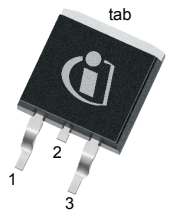
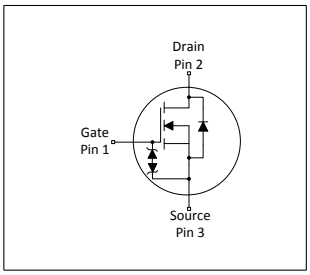
# MOSFET

## 600V CoolMOS™ P7 Power Transistor

The CoolMOS™ 7th generation platform is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. The 600V CoolMOS™ P7 series is the successor to the CoolMOS™ P6 series. It combines the benefits of a fast switching SJ MOSFET with excellent ease of use, e.g. very low ringing tendency, outstanding robustness of body diode against hard commutation and excellent ESD capability. Furthermore, extremely low switching and conduction losses make switching applications even more efficient, more compact and much cooler.

D²PAK




## Features

- Suitable for hard and soft switching (PFC and LLC) due to an outstanding commutation ruggedness
- Significant reduction of switching and conduction losses
- Excellent ESD robustness >2kV (HBM) for all products
- Better $R_{DS(on)}$/package products compared to competition enabled by a low $R_{DS(on)}$*A (below 1Ohm*mm²)
- Fully qualified acc. JEDEC for Industrial Applications

## Benefits

- Ease of use and fast design-in through low ringing tendency and usage across PFC and PWM stages
- Simplified thermal management due to low switching and conduction losses
- Increased power density solutions enabled by using products with smaller footprint and higher manufacturing quality due to >2 kV ESD protection
- Suitable for a wide variety of applications and power ranges

## Potential applications

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

*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 |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 180 | mΩ |
| $Q_{g,typ}$ | 25 | nC |
| $I_{D,pulse}$ | 53 | A |
| $E_{oss}$ @ 400V | 2.9 | µJ |
| Body diode $di_F/dt$ | 900 | A/µs |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPB60R180P7 | PG-TO 263-3 | 60R180P7 | see Appendix A |

## Table of Contents

# 1 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>- | 18<br>11 | A | $T_C$=25°C<br>$T_C$=100°C |
| Pulsed drain current[2)] | $I_{D,pulse}$ | - | - | 53 | A | $T_C$=25°C |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 56 | mJ | $I_D$=4.0A; $V_{DD}$=50V; see table 10 |
| Avalanche energy, repetitive | $E_{AR}$ | - | - | 0.28 | mJ | $I_D$=4.0A; $V_{DD}$=50V; see table 10 |
| Avalanche current, single pulse | $I_{AS}$ | - | - | 4.0 | A | - |
| MOSFET dv/dt ruggedness | dv/dt | - | - | 80 | V/ns | $V_{DS}$=0...400V |
| Gate source voltage (static) | $V_{GS}$ | -20 | - | 20 | V | static; |
| Gate source voltage (dynamic) | $V_{GS}$ | -30 | - | 30 | V | AC (f>1 Hz) |
| Power dissipation | $P_{tot}$ | - | - | 72 | W | $T_C$=25°C |
| Storage temperature | $T_{stg}$ | -55 | - | 150 | °C | - |
| Operating junction temperature | $T_j$ | -55 | - | 150 | °C | - |
| Mounting torque | - | - | - | - | Ncm | - |
| Continuous diode forward current | $I_S$ | - | - | 18 | A | $T_C$=25°C |
| Diode pulse current[2)] | $I_{S,pulse}$ | - | - | 53 | A | $T_C$=25°C |
| Reverse diode dv/dt[3)] | dv/dt | - | - | 50 | V/ns | $V_{DS}$=0...400V, $I_{SD}$<=18A, $T_j$=25°C see table 8 |
| Maximum diode commutation speed | $di_F/dt$ | - | - | 900 | A/µs | $V_{DS}$=0...400V, $I_{SD}$<=18A, $T_j$=25°C see table 8 |
| Insulation withstand voltage | $V_{ISO}$ | - | - | n.a. | V | $V_{rms}$, $T_C$=25°C, $t$=1min |

[1)] Limited by $T_{j,max}$. Maximum Duty Cycle D = 0.50
[2)] Pulse width $t_p$ limited by $T_{j,max}$
[3)] Identical low side and high side switch with identical $R_G$

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 1.74 | °C/W | - |
| Thermal resistance, junction - ambient | $R_{thJA}$ | - | - | 62 | °C/W | device on PCB, minimal footprint |
| Thermal resistance, junction - ambient for SMD version | $R_{thJA}$ | - | 35 | 45 | °C/W | Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling. |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ | - | - | 260 | °C | reflow MSL1 |

# 3 Electrical characteristics

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

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 600 | - | - | V | $V_{GS}$=0V, $I_D$=1mA |
| Gate threshold voltage | $V_{(GS)th}$ | 3 | 3.5 | 4 | V | $V_{DS}$=$V_{GS}$, $I_D$=0.28mA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | -<br>10 | 1<br>- | µA | $V_{DS}$=600V, $V_{GS}$=0V, $T_j$=25°C<br>$V_{DS}$=600V, $V_{GS}$=0V, $T_j$=150°C |
| Gate-source leakage current | $I_{GSS}$ | - | - | 1000 | nA | $V_{GS}$=20V, $V_{DS}$=0V |
| Drain-source on-state resistance | $R_{DS(on)}$ | -<br>- | 0.145<br>0.34 | 0.180<br>- | Ω | $V_{GS}$=10V, $I_D$=5.6A, $T_j$=25°C<br>$V_{GS}$=10V, $I_D$=5.6A, $T_j$=150°C |
| Gate resistance | $R_G$ | - | 11 | - | Ω | $f$=1MHz, open drain |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 1081 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Output capacitance | $C_{oss}$ | - | 19 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Effective output capacitance, energy related[1)] | $C_{o(er)}$ | - | 36 | - | pF | $V_{GS}$=0V, $V_{DS}$=0...400V |
| Effective output capacitance, time related[2)] | $C_{o(tr)}$ | - | 381 | - | pF | $I_D$=constant, $V_{GS}$=0V, $V_{DS}$=0...400V |
| Turn-on delay time | $t_{d(on)}$ | - | 14 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=5.6A, $R_G$=10.0Ω; see table 9 |
| Rise time | $t_r$ | - | 12 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=5.6A, $R_G$=10.0Ω; see table 9 |
| Turn-off delay time | $t_{d(off)}$ | - | 85 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=5.6A, $R_G$=10.0Ω; see table 9 |
| Fall time | $t_f$ | - | 8 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=5.6A, $R_G$=10.0Ω; see table 9 |

## Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 6 | - | nC | $V_{DD}$=400V, $I_D$=5.6A, $V_{GS}$=0 to 10V |
| Gate to drain charge | $Q_{gd}$ | - | 8 | - | nC | $V_{DD}$=400V, $I_D$=5.6A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 25 | - | nC | $V_{DD}$=400V, $I_D$=5.6A, $V_{GS}$=0 to 10V |
| Gate plateau voltage | $V_{plateau}$ | - | 5.2 | - | V | $V_{DD}$=400V, $I_D$=5.6A, $V_{GS}$=0 to 10V |

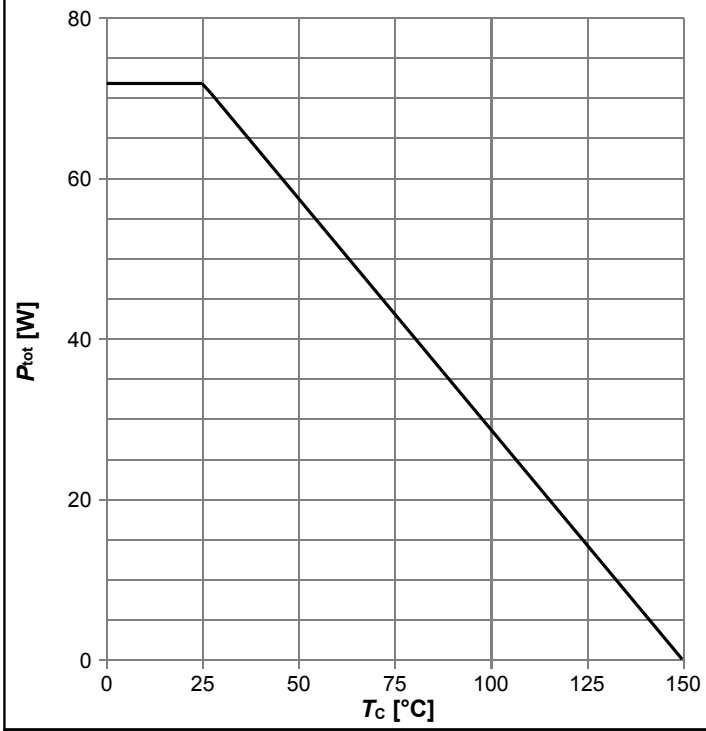
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V

## 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, $I_F$=5.6A, $T_j$=25°C |
| Reverse recovery time | $t_{rr}$ | - | 175 | - | ns | $V_R$=400V, $I_F$=2A, d$i_F$/d$t$=100A/µs; see table 8 |
| Reverse recovery charge | $Q_{rr}$ | - | 1.3 | - | µC | $V_R$=400V, $I_F$=2A, d$i_F$/d$t$=100A/µs; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | - | 15 | - | A | $V_R$=400V, $I_F$=2A, d$i_F$/d$t$=100A/µs; see table 8 |

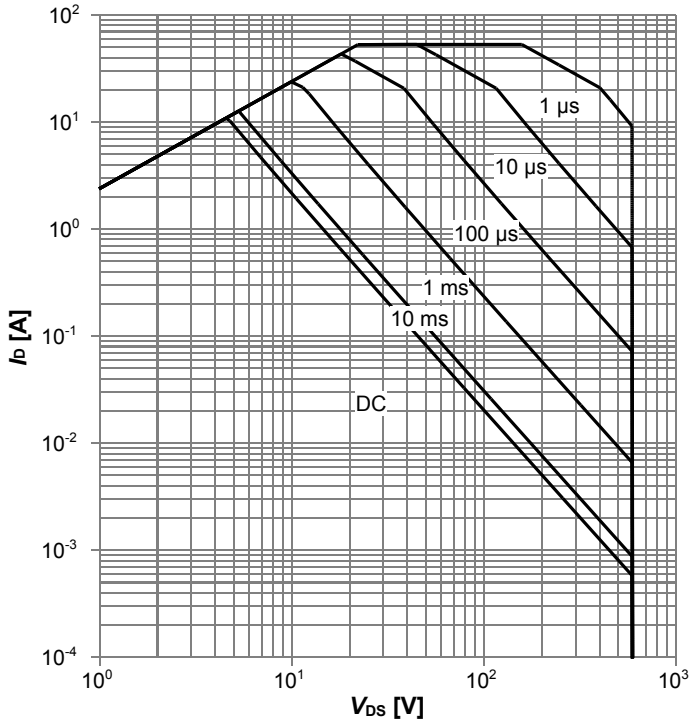
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



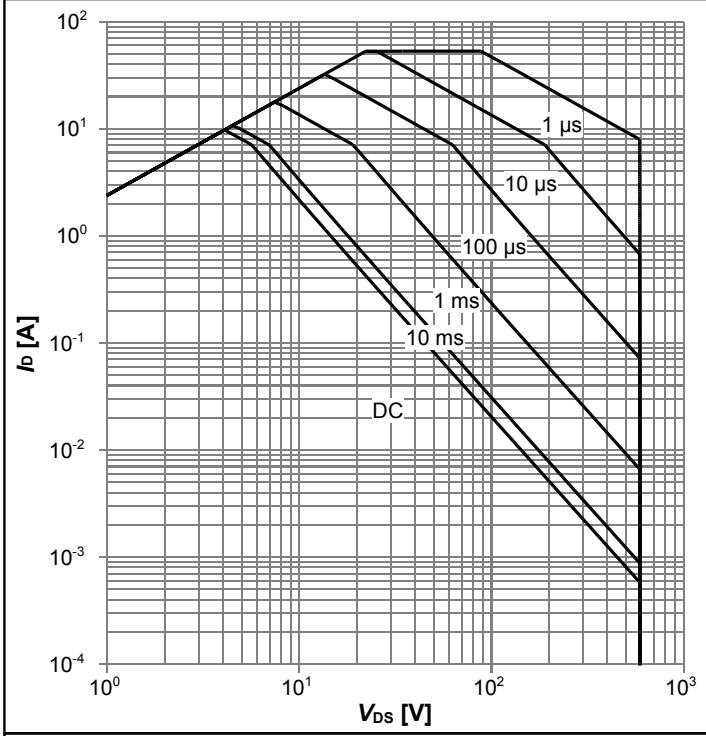

$P_{tot}=f(T_C)$

**Diagram 2: Safe operating area**



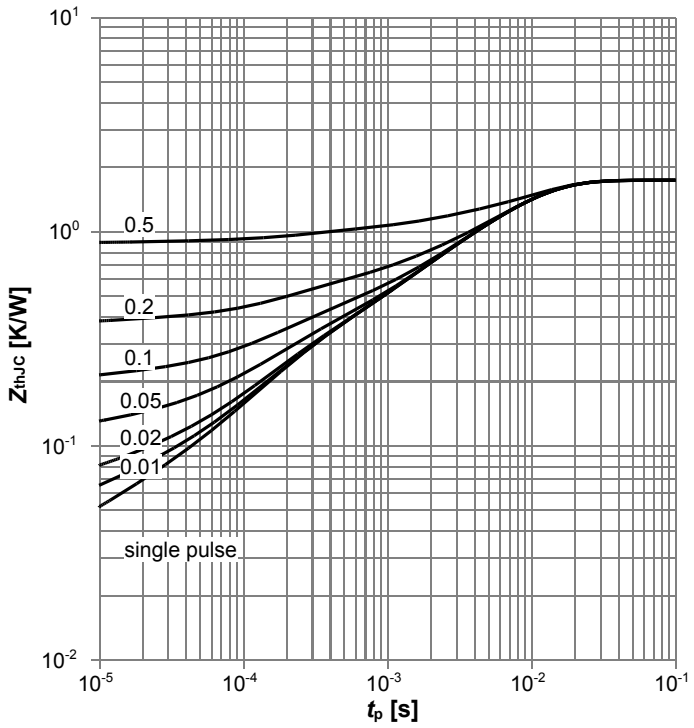

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: $t_p$

**Diagram 3: Safe operating area**



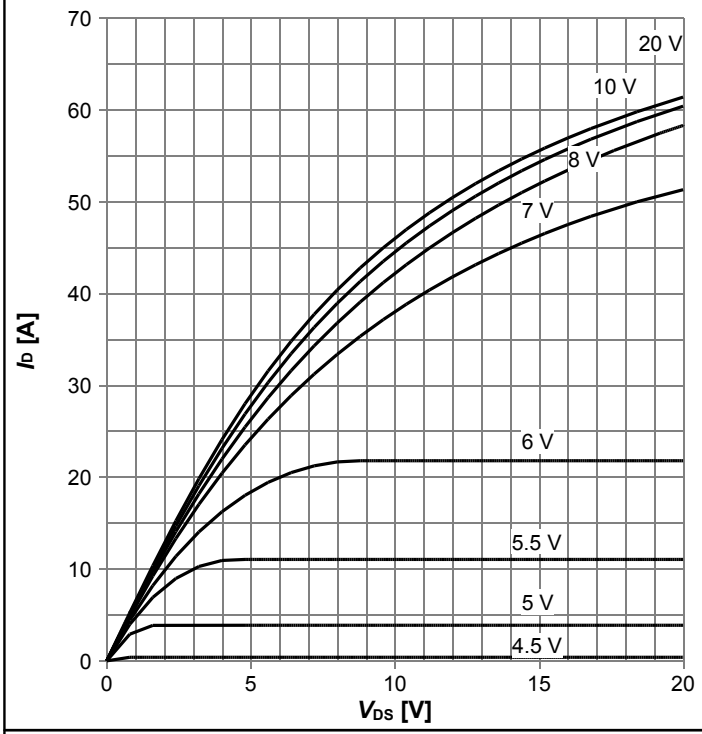

$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: $t_p$

**Diagram 4: Max. transient thermal impedance**



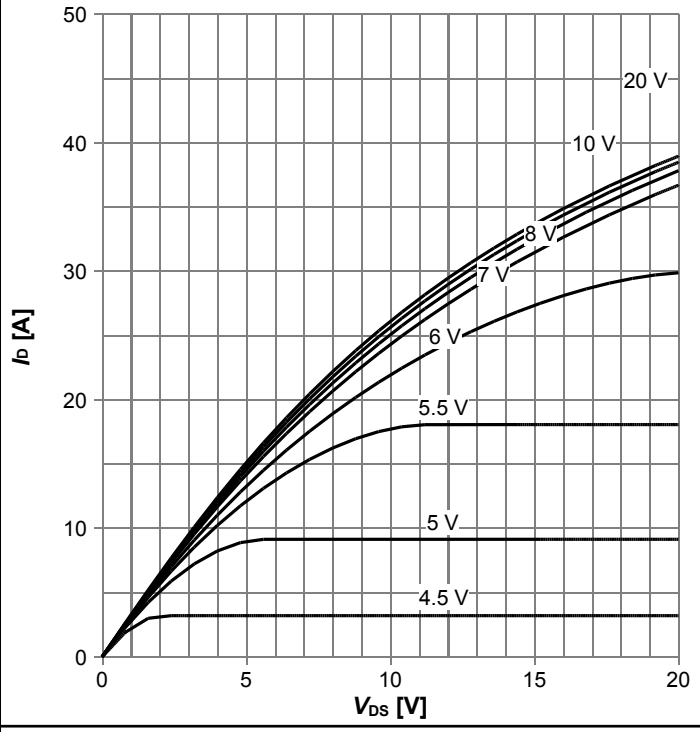

$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



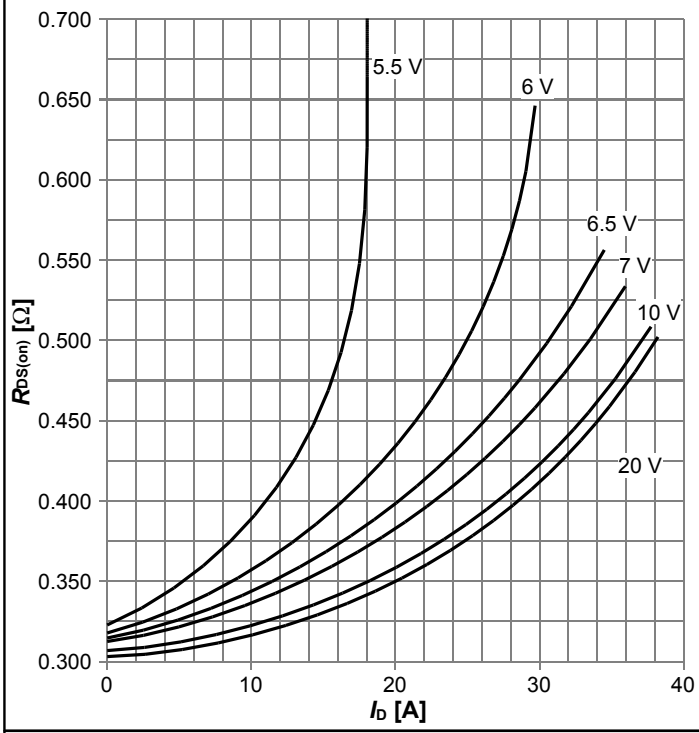

$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**



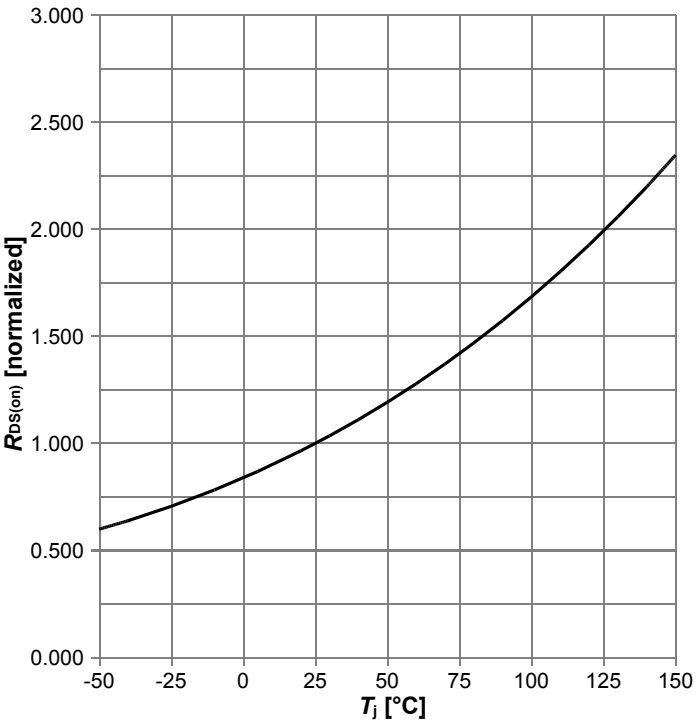

$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: $V_{GS}$

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



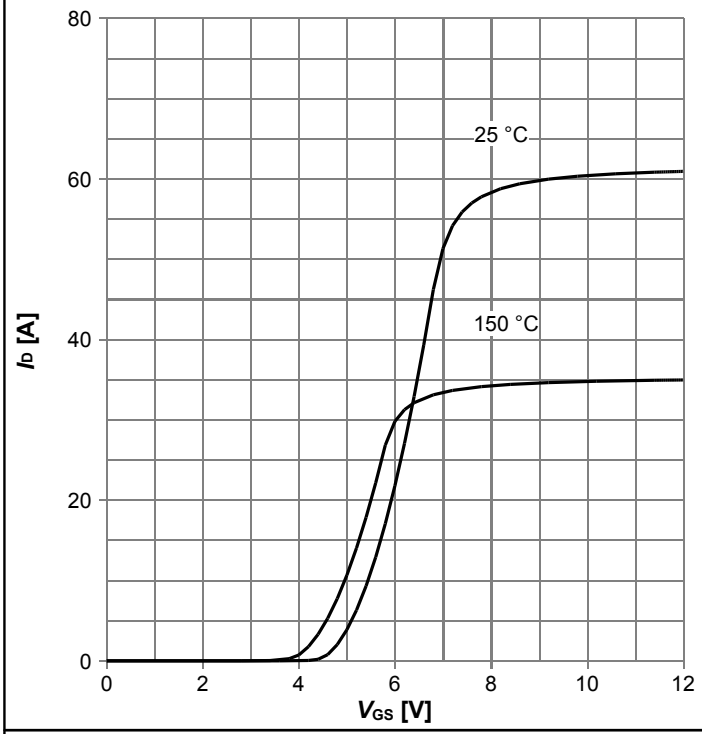

$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: $V_{GS}$

**Diagram 8: Drain-source on-state resistance**



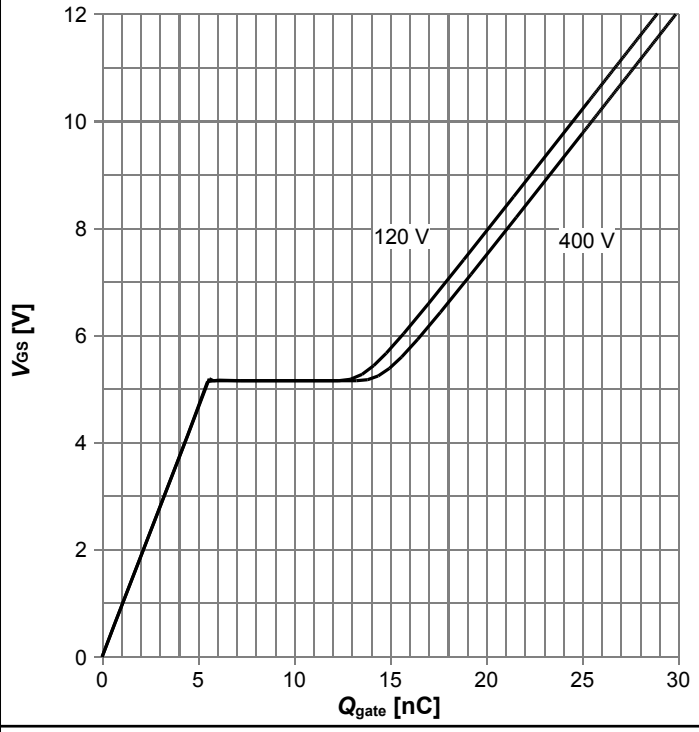

$R_{DS(on)}=f(T_j)$; $I_D=5.6$ A; $V_{GS}=10$ V

**Diagram 9: Typ. transfer characteristics**



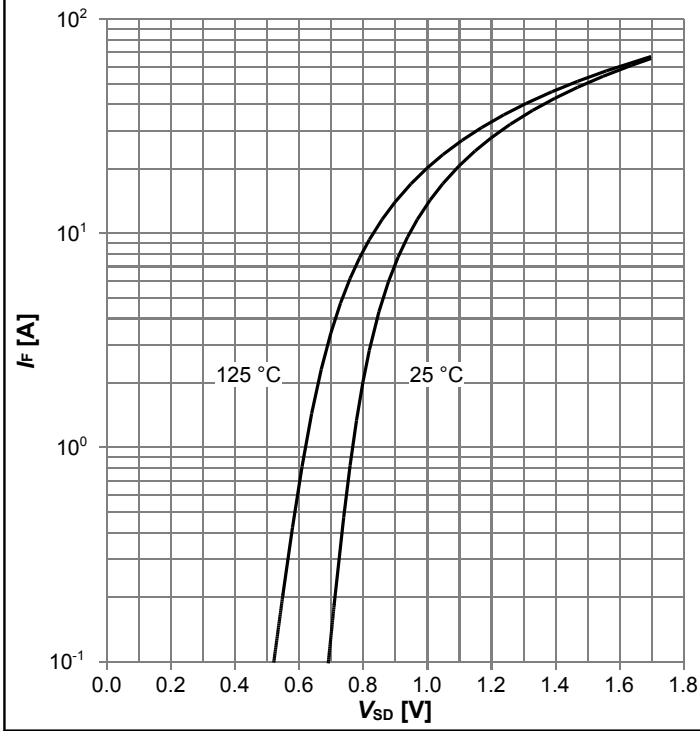

$I_D$=f($V_{GS}$); $V_{DS}$=20V; parameter: $T_j$

**Diagram 10: Typ. gate charge**



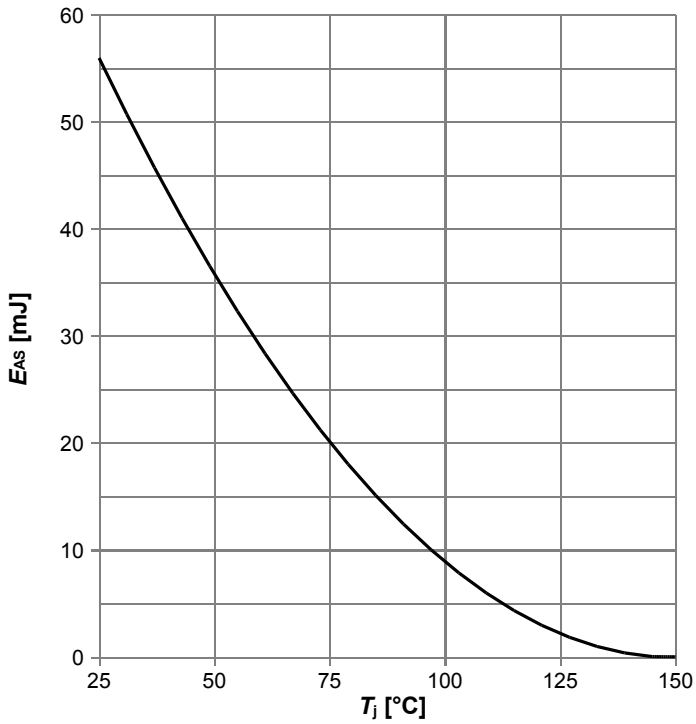

$V_{GS}$=f($Q_{gate}$); $I_D$=5.6 A pulsed; parameter: $V_{DD}$

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



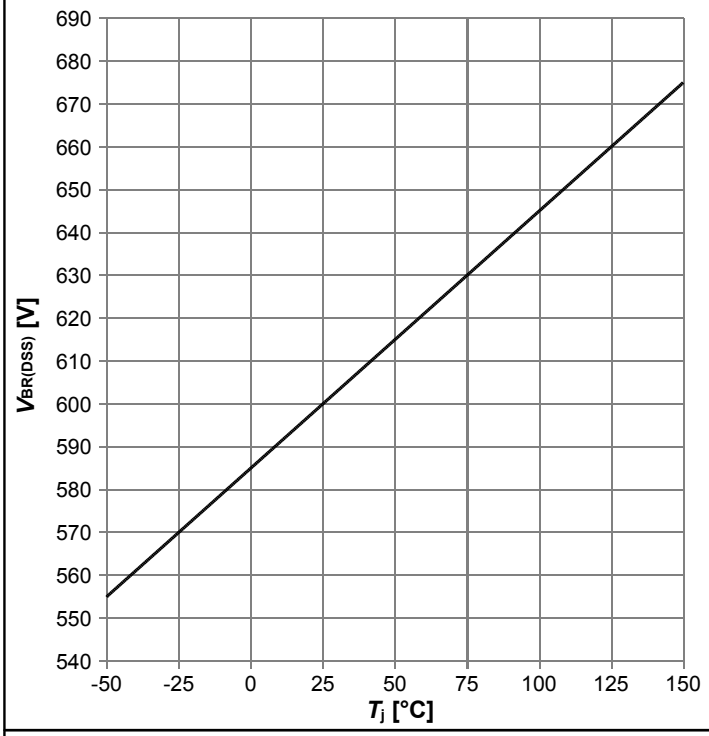

$I_F$=f($V_{SD}$); parameter: $T_j$

**Diagram 12: Avalanche energy**



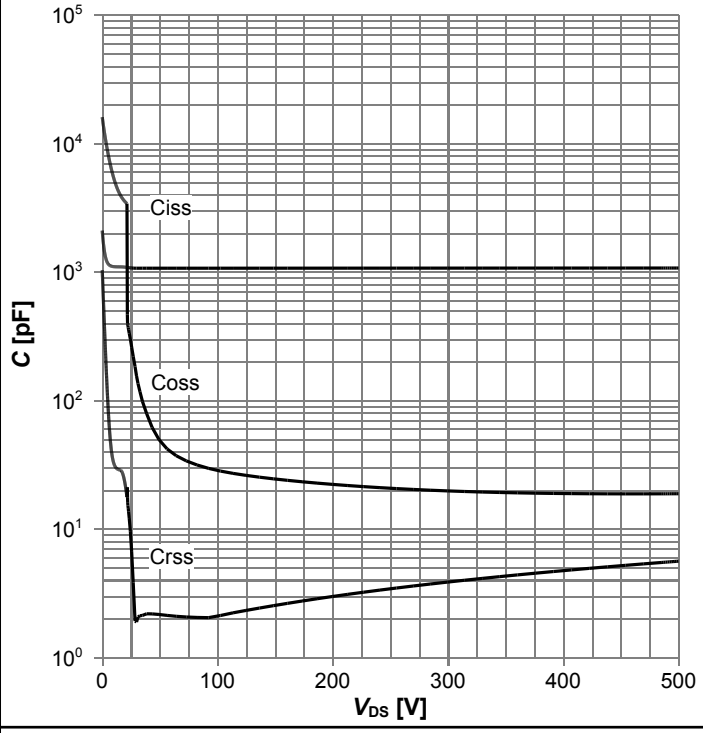

$E_{AS}$=f($T_j$); $I_D$=4.0 A; $V_{DD}$=50 V

**Diagram 13: Drain-source breakdown voltage**



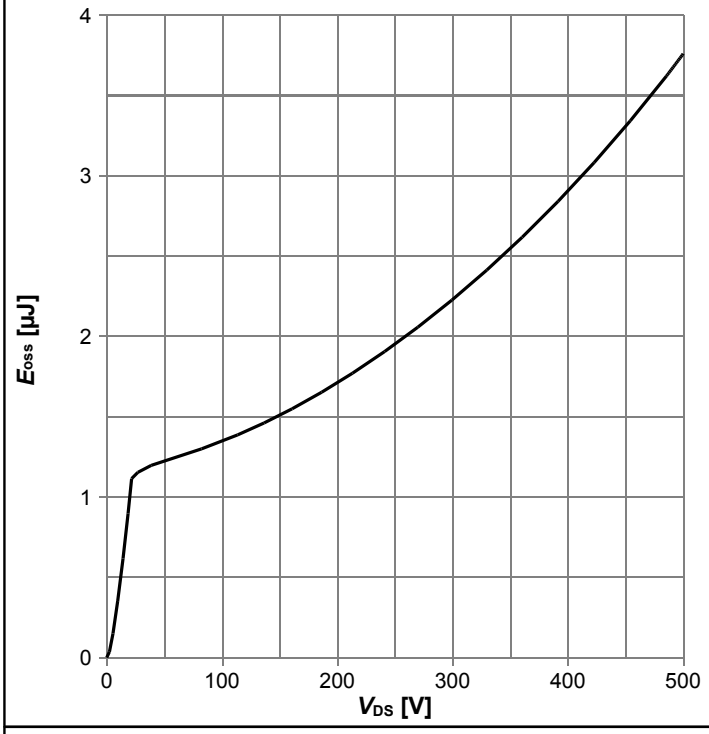

$V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA

**Diagram 14: Typ. capacitances**




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

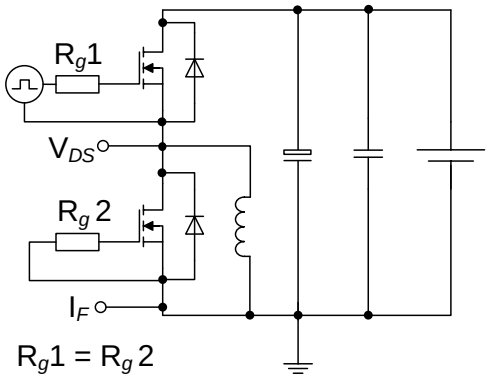
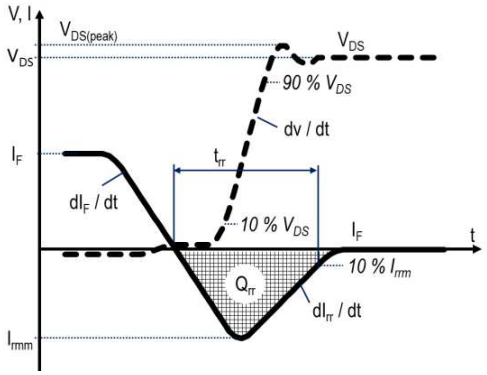
**Diagram 15: Typ. Coss stored energy**



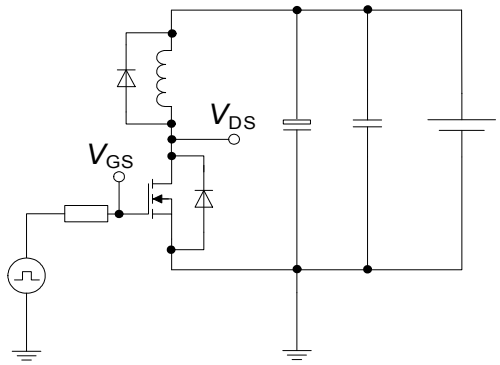
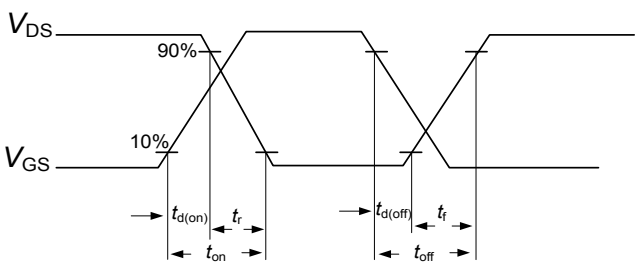

$E_{oss}$=f($V_{DS}$)

# 5 Test Circuits

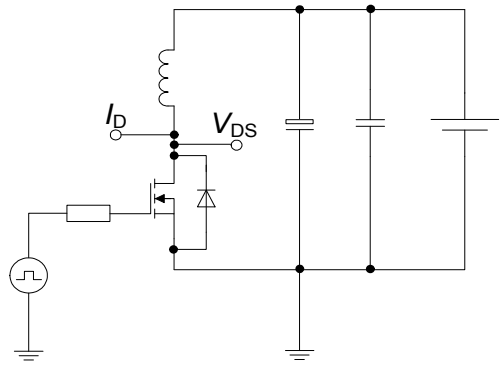
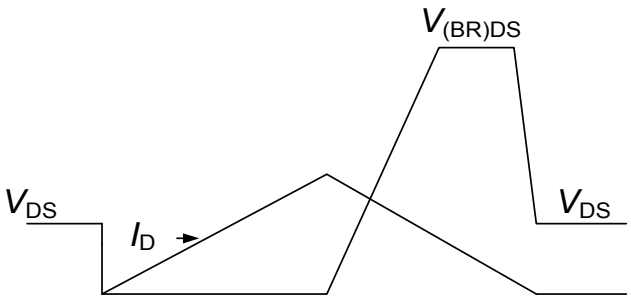
## Table 8 Diode characteristics

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

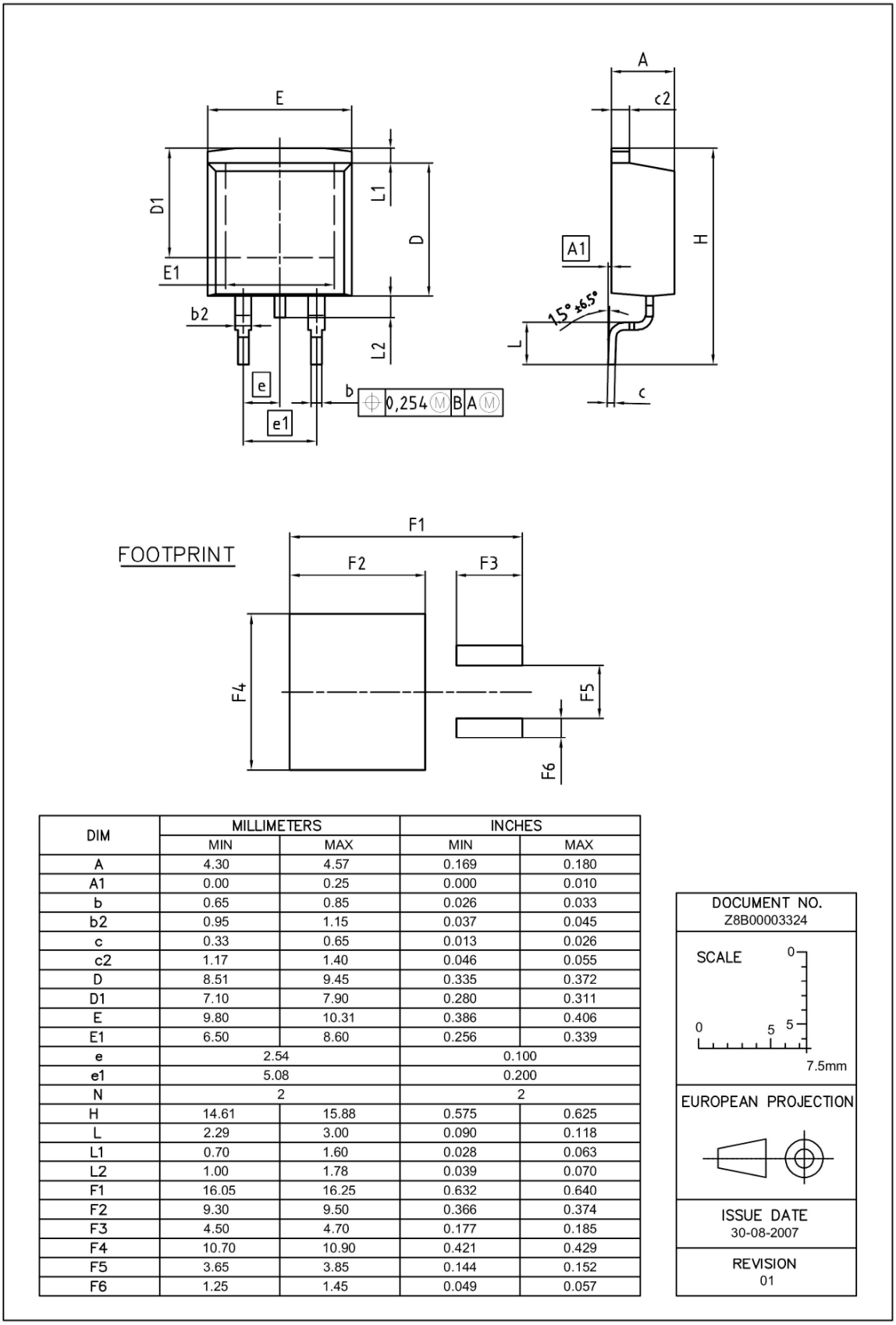
## Table 9 Switching times

| 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 | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.30 | 4.57 | 0.169 | 0.180 |
| A1 | 0.00 | 0.25 | 0.000 | 0.010 |
| b | 0.65 | 0.85 | 0.026 | 0.033 |
| b2 | 0.95 | 1.15 | 0.037 | 0.045 |
| c | 0.33 | 0.65 | 0.013 | 0.026 |
| c2 | 1.17 | 1.40 | 0.046 | 0.055 |
| D | 8.51 | 9.45 | 0.335 | 0.372 |
| D1 | 7.10 | 7.90 | 0.280 | 0.311 |
| E | 9.80 | 10.31 | 0.386 | 0.406 |
| E1 | 6.50 | 8.60 | 0.256 | 0.339 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 2 | | 2 | |
| H | 14.61 | 15.88 | 0.575 | 0.625 |
| L | 2.29 | 3.00 | 0.090 | 0.118 |
| L1 | 0.70 | 1.60 | 0.028 | 0.063 |
| L2 | 1.00 | 1.78 | 0.039 | 0.070 |
| F1 | 16.05 | 16.25 | 0.632 | 0.640 |
| F2 | 9.30 | 9.50 | 0.366 | 0.374 |
| F3 | 4.50 | 4.70 | 0.177 | 0.185 |
| F4 | 10.70 | 10.90 | 0.421 | 0.429 |
| F5 | 3.65 | 3.85 | 0.144 | 0.152 |
| F6 | 1.25 | 1.45 | 0.049 | 0.057 |

DOCUMENT NO.
Z8B00003324

SCALE 0 5 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

**Figure 1 Outline PG-TO 263-3, dimensions in mm/inches**

# 7 Appendix A

## Table 11 Related Links

- **IFX CoolMOS P7 Webpage:** www.infineon.com
- **IFX CoolMOS P7 application note:** www.infineon.com
- **IFX CoolMOS P7 simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

## Revision History

IPB60R180P7

**Revision: 2018-05-15, Rev. 2.1**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.0 | 2017-09-29 | Release of final version |
| 2.1 | 2018-05-15 | Nomenclature of product qualification grade was changed |



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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.