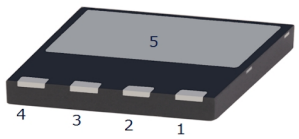
# MOSFET

## 600V CoolMOS™ C7 Power Transistor

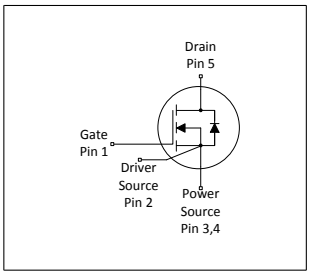
ThinPAK 8x8




CoolMOS™ C7 is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies.

600V CoolMOS™ C7 series combines the experience of the leading SJ MOSFET supplier with high class innovation.

The 600V C7 is the first technology ever with $R_{DS(on)}$*A below 1Ohm*mm².




## Features

- Suitable for hard and soft switching (PFC and high performance LLC)
- Increased MOSFET dv/dt ruggedness to 120V/ns
- Increased efficiency due to best in class FOM $R_{DS(on)}$*$E_{oss}$ and $R_{DS(on)}$*$Q_g$
- Best in class $R_{DS(on)}$ /package
- SMD package with very low parasitic inductance for easy device control
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)
- 4pin kelvin source concept

## Benefits

- Increased economies of scale by use in PFC and PWM topologies in the application
- Higher dv/dt limit enables faster switching leading to higher efficiency
- Enabling higher system efficiency by lower switching losses
- Increased power density solutions due to smaller packages
- Optimized PCB assembly and layout solutions
- Suitable for applications such as server, telecom and solar
- Up to 0.5% better full load efficiency @100kHz compared to conventional 3pin package

## Potential applications

PFC stages and PWM stages (TTF, LLC) for high power/performance SMPS e.g. Computing, Server, Telecom, UPS 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 |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 125 | mΩ |
| $Q_{g,typ}$ | 34 | nC |
| $I_{D,pulse}$ | 66 | A |
| $I_{D,continuous}$ @ $T_j$<150°C | 30 | A |
| $E_{oss}$ @ 400V | 4 | µJ |
| Body diode $di_F/dt$ | 380 | A/µs |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPL60R125C7 | PG-VSON-4 | 60C7125 | 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>- | 17<br>12 | A | $T_C$=25°C<br>$T_C$=100°C |
| Pulsed drain current[2] | $I_{D,pulse}$ | - | - | 66 | A | $T_C$=25°C |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 78 | mJ | $I_D$=4.4A; $V_{DD}$=50V; see table 10 |
| Avalanche energy, repetitive | $E_{AR}$ | - | - | 0.39 | mJ | $I_D$=4.4A; $V_{DD}$=50V; see table 10 |
| Avalanche current, single pulse | $I_{AS}$ | - | - | 4.4 | A | - |
| MOSFET dv/dt ruggedness | dv/dt | - | - | 120 | 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 | $P_{tot}$ | - | - | 103 | W | $T_C$=25°C |
| Storage temperature | $T_{stg}$ | -40 | - | 150 | °C | - |
| Operating junction temperature | $T_j$ | -40 | - | 150 | °C | - |
| Mounting torque | - | - | - | n.a. | Ncm | - |
| Continuous diode forward current | $I_S$ | - | - | 17 | A | $T_C$=25°C |
| Diode pulse current[2] | $I_{S,pulse}$ | - | - | 66 | A | $T_C$=25°C |
| Reverse diode dv/dt[3] | dv/dt | - | - | 20 | V/ns | $V_{DS}$=0...400V, $I_{SD}$<=6.7A, $T_j$=25°C see table 8 |
| Maximum diode commutation speed | $di_F/dt$ | - | - | 380 | A/µs | $V_{DS}$=0...400V, $I_{SD}$<=6.7A, $T_j$=25°C see table 8 |
| Insulation withstand voltage | $V_{ISO}$ | - | - | n.a. | V | $V_{rms}$, $T_C$=25°C, $t$=1min |

[1] Limited by $T_{j\,max}$.
[2] Pulse width $t_p$ limited by $T_{j,max}$
[3] Identical low side and high side switch

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 1.216 | °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. |
| Reflow soldering temperature | $T_{sold}$ | - | - | 260 | °C | reflow MSL2a |

# 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 | $V_{DS}$=$V_{GS}$, $I_D$=0.39mA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | -<br>10 | 1<br>- | µA | $V_{DS}$=600, $V_{GS}$=0V, $T_j$=25°C<br>$V_{DS}$=600, $V_{GS}$=0V, $T_j$=150°C |
| Gate-source leakage current | $I_{GSS}$ | - | - | 100 | nA | $V_{GS}$=20V, $V_{DS}$=0V |
| Drain-source on-state resistance | $R_{DS(on)}$ | -<br>- | 0.108<br>0.240 | 0.125<br>- | Ω | $V_{GS}$=10V, $I_D$=7.8A, $T_j$=25°C<br>$V_{GS}$=10V, $I_D$=7.8A, $T_j$=150°C |
| Gate resistance | $R_G$ | - | 0.83 | - | Ω | $f$=1MHz, open drain |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 1500 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Output capacitance | $C_{oss}$ | - | 27 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Effective output capacitance, energy related[1)] | $C_{o(er)}$ | - | 50 | - | pF | $V_{GS}$=0V, $V_{DS}$=0...400V |
| Effective output capacitance, time related[2)] | $C_{o(tr)}$ | - | 515 | - | pF | $I_D$=constant, $V_{GS}$=0V, $V_{DS}$=0...400V |
| Turn-on delay time | $t_{d(on)}$ | - | 9.6 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=7.8A, $R_G$=5.3Ω; see table 9 |
| Rise time | $t_r$ | - | 4 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=7.8A, $R_G$=5.3Ω; see table 9 |
| Turn-off delay time | $t_{d(off)}$ | - | 45 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=7.8A, $R_G$=5.3Ω; see table 9 |
| Fall time | $t_f$ | - | 4 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=7.8A, $R_G$=5.3Ω; see table 9 |

## Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 8 | - | nC | $V_{DD}$=400V, $I_D$=7.8A, $V_{GS}$=0 to 10V |
| Gate to drain charge | $Q_{gd}$ | - | 11 | - | nC | $V_{DD}$=400V, $I_D$=7.8A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 34 | - | nC | $V_{DD}$=400V, $I_D$=7.8A, $V_{GS}$=0 to 10V |
| Gate plateau voltage | $V_{plateau}$ | - | 5.0 | - | V | $V_{DD}$=400V, $I_D$=7.8A, $V_{GS}$=0 to 10V |

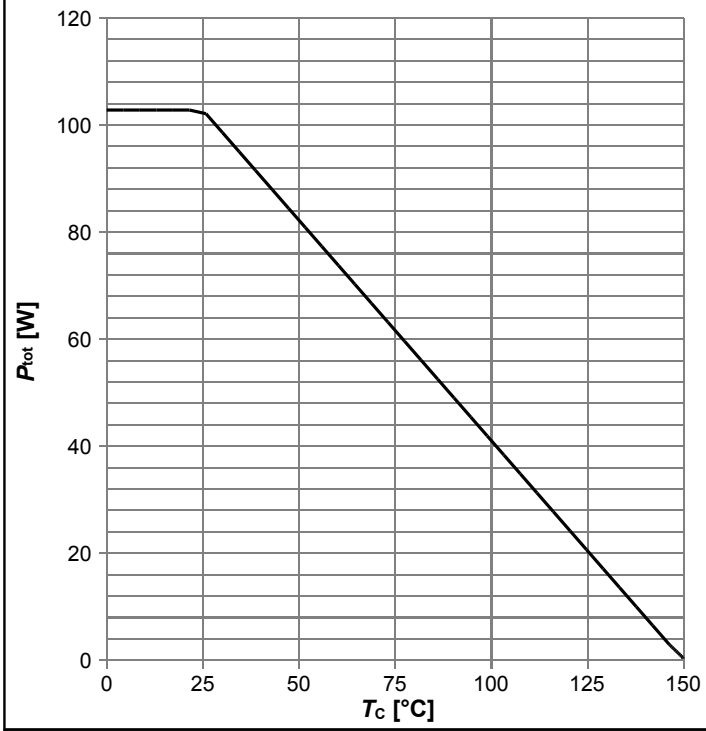
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V

## 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, $I_F$=7.8A, $T_j$=25°C |
| Reverse recovery time | $t_{rr}$ | - | 310 | - | ns | $V_R$=400V, $I_F$=7.8A, d$i_F$/d$t$=100A/µs; see table 8 |
| Reverse recovery charge | $Q_{rr}$ | - | 3.5 | - | µC | $V_R$=400V, $I_F$=7.8A, d$i_F$/d$t$=100A/µs; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | - | 24 | - | A | $V_R$=400V, $I_F$=7.8A, d$i_F$/d$t$=100A/µs; see table 8 |

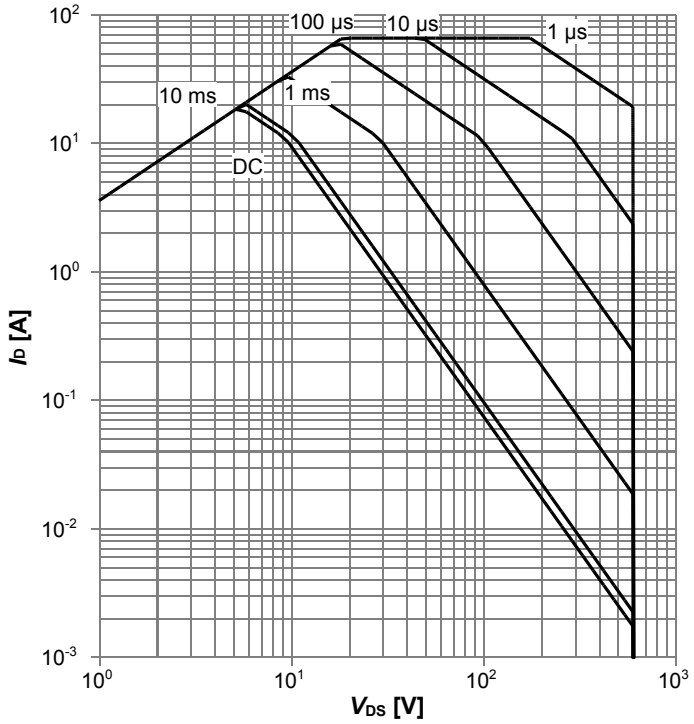
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



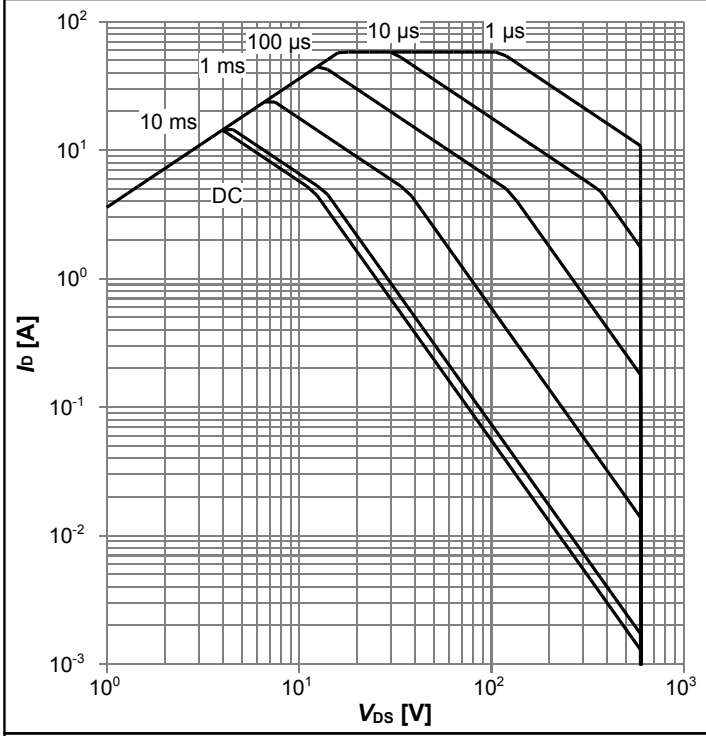

$P_{tot}=f(T_C)$

**Diagram 2: Safe operating area**



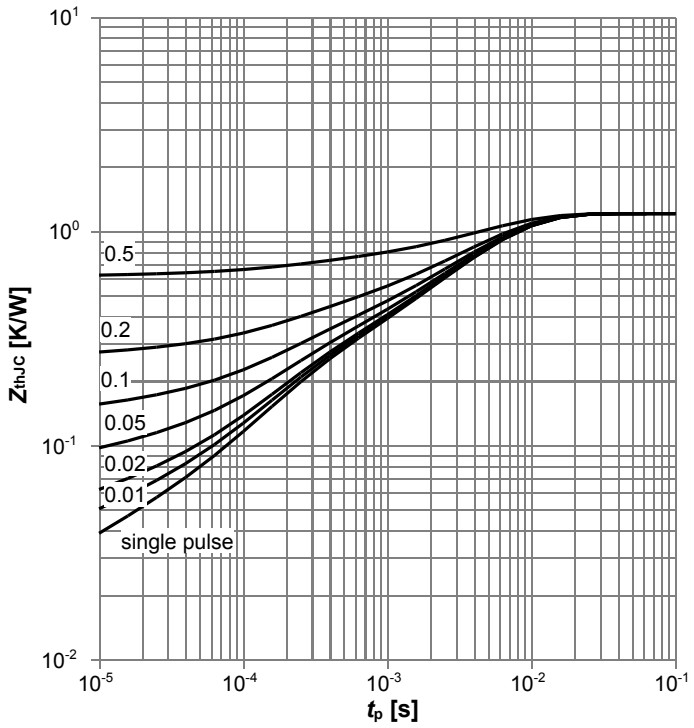

$I_D=f(V_{DS})$; $T_C$=25 °C; $D$=0; parameter: $t_p$

**Diagram 3: Safe operating area**



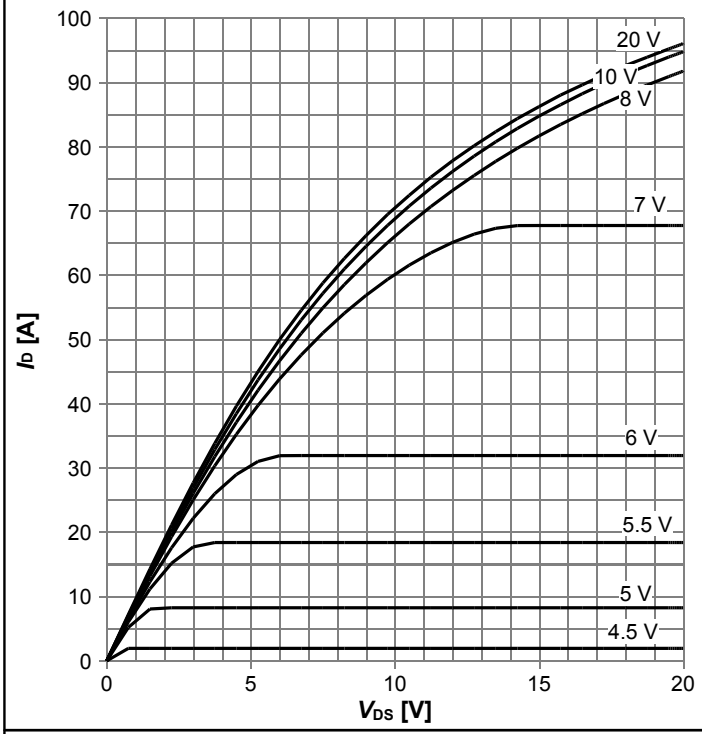

$I_D=f(V_{DS})$; $T_C$=80 °C; $D$=0; parameter: $t_p$

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



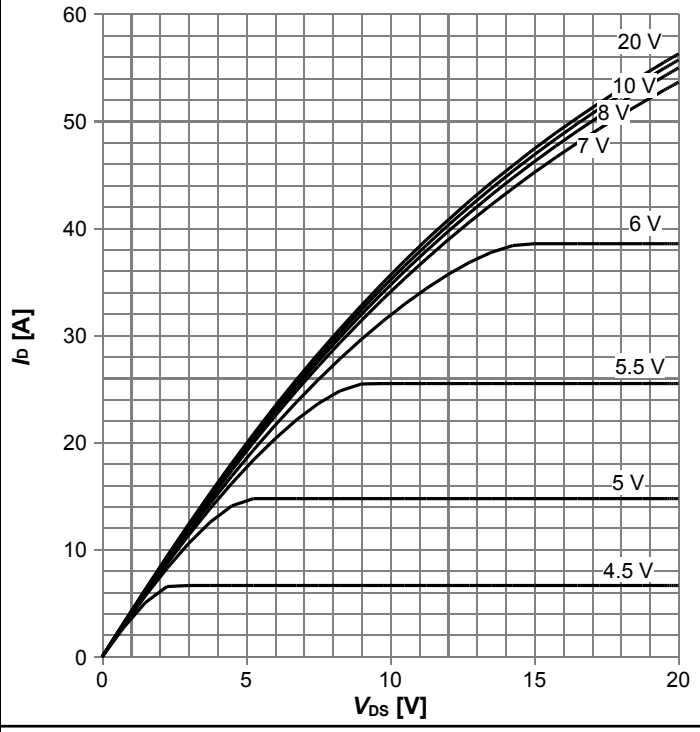

$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



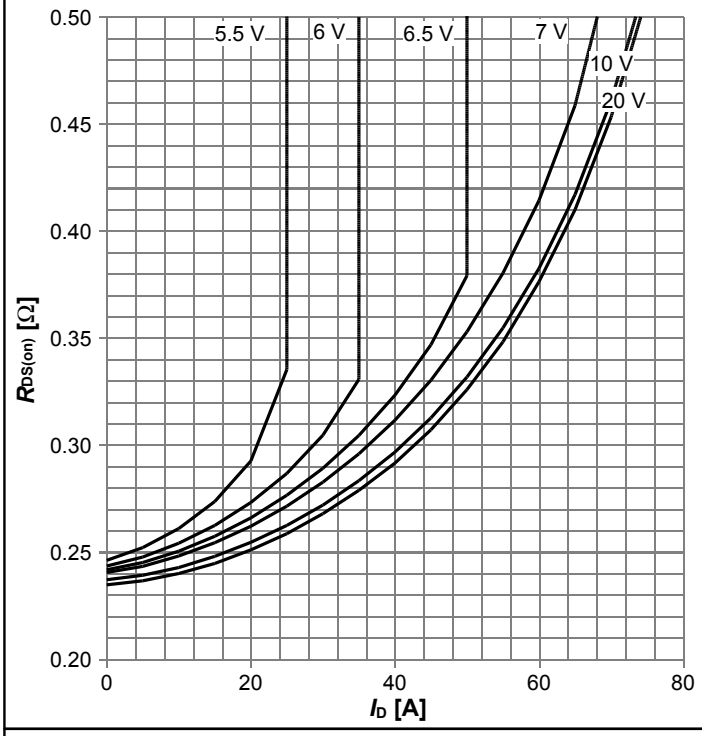

$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**



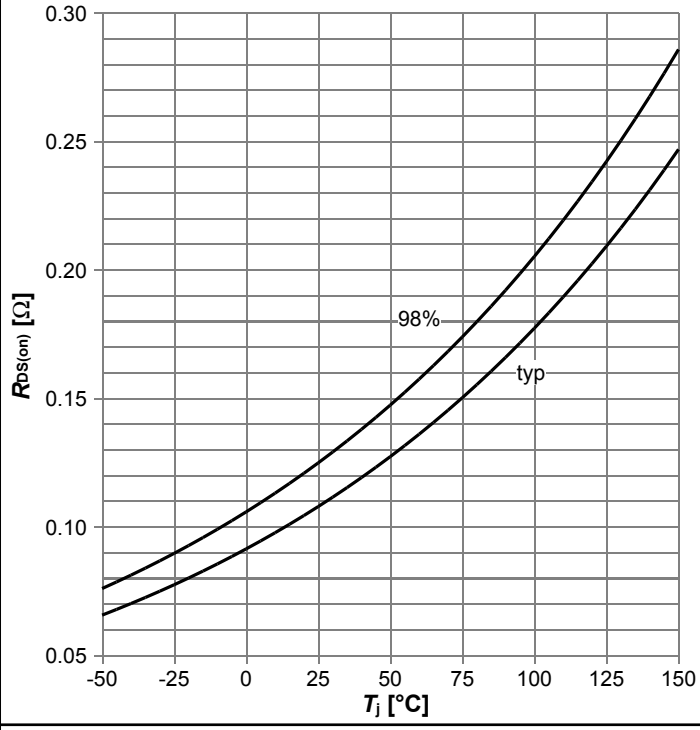

$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: $V_{GS}$

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



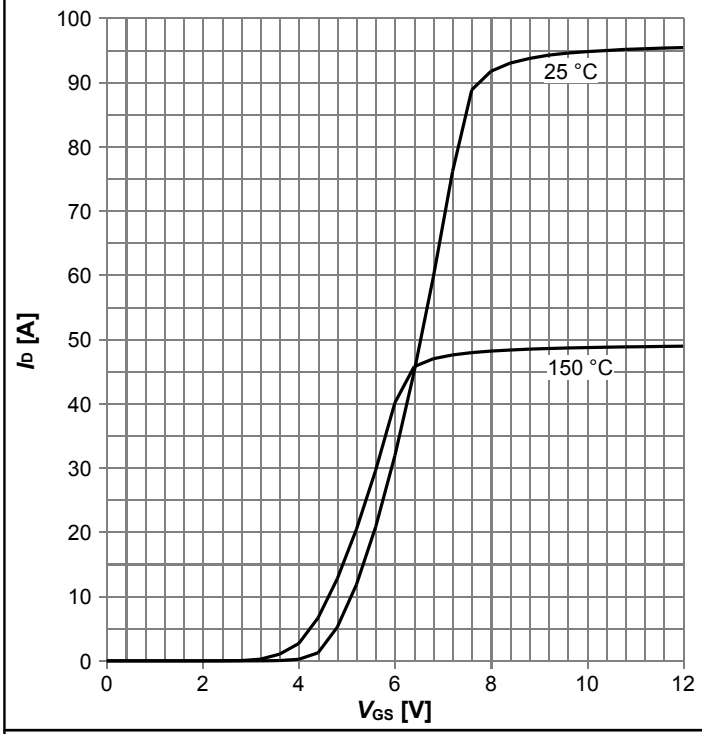

$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: $V_{GS}$

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



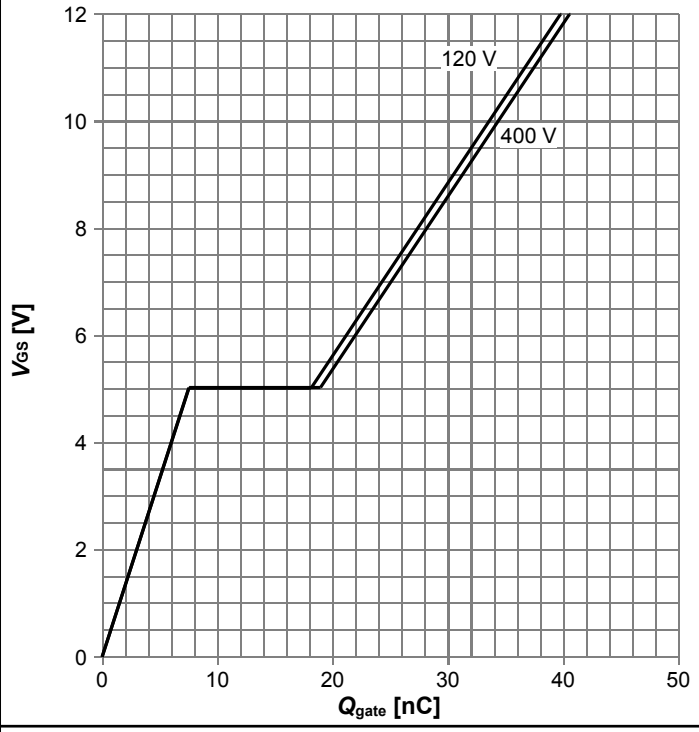

$R_{DS(on)}=f(T_j)$; $I_D=7.8$ A; $V_{GS}=10$ V

**Diagram 9: Typ. transfer characteristics**



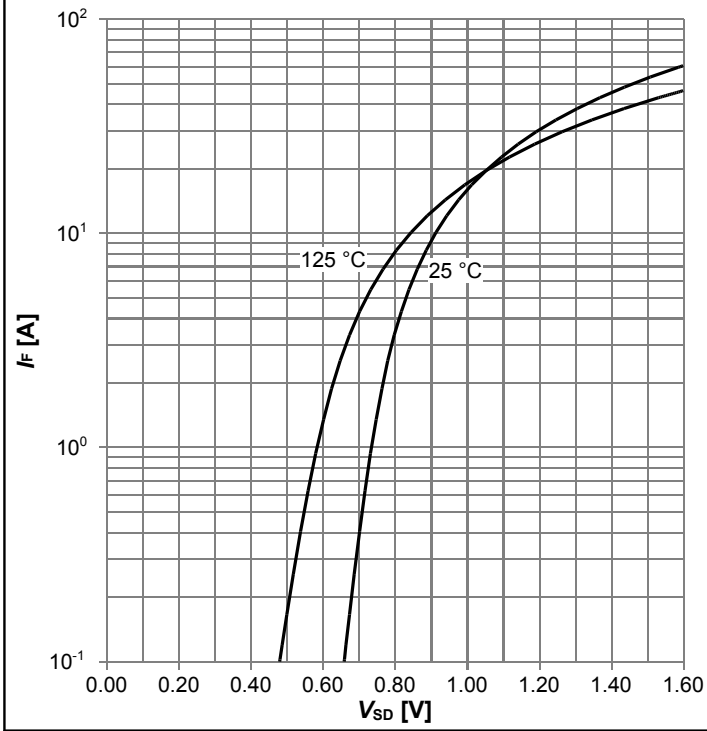

$I_D$=f($V_{GS}$); $V_{DS}$=20V; parameter: $T_j$

**Diagram 10: Typ. gate charge**



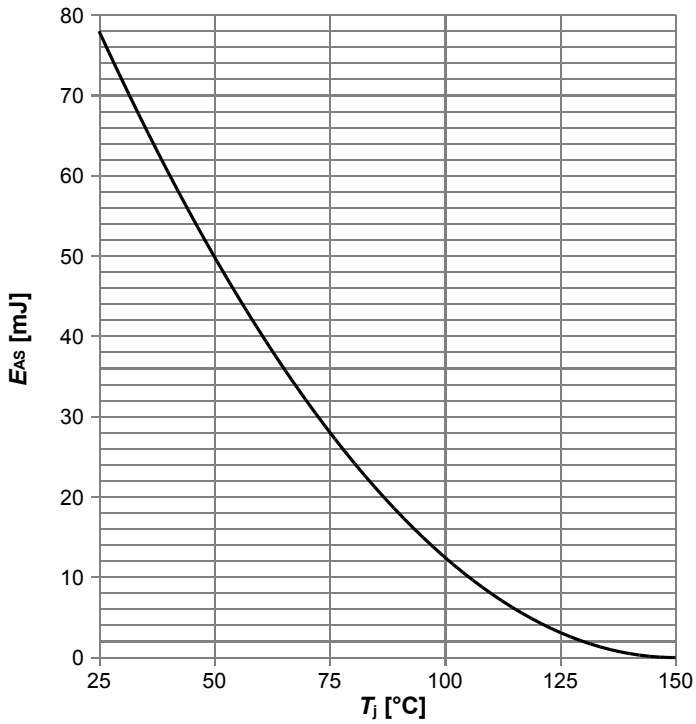

$V_{GS}$=f($Q_{gate}$); $I_D$=7.8 A pulsed; parameter: $V_{DD}$

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



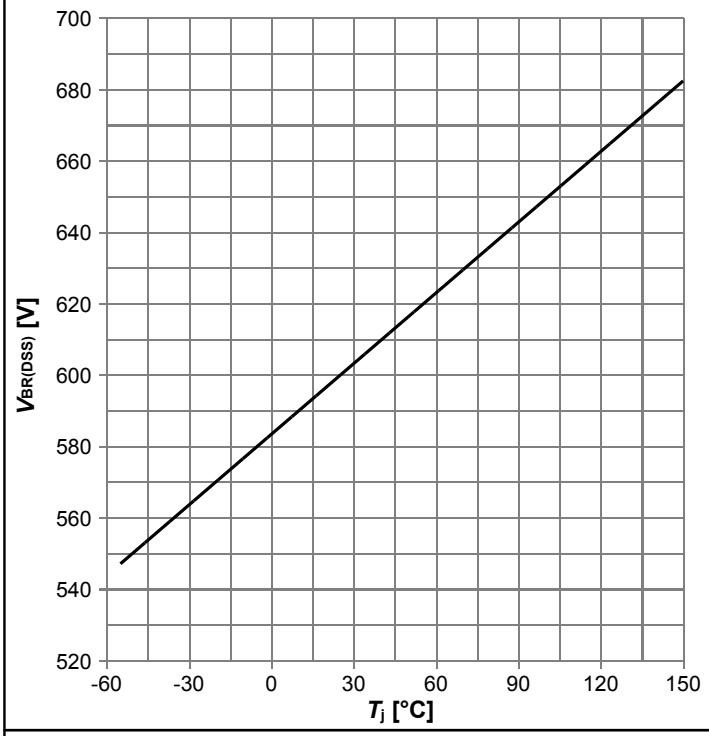

$I_F$=f($V_{SD}$); parameter: $T_j$

**Diagram 12: Avalanche energy**



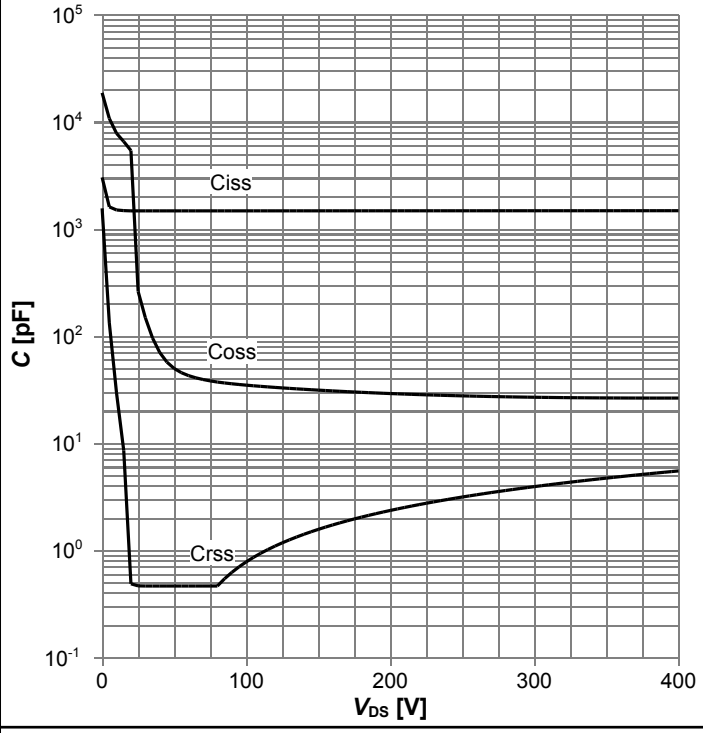

$E_{AS}$=f($T_j$); $I_D$=4.4 A; $V_{DD}$=50 V

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



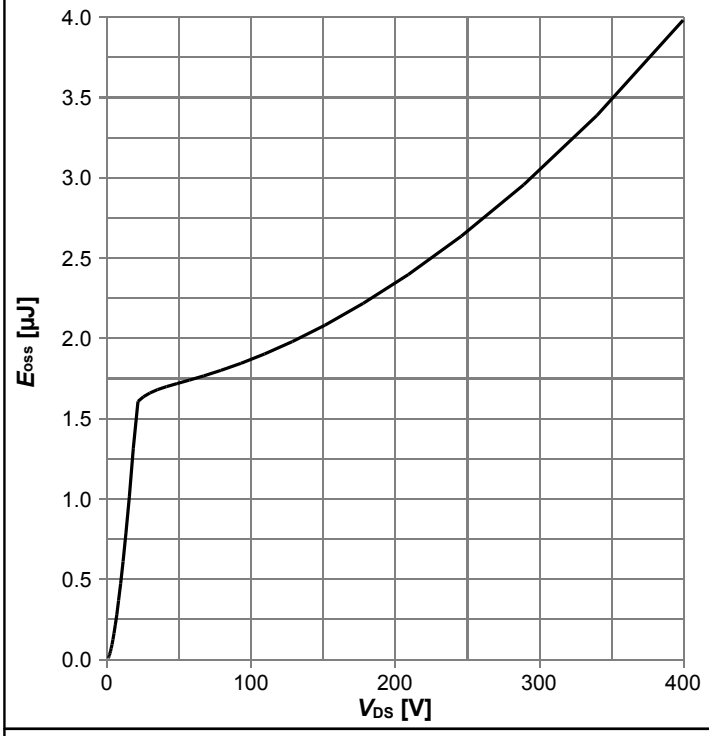

$V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA

**Diagram 14: Typ. capacitances**




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

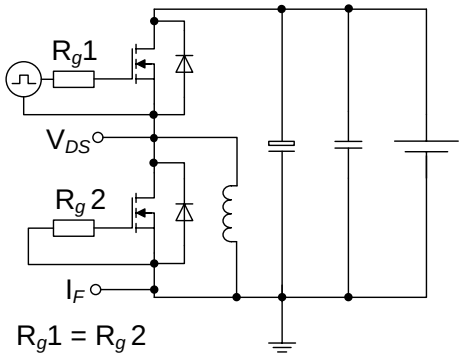
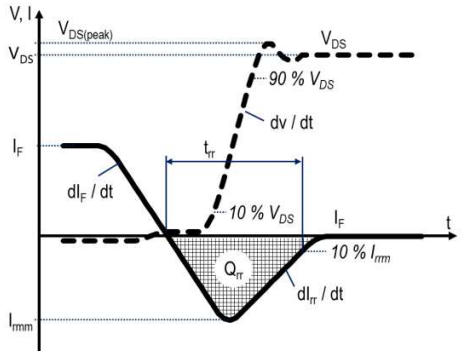
**Diagram 15: Typ. Coss stored energy**



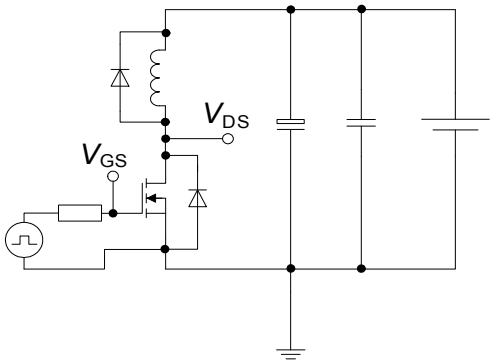
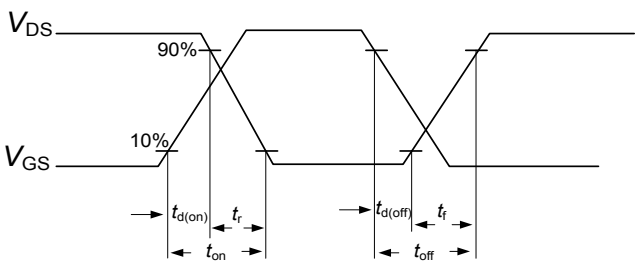

$E_{oss}$=f($V_{DS}$)

# 5 Test Circuits

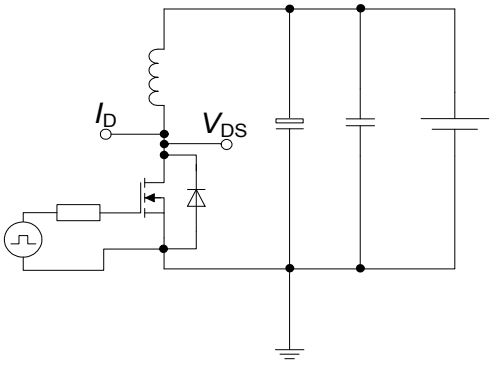
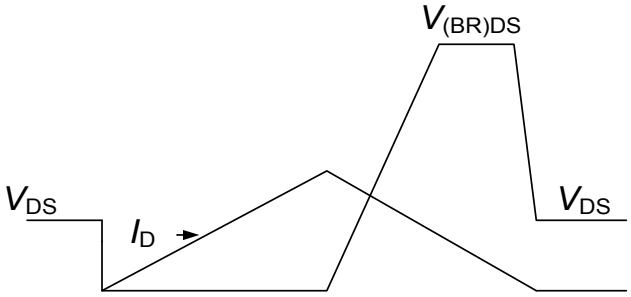
## Table 8 Diode characteristics

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

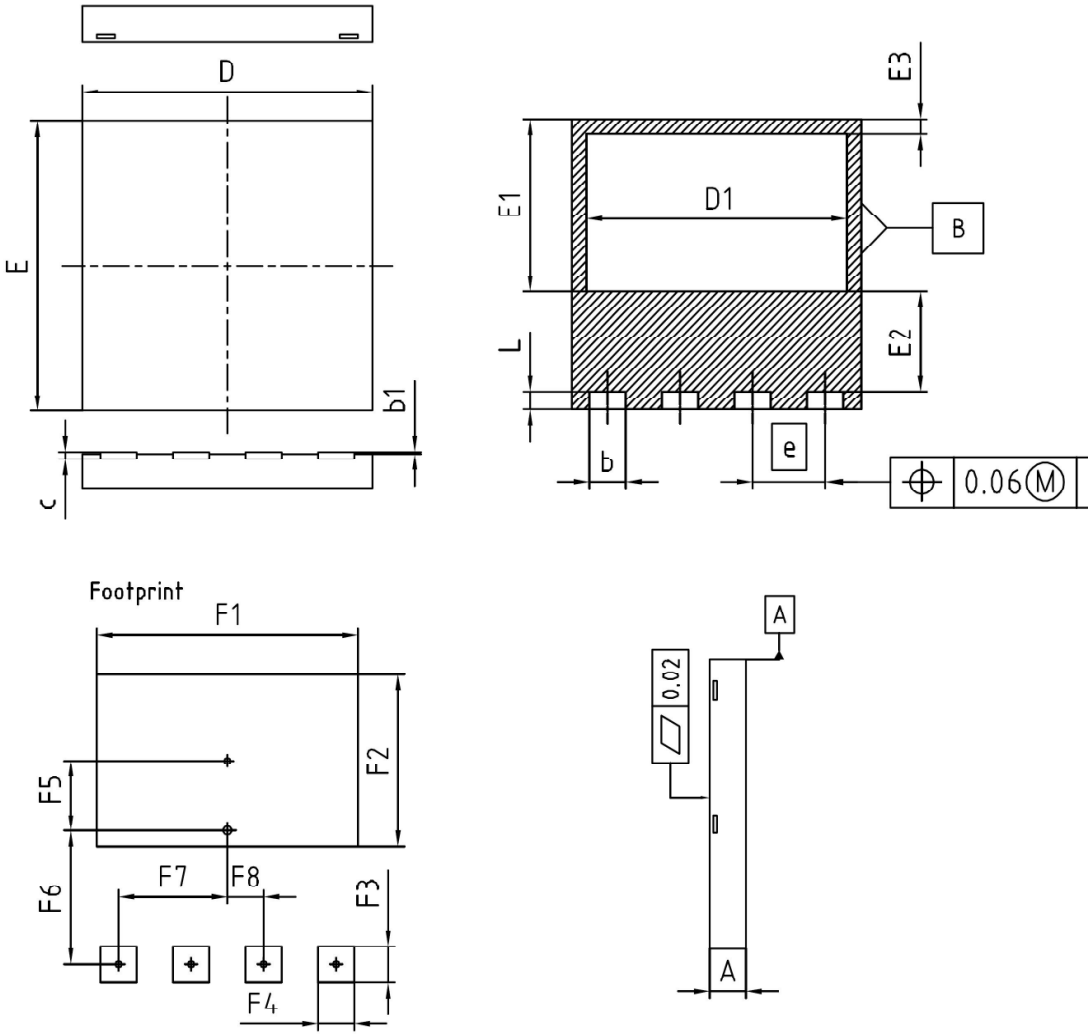
## Table 9 switching times (ss)

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

## Table 10 Unclamped inductive load (ss)

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

# 6 Package Outlines




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.90 | 1.10 | 0.035 | 0.043 |
| b | 0.90 | 1.10 | 0.035 | 0.043 |
| b1 | 0.00 | 0.05 | 0.000 | 0.002 |
| c | 0.10 | 0.30 | 0.004 | 0.012 |
| D | 7.90 | 8.10 | 0.311 | 0.319 |
| D1 | 7.10 | 7.30 | 0.280 | 0.287 |
| E | 7.90 | 8.10 | 0.311 | 0.319 |
| E1 | 4.65 | 4.85 | 0.183 | 0.191 |
| E2 | 2.65 | 2.85 | 0.104 | 0.112 |
| E3 | 0.30 | 0.50 | 0.012 | 0.020 |
| e | 2.00 (BSC) | | 0.079 (BSC) | |
| L | 0.40 | 0.60 | 0.016 | 0.024 |
| N | 4 | | 4 | |
| F1 | 7.20 | | 0.283 | |
| F2 | 4.75 | | 0.187 | |
| F3 | 1.00 | | 0.039 | |
| F4 | 1.00 | | 0.039 | |
| F5 | 1.43 | | 0.056 | |
| F6 | 4.20 | | 0.165 | |
| F7 | 3.00 | | 0.118 | |
| F8 | 1.00 | | 0.039 | |

DOCUMENT NO.
Z8B00156707

SCALE 0 2.5 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
05-04-2010

REVISION
01

**Figure 1 Outline PG-VSON-4, dimensions in mm/inches**

# 7 Appendix A

## Table 11 Related Links

- **IFX CoolMOS™ C7 Webpage:** www.infineon.com
- **IFX CoolMOS™ C7 application note:** www.infineon.com
- **IFX CoolMOS™ C7 simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

## Revision History

IPL60R125C7

**Revision: 2017-08-30, Rev. 2.1**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.0 | 2015-12-11 | Release of final version |
| 2.1 | 2017-08-30 | Updated MSL |



**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**

**Published by**
**Infineon Technologies AG**
**81726 München, Germany**


**Legal Disclaimer**
The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics (“Beschaffenheitsgarantie”) .

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, 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.
In addition, any information given in this document is subject to customer’s compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer’s products and any use of the product of Infineon Technologies in customer’s applications.
The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

**Information**
For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (**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.