# MOSFET

## 600V CoolMOS™ C7 Power Transistor

TO-247

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.

1  2  3

## 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
• Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)

Drain
Pin 2, Tab

Gate
Pin 1

Source
Pin 3

## 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
• Suitable for applications such as server, telecom and solar
• Higher switching frequencies possible without loss in efficiency due to low Eoss and Qg

RoHS

## 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.*
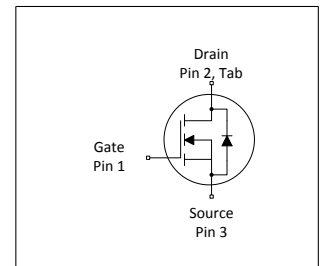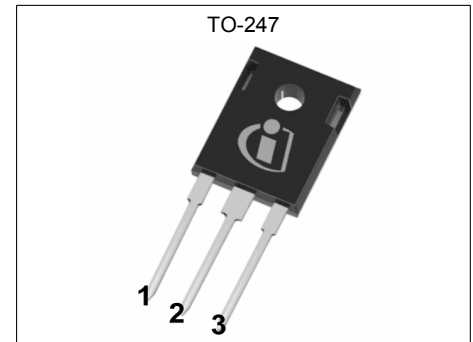
## Table 1    Key Performance Parameters

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 17 | mΩ |
| $Q_{g,typ}$ | 240 | nC |
| $I_{D,pulse}$ | 495 | A |
| $I_{D,continuous}$ @ $T_j$<150°C | 129 | A |
| $E_{oss}$@400V | 30 | μJ |
| Body diode di/dt | 200 | A/μs |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPW60R017C7 | PG-TO 247 | 60C7017 | 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>- | 109<br>69 | A | $T_C$=25°C<br>$T_C$=100°C |
| Pulsed drain current[2] | $I_{D,pulse}$ | - | - | 495 | A | $T_C$=25°C |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 582 | mJ | $I_D$=12.6A; $V_{DD}$=50V; see table 10 |
| Avalanche energy, repetitive | $E_{AR}$ | - | - | 2.91 | mJ | $I_D$=12.6A; $V_{DD}$=50V; see table 10 |
| Avalanche current, single pulse | $I_{AS}$ | - | - | 12.6 | 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 | $P_{tot}$ | - | - | 446 | W | $T_C$=25°C |
| Storage temperature | $T_{stg}$ | -55 | - | 150 | °C | - |
| Operating junction temperature | $T_j$ | -55 | - | 150 | °C | - |
| Mounting torque | - | - | - | 60 | Ncm | M3 and M3.5 screws |
| Continuous diode forward current | $I_S$ | - | - | 109 | A | $T_C$=25°C |
| Diode pulse current[2] | $I_{S,pulse}$ | - | - | 495 | A | $T_C$=25°C |
| Reverse diode dv/dt[3] | dv/dt | - | - | 20 | V/ns | $V_{DS}$=0...400V, $I_{SD}$<=12.6A, $T_j$=25°C<br>see table 8 |
| Maximum diode commutation speed | $di_f$/dt | - | - | 200 | A/µs | $V_{DS}$=0...400V, $I_{SD}$<=12.6A, $T_j$=25°C<br>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 | $R_{thJC}$ | - | - | 0.28 | °C/W | - |
| Thermal resistance, junction  - ambient | $R_{thJA}$ | - | - | 62 | °C/W | leaded |
| Thermal resistance, junction  - ambient for SMD version | $R_{thJA}$ | - | - | - | °C/W | n.a. |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ | - | - | 260 | °C | 1.6mm (0.063 in.) from case for 10s |

# 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 | $V_{DS}$=$V_{GS}$, $I_D$=2.91mA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | -<br>50 | 2<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>- | 0.015<br>0.033 | 0.017<br>- | Ω | $V_{GS}$=10V, $I_D$=58.2A, $T_j$=25°C<br>$V_{GS}$=10V, $I_D$=58.2A, $T_j$=150°C |
| Gate resistance | $R_G$ | - | 0.45 | - | Ω | $f$=1MHz, open drain |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 9890 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Output capacitance | $C_{oss}$ | - | 200 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Effective output capacitance, energy related[1] | $C_{o(er)}$ | - | 375 | - | pF | $V_{GS}$=0V, $V_{DS}$=0...400V |
| Effective output capacitance, time related[2] | $C_{o(tr)}$ | - | 3840 | - | pF | $I_D$=constant, $V_{GS}$=0V, $V_{DS}$=0...400V |
| Turn-on delay time | $t_{d(on)}$ | - | 30 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=58.2A, $R_G$=1.8Ω; see table 9 |
| Rise time | $t_r$ | - | 25 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=58.2A, $R_G$=1.8Ω; see table 9 |
| Turn-off delay time | $t_{d(off)}$ | - | 106 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=58.2A, $R_G$=1.8Ω; see table 9 |
| Fall time | $t_f$ | - | 4 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=58.2A, $R_G$=1.8Ω; see table 9 |

## Table 6 Gate charge characteristics

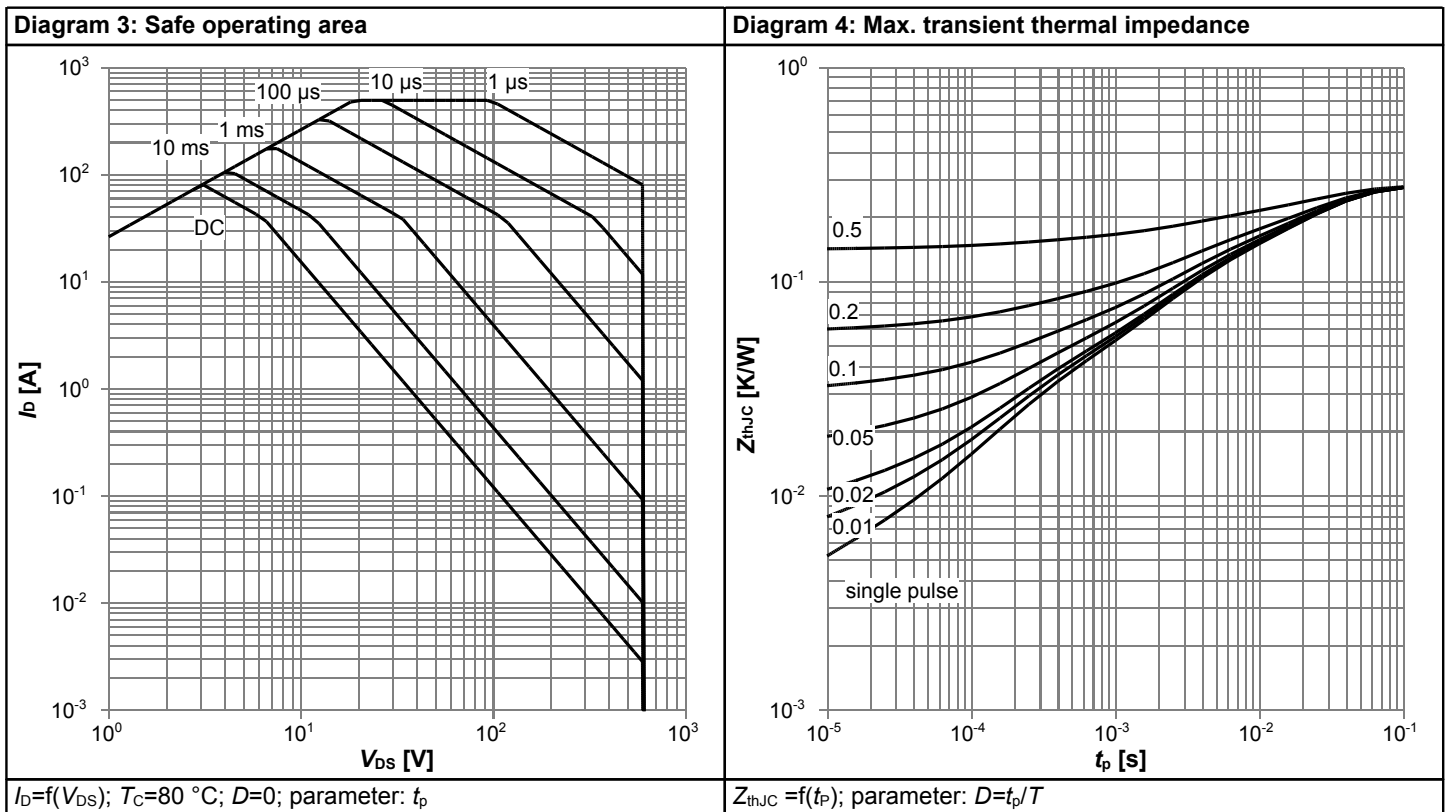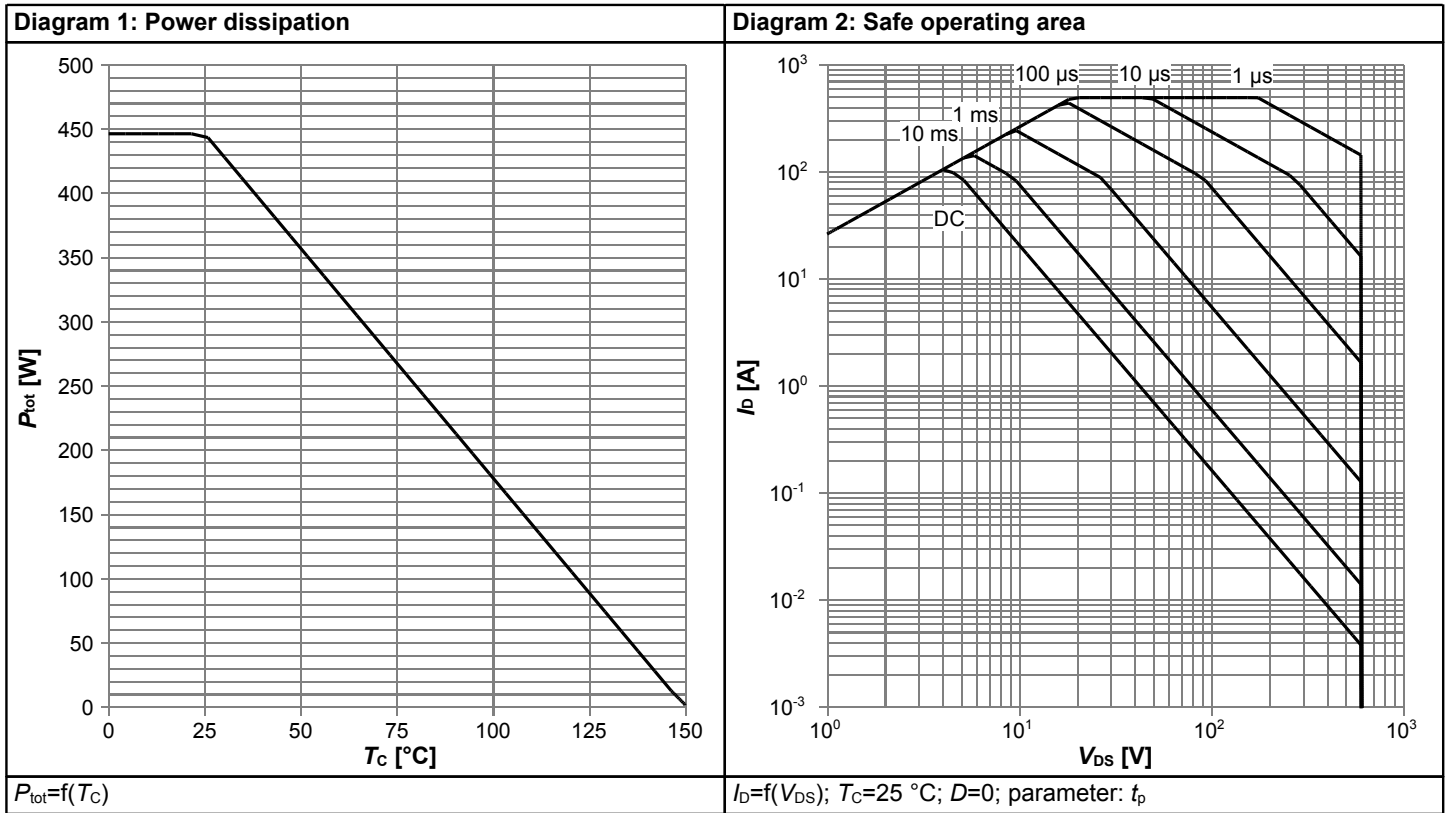| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 50 | - | nC | $V_{DD}$=400V, $I_D$=58.2A, $V_{GS}$=0 to 10V |
| Gate to drain charge | $Q_{gd}$ | - | 85 | - | nC | $V_{DD}$=400V, $I_D$=58.2A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 240 | - | nC | $V_{DD}$=400V, $I_D$=58.2A, $V_{GS}$=0 to 10V |
| Gate plateau voltage | $V_{plateau}$ | - | 5.0 | - | V | $V_{DD}$=400V, $I_D$=58.2A, $V_{GS}$=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, $I_F$=58.2A, $T_j$=25°C |
| Reverse recovery time | $t_{rr}$ | - | 630 | - | ns | $V_R$=400V, $I_F$=58.2A, d$i_F$/d$t$=100A/µs; see table 8 |
| Reverse recovery charge | $Q_{rr}$ | - | 18 | - | µC | $V_R$=400V, $I_F$=58.2A, d$i_F$/d$t$=100A/µs; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | - | 55 | - | A | $V_R$=400V, $I_F$=58.2A, 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**
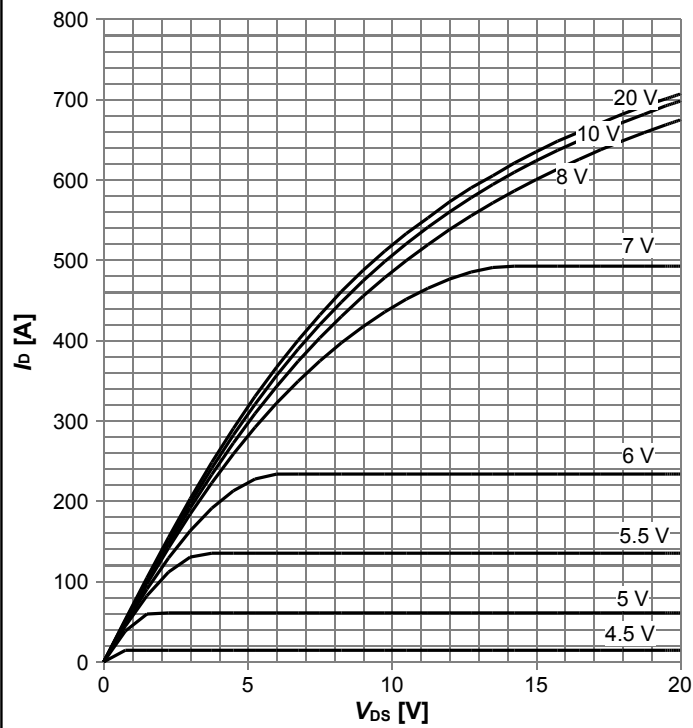


$I_D$=f($V_{DS}$); $T_j$=25 °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**
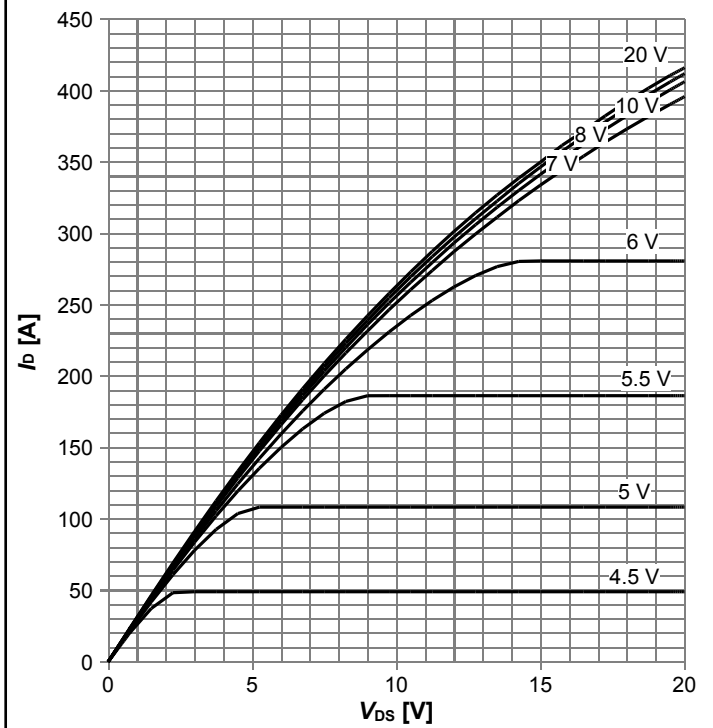


$I_D$=f($V_{DS}$); $T_j$=125 °C; parameter: $V_{GS}$

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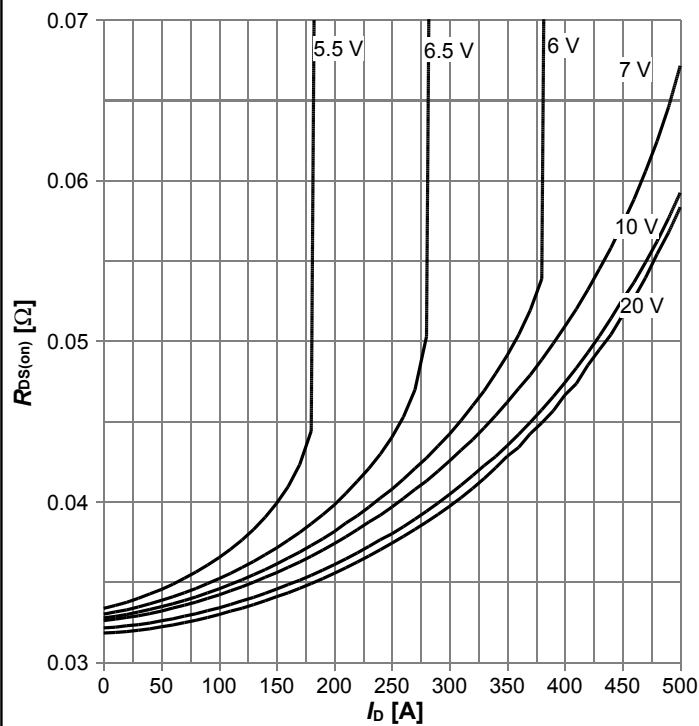


$R_{DS(on)}$=f($I_D$); $T_j$=125 °C; parameter: $V_{GS}$

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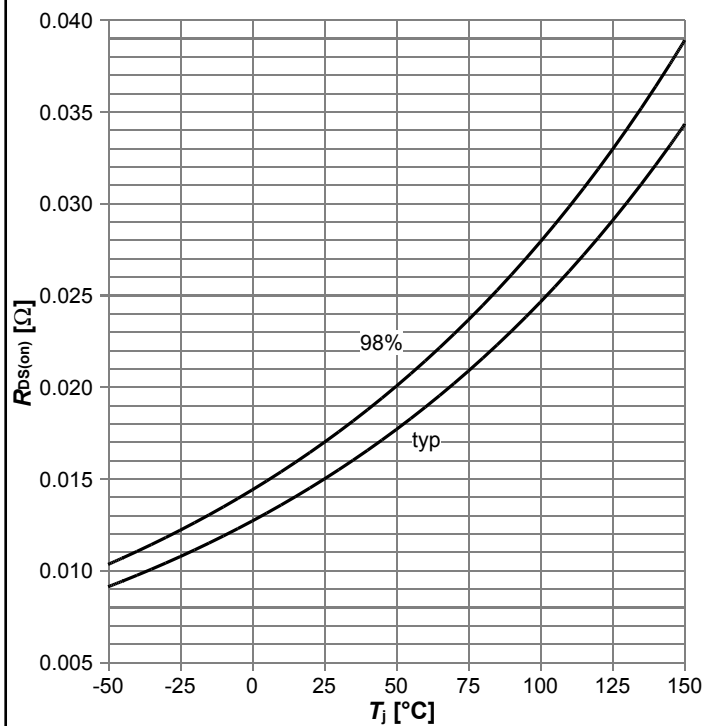


$R_{DS(on)}$=f($T_j$); $I_D$=58.2A; $V_{GS}$=10 V
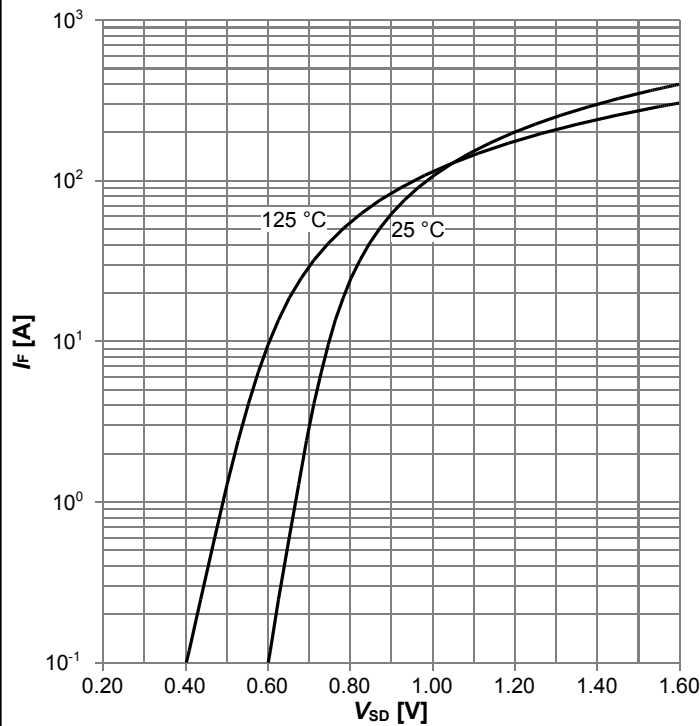
**Diagram 9: Typ. transfer characteristics**
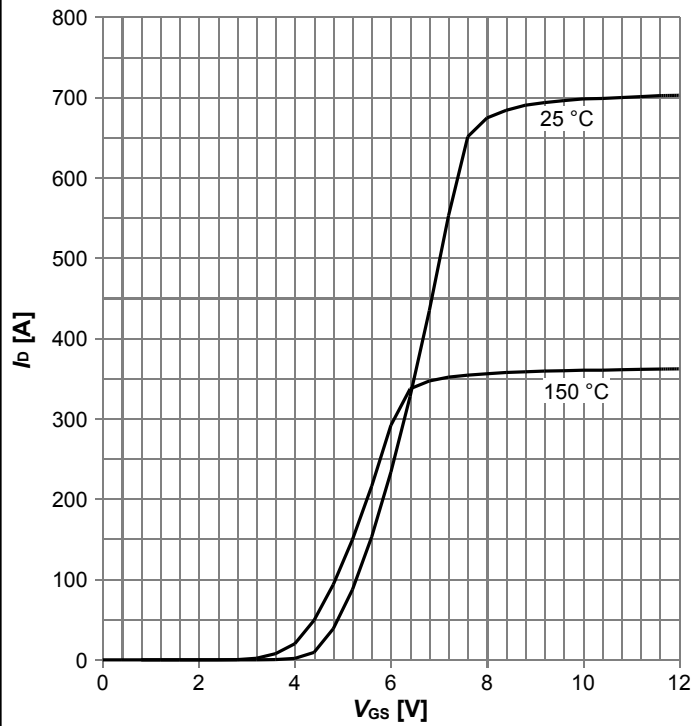


$I_D$=f($V_{GS}$); $V_{DS}$=20V; parameter: $T_j$

**Diagram 10: Typ. gate charge**
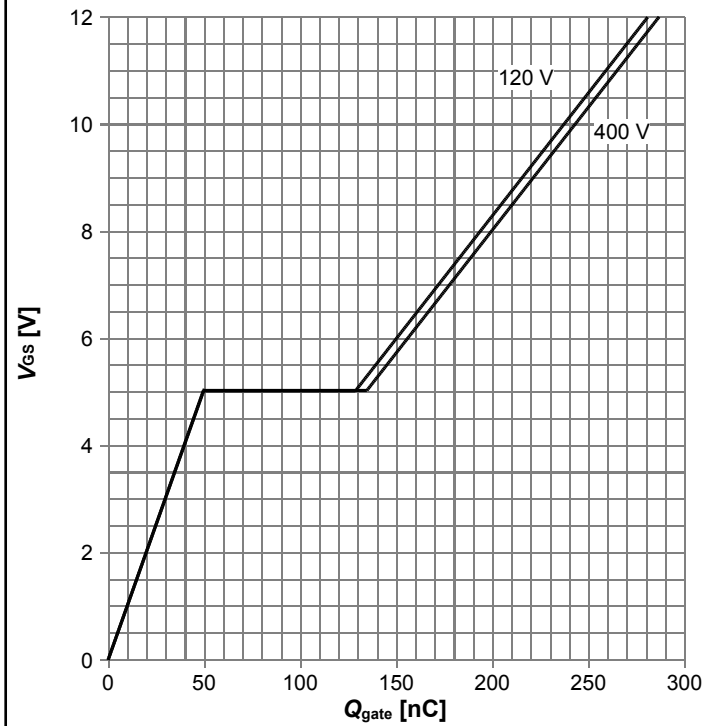


$V_{GS}$=f($Q_{gate}$); $I_D$=58.2 A pulsed; parameter: $V_{DD}$

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



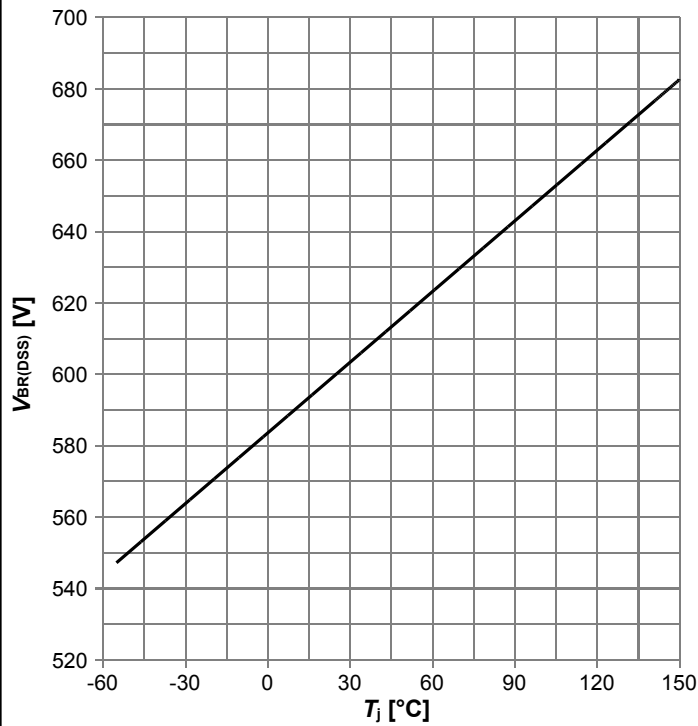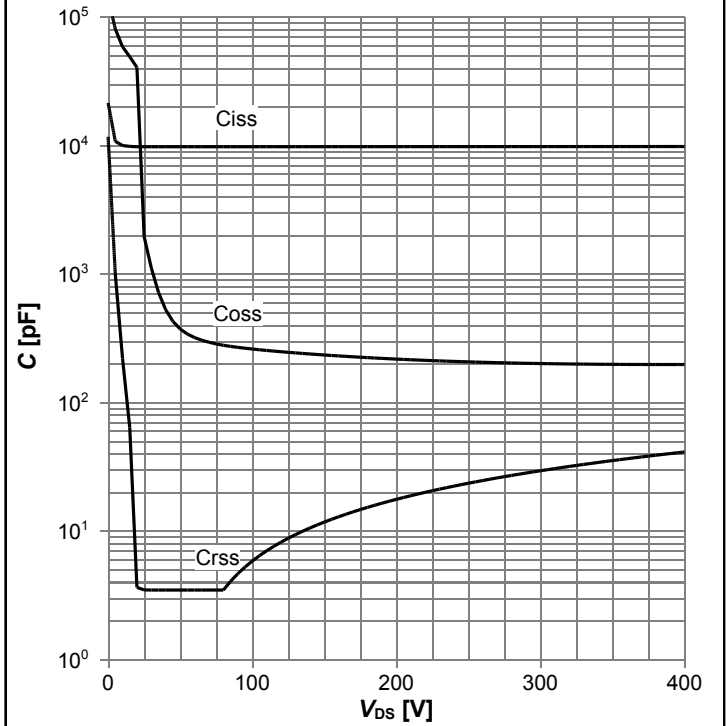$I_F$=f($V_{SD}$); parameter: $T_j$

**Diagram 12: Avalanche energy**
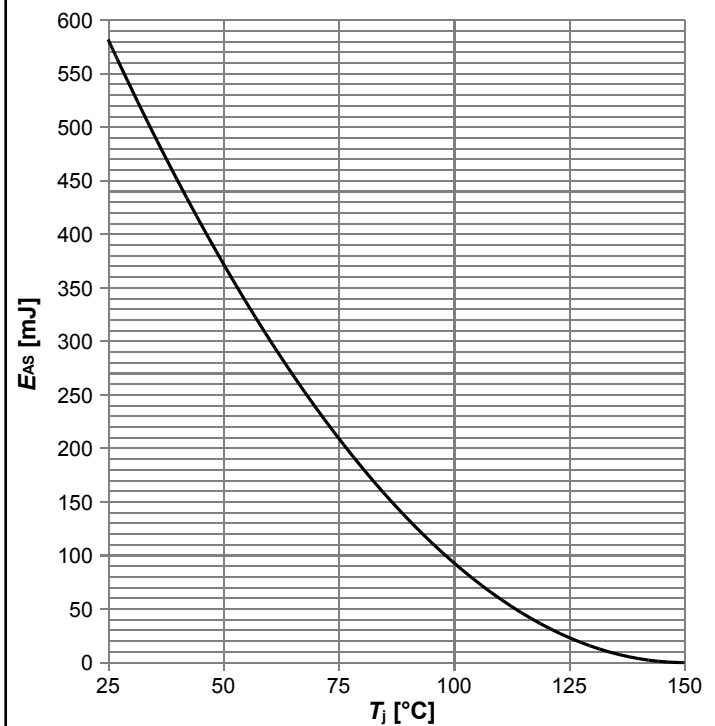


$E_{AS}$=f($T_j$); $I_D$=12.6 A; $V_{DD}$=50 V

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



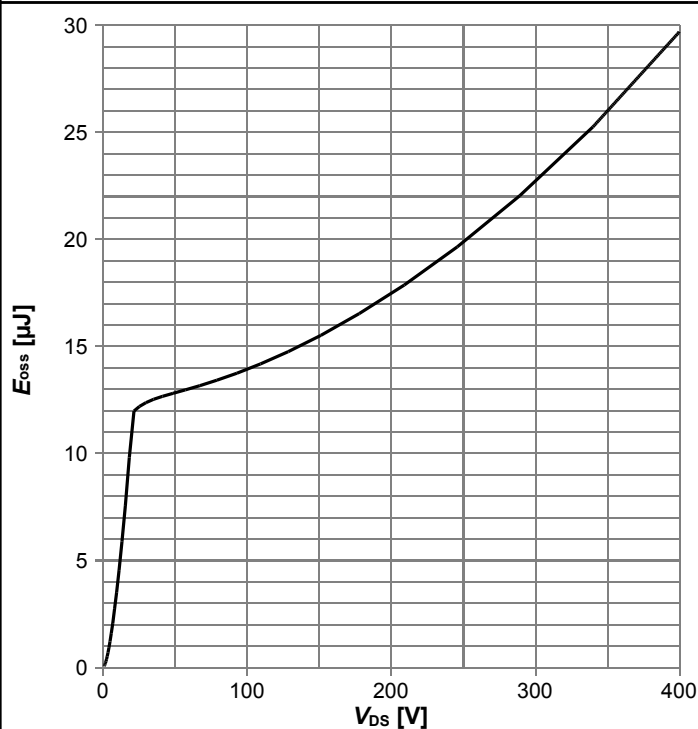$V_{BR(DSS)}=f(T_j)$; $I_D$=1 mA

**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

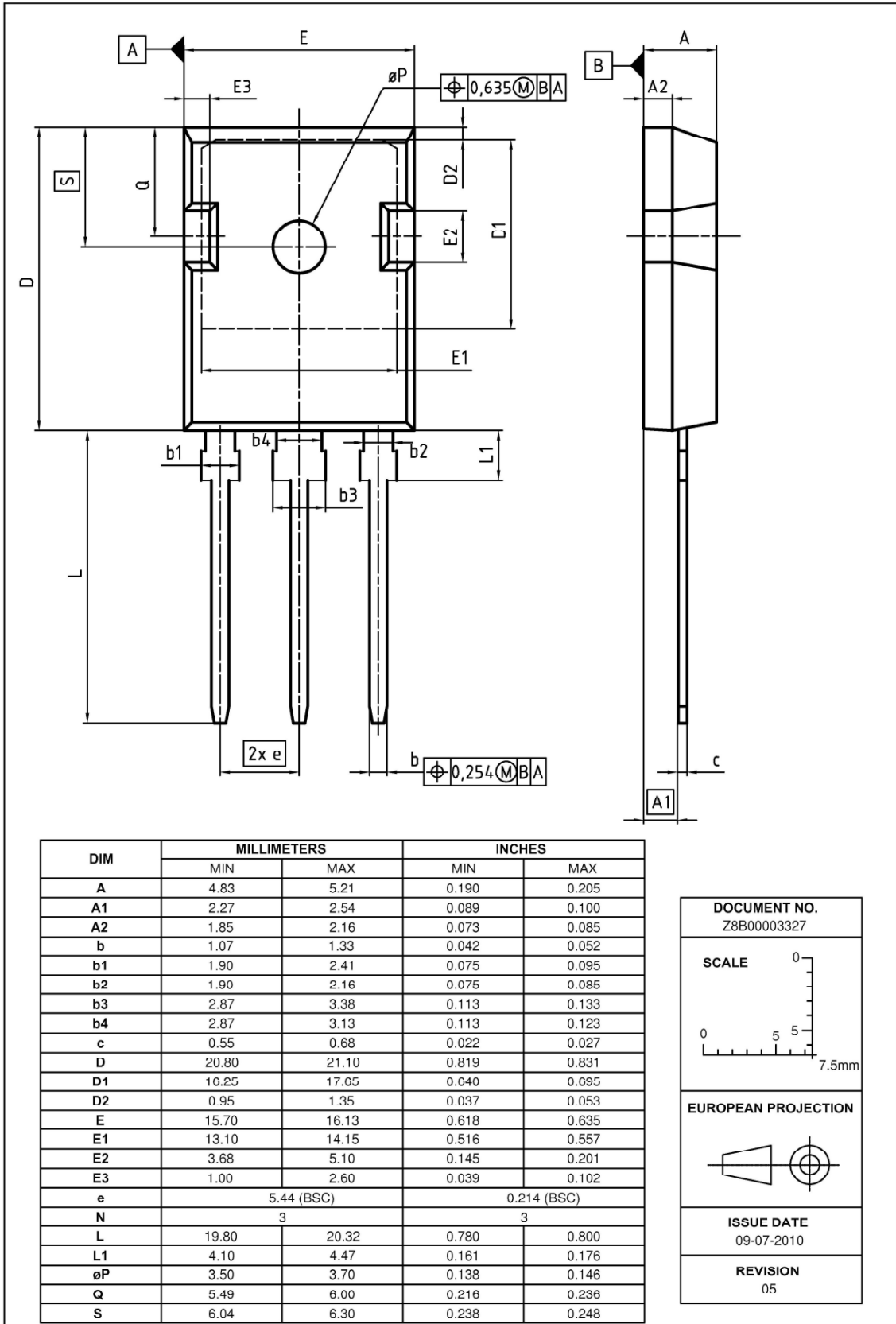| Test circuit for diode characteristics | Diode recovery waveform |
|---|---|



$t_{rr} = t_F + t_S$
$Q_{rr} = Q_F + Q_S$

## 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 | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.27 | 2.54 | 0.089 | 0.100 |
| A2 | 1.85 | 2.16 | 0.073 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.90 | 2.41 | 0.075 | 0.095 |
| b2 | 1.90 | 2.16 | 0.075 | 0.085 |
| b3 | 2.87 | 3.38 | 0.113 | 0.133 |
| b4 | 2.87 | 3.13 | 0.113 | 0.123 |
| c | 0.55 | 0.68 | 0.022 | 0.027 |
| D | 20.80 | 21.10 | 0.819 | 0.831 |
| D1 | 16.25 | 17.65 | 0.040 | 0.095 |
| D2 | 0.95 | 1.35 | 0.037 | 0.053 |
| E | 15.70 | 16.13 | 0.618 | 0.635 |
| E1 | 13.10 | 14.15 | 0.516 | 0.557 |
| E2 | 3.68 | 5.10 | 0.145 | 0.201 |
| E3 | 1.00 | 2.60 | 0.039 | 0.102 |
| e | 5.44 (BSC) | | 0.214 (BSC) | |
| N | 3 | | 3 | |
| L | 19.80 | 20.32 | 0.780 | 0.800 |
| L1 | 4.10 | 4.47 | 0.161 | 0.176 |
| øP | 3.50 | 3.70 | 0.138 | 0.146 |
| Q | 5.49 | 6.00 | 0.216 | 0.236 |
| S | 6.04 | 6.30 | 0.238 | 0.248 |

**DOCUMENT NO.**
Z8B00003327

**SCALE**

**EUROPEAN PROJECTION**

**ISSUE DATE**
09-07-2010

**REVISION**
05

**Figure 1    Outline PG-TO 247, dimensions in mm/inches**

# 7    Appendix A

**Table 11    Related Links**

- **IFX CoolMOS<sup>TM</sup> C7 Webpage:** www.infineon.com

- **IFX CoolMOS<sup>TM</sup> C7 application note:** www.infineon.com

- **IFX CoolMOS<sup>TM</sup> C7 simulation model:** www.infineon.com

- **IFX Design tools:** www.infineon.com

## Revision History

IPW60R017C7

**Revision: 2016-03-01, Rev. 2.0**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 2.0 | 2016-03-01 | Release of final version |

**Trademarks of Infineon Technologies AG**

AURIX™, C166™, CanPAK™, CIPOS™, CoolGaN™, CoolMOS™, CoolSET™, CoolSiC™, CORECONTROL™, CROSSAVE™, DAVE™, DI-POL™, DrBlade™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPACK™, EconoPIM™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, Infineon™, ISOFACE™, IsoPACK™, i-Wafer™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OmniTune™, OPTIGA™, OptiMOS™, ORIGA™, POWERCODE™, PRIMARION™, PrimePACK™, PrimeSTACK™, PROFET™, PRO-SIL™, RASIC™, REAL3™, ReverSave™, SatRIC™, SIEGET™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, SPOC™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

Trademarks updated August 2015

**Other Trademarks**

All referenced product or service names and trademarks are the property of their respective owners.

**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**