63 | 0.016 | 0.025 |
| D | 15.85 | 16.15 | 0.624 | 0.636 |
| D1 | 9.53 | 9.83 | 0.375 | 0.387 |
| E | 10.35 | 10.65 | 0.407 | 0.419 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 3 | | 3 | |
| H | 29.45 | 29.75 | 1.159 | 1.171 |
| L | 13.45 | 13.75 | 0.530 | 0.541 |
| L1 | 3.15 | 3.45 | 0.124 | 0.136 |
| øP | 2.95 | 3.20 | 0.116 | 0.126 |
| Q | 3.15 | 3.50 | 0.124 | 0.138 |

DOCUMENT NO.
Z8B00003319

SCALE 0 2.5 5mm

EUROPEAN PROJECTION



ISSUE DATE
08-03-2007

REVISION
03

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

# 8 Appendix A

**Table 19 Related Links**

- **IFX CoolMOS Webpage:**
  http://www.infineon.com/cms/en/product/channel.html?channel=ff80808112ab681d0112ab6a628704d8

- **IFX Design tools:**
  http://www.infineon.com/cms/en/product/promopages/designtools/index.html

## Revision History

IPA50R800CE

**Revision: 2012-08-24, Rev. 2.0**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 2.0 | 2012-08-24 | Release of final version |

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