

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## CoolMOS C6

600V CoolMOS™ C6 Power Transistor  
IPW60R070C6

## Data Sheet

Rev. 2.1, 2010-02-09  
Final

Industrial & Multimarket

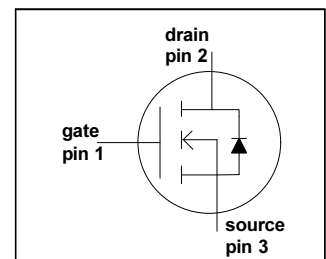
## 1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ C6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The offered 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.



### Features

- Extremely low losses due to very low FOM  $R_{DS(on)} \cdot Q_g$  and  $E_{oss}$
- Very high commutation ruggedness
- Easy to use/drive
- JEDEC<sup>1)</sup> qualified, Pb-free plating, Halogen free



### Applications

PFC stages, hard switching PWM stages and resonant switching PWM 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          |
| $R_{DS(on),max}$     | 0.07  | $\Omega$   |
| $Q_{g,typ}$          | 170   | nC         |
| $I_{D,pulse}$        | 159   | A          |
| $E_{oss} @ 400V$     | 13    | $\mu J$    |
| Body diode $di/dt$   | 300   | A/ $\mu s$ |

### Related Links

- [IFX C6 Product Brief](#)
- [IFX C6 Portfolio](#)
- [IFX CoolMOS Webpage](#)
- [IFX Design tools](#)

| Type        | Package  | Marking |
|-------------|----------|---------|
| IPW60R070C6 | PG-T0247 | 6R070C6 |

1) J-STD20 and JESD22

## Table of Contents

|   |   |    |
|---|---|----|
| 1 | Description .....                         | 2  |
|   | Table of Contents .....                   | 3  |
| 2 | Maximum ratings .....                     | 4  |
| 3 | Thermal characteristics .....             | 4  |
| 4 | Electrical characteristics .....          | 5  |
| 5 | Electrical characteristics diagrams ..... | 7  |
| 6 | Test circuits .....                       | 11 |
| 7 | Package outlines .....                    | 12 |
| 8 | Revision History .....                    | 13 |

## 2 Maximum ratings

at  $T_j = 25\text{ °C}$ , unless otherwise specified.

**Table 2 Maximum ratings**

| Parameter                                     | Symbol         | Values |      |      | Unit             | Note / Test Condition   |
|---|----------------|--------|------|------|------------------|---|
|   |                | Min.   | Typ. | Max. |                  |   |
| Continuous drain current <sup>1)</sup>        | $I_D$          | -      | -    | 53   | A                | $T_C = 25\text{ °C}$  |
|   |                |        |      | 34   |                  | $T_C = 100\text{ °C}$   |
| Pulsed drain current <sup>2)</sup>            | $I_{D,pulse}$  | -      | -    | 159  | A                | $T_C = 25\text{ °C}$  |
| Avalanche energy, single pulse                | $E_{AS}$       | -      | -    | 1135 | mJ               | $I_D = 9.3\text{ A}, V_{DD} = 50\text{ V}$<br>(see table 17)              |
| Avalanche energy, repetitive                  | $E_{AR}$       | -      | -    | 1.72 |                  | $I_D = 9.3\text{ A}, V_{DD} = 50\text{ V}$                                |
| Avalanche current, repetitive                 | $I_{AR}$       | -      | -    | 9.3  | A                |   |
| MOSFET dv/dt ruggedness                       | dv/dt          | -      | -    | 50   | V/ns             | $V_{DS} = 0 \dots 480\text{ V}$   |
| Gate source voltage                           | $V_{GS}$       | -20    | -    | 20   | V                | static  |
|   |                | -30    |      | 30   |                  | AC ( $f > 1\text{ Hz}$ )  |
| Power dissipation                             | $P_{tot}$      | -      | -    | 391  | W                | $T_C = 25\text{ °C}$  |
| Operating and storage temperature             | $T_j, T_{stg}$ | -55    | -    | 150  | °C               |   |
| Mounting torque                               |                | -      | -    | 60   | Ncm              | M3 and M3.5 screws  |
| Continuous diode forward current              | $I_S$          | -      | -    | 46   | A                | $T_C = 25\text{ °C}$  |
| Diode pulse current <sup>2)</sup>             | $I_{S,pulse}$  | -      | -    | 159  | A                | $T_C = 25\text{ °C}$  |
| Reverse diode dv/dt <sup>3)</sup>             | dv/dt          | -      | -    | 15   | V/ns             | $V_{DS} = 0 \dots 400\text{ V}, I_{SD} \leq I_D,$<br>$T_j = 25\text{ °C}$ |
| Maximum diode commutation speed <sup>3)</sup> | $di/dt$        | -      | -    | 300  | A/ $\mu\text{s}$ | (see table 18)  |

1) Limited by  $T_{j,max}$ . Maximum duty cycle  $D = 0.75$

2) Pulse width  $t_p$  limited by  $T_{j,max}$

3) Identical low side and high side switch with identical  $R_G$

## 3 Thermal characteristics

**Table 3 Thermal characteristics TO-247 (IPW60R070C6)**

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition                 |
|--|------------|--------|------|------|------|---------------------------------------|
|  |            | Min.   | Typ. | Max. |      |                                       |
| Thermal resistance, junction - case                        | $R_{thJC}$ | -      | -    | 0.32 | °C/W |                                       |
| Thermal resistance, junction - ambient                     | $R_{thJA}$ | -      | -    | 62   |      | leaded                                |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ | -      | -    | 260  | °C   | 1.6 mm (0.063 in.) from case for 10 s |

## 4 Electrical characteristics

Electrical characteristics, at  $T_J=25\text{ °C}$ , unless otherwise specified.

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |       |      | Unit          | Note / Test Condition  |
|----------------------------------|---------------|--------|-------|------|---------------|--|
|                                  |               | Min.   | Typ.  | Max. |               |  |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 600    | -     | -    | V             | $V_{GS}=0\text{ V}$ , $I_D=0.25\text{ mA}$                           |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.5    | 3     | 3.5  |               | $V_{DS}=V_{GS}$ , $I_D=1.72\text{ mA}$                               |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -     | 5    | $\mu\text{A}$ | $V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_J=25\text{ °C}$  |
|                                  |               | -      | 50    | -    |               | $V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_J=150\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -     | 100  | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                           |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.063 | 0.07 | $\Omega$      | $V_{GS}=10\text{ V}$ , $I_D=25.8\text{ A}$ ,<br>$T_J=25\text{ °C}$   |
|                                  |               | -      | 0.164 | -    |               | $V_{GS}=10\text{ V}$ , $I_D=25.8\text{ A}$ ,<br>$T_J=150\text{ °C}$  |
| Gate resistance                  | $R_G$         | -      | 0.85  | -    | $\Omega$      | $f=1\text{ MHz}$ , open drain  |

**Table 5 Dynamic characteristics**

| Parameter  | Symbol       | Values |      |      | Unit | Note / Test Condition  |  |
|--|--------------|--------|------|------|------|--|--|
|  |              | Min.   | Typ. | Max. |      |  |  |
| Input capacitance  | $C_{iss}$    | -      | 3800 | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ ,<br>$f=1\text{ MHz}$  |  |
| Output capacitance   | $C_{oss}$    | -      | 215  | -    |      |  |  |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 140  | -    |      |  | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=0\dots480\text{ V}$                       |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 710  | -    |      |  | $I_D=\text{constant}$ , $V_{GS}=0\text{ V}$<br>$V_{DS}=0\dots480\text{ V}$ |
| Turn-on delay time   | $t_{d(on)}$  | -      | 16   | -    | ns   | $V_{DD}=400\text{ V}$ ,<br>$V_{GS}=13\text{ V}$ , $I_D=25.8\text{ A}$ ,<br>$R_G=1.7\Omega$<br>(see table 16) |  |
| Rise time  | $t_r$        | -      | 12   | -    |      |  |  |
| Turn-off delay time  | $t_{d(off)}$ | -      | 83   | -    |      |  |  |
| Fall time  | $t_f$        | -      | 5    | -    |      |  |  |

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 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|-----------------------|---------------|--------|------|------|------|--|
|                       |               | Min.   | Typ. | Max. |      |  |
| Gate to source charge | $Q_{gs}$      | -      | 21   | -    | nC   | $V_{DD}=480\text{ V}$ ,<br>$I_D=25.8\text{ A}$ ,<br>$V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 87   | -    |      |  |
| Gate charge total     | $Q_g$         | -      | 170  | -    |      |  |
| Gate plateau voltage  | $V_{plateau}$ | -      | 5.4  | -    | V    |  |

**Table 7 Reverse diode characteristics**

| Parameter                     | Symbol    | Values |      |      | Unit          | Note / Test Condition  |
|-------------------------------|-----------|--------|------|------|---------------|--|
|                               |           | Min.   | Typ. | Max. |               |  |
| Diode forward voltage         | $V_{SD}$  | -      | 0.9  | -    | V             | $V_{GS}=0\text{ V}$ , $I_F=25.8\text{ A}$ ,<br>$T_j=25\text{ °C}$                                  |
| Reverse recovery time         | $t_{rr}$  | -      | 720  | -    | ns            | $V_R=400\text{ V}$ , $I_F=25.8\text{ A}$ ,<br>$di_F/dt=100\text{ A}/\mu\text{s}$<br>(see table 18) |
| Reverse recovery charge       | $Q_{rr}$  | -      | 19   | -    | $\mu\text{C}$ |  |
| Peak reverse recovery current | $I_{rrm}$ | -      | 52   | -    | A             |  |

5 Electrical characteristics diagrams

Table 8

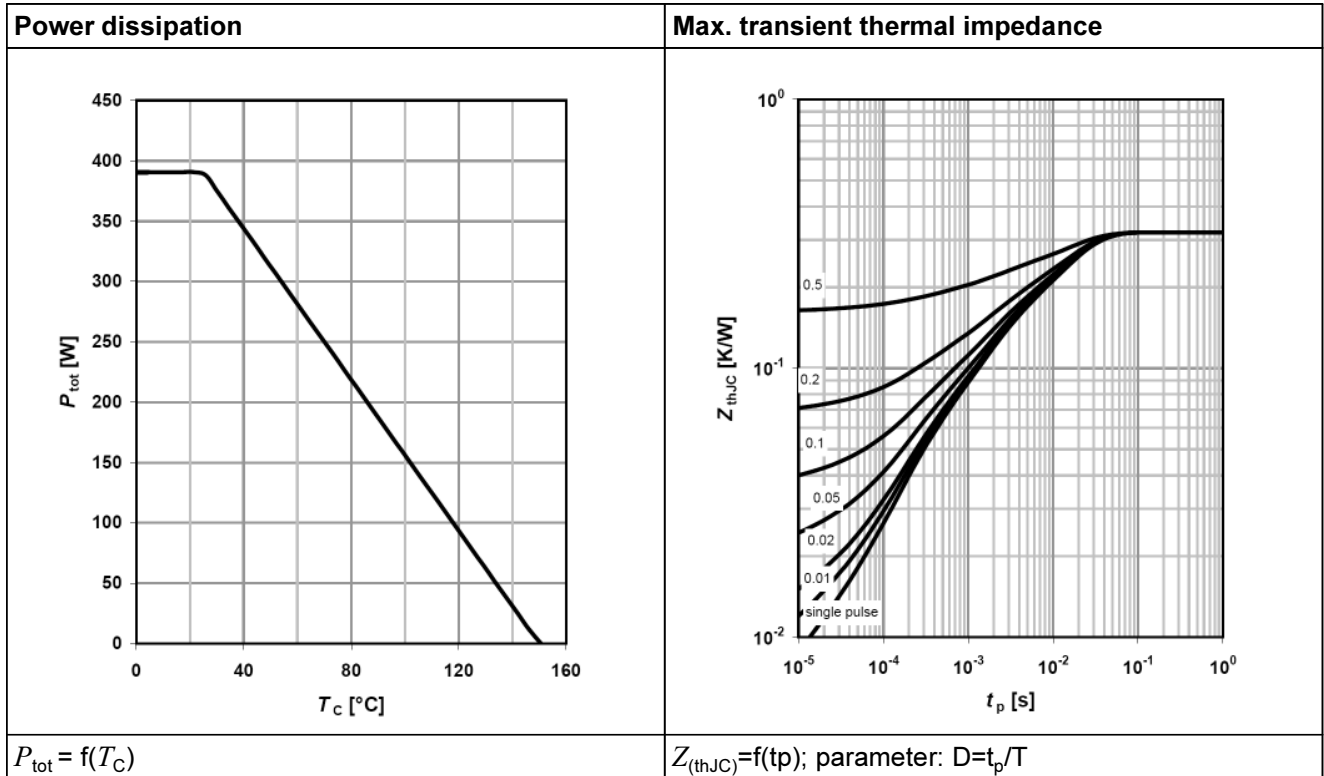


Table 9

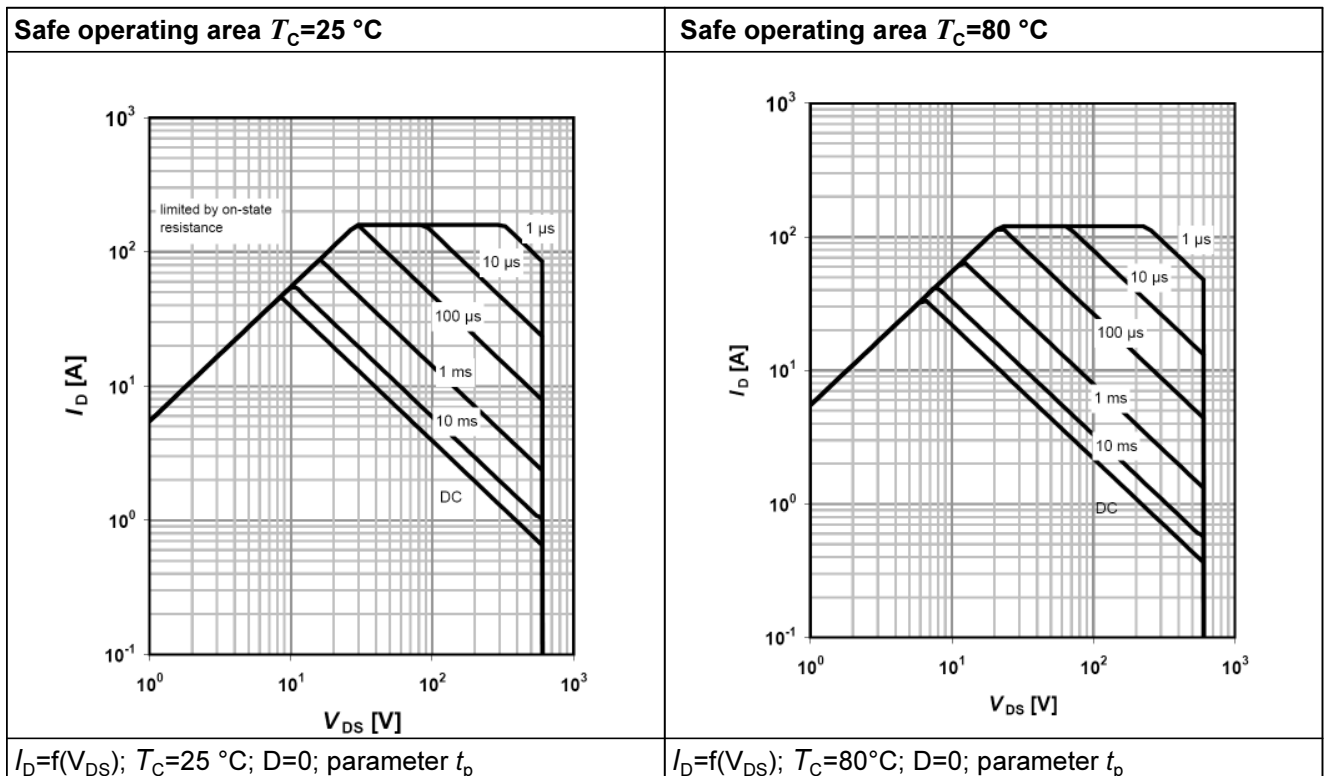


Table 10

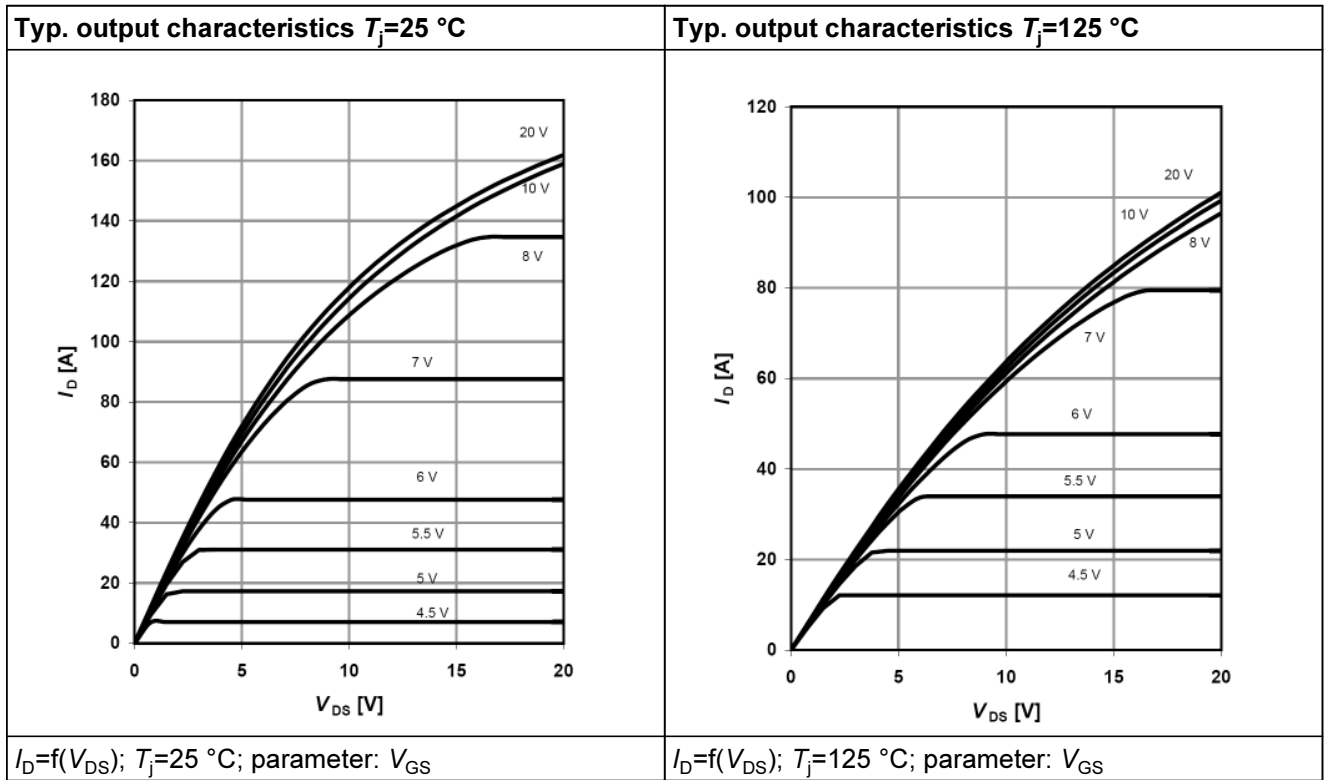


Table 11

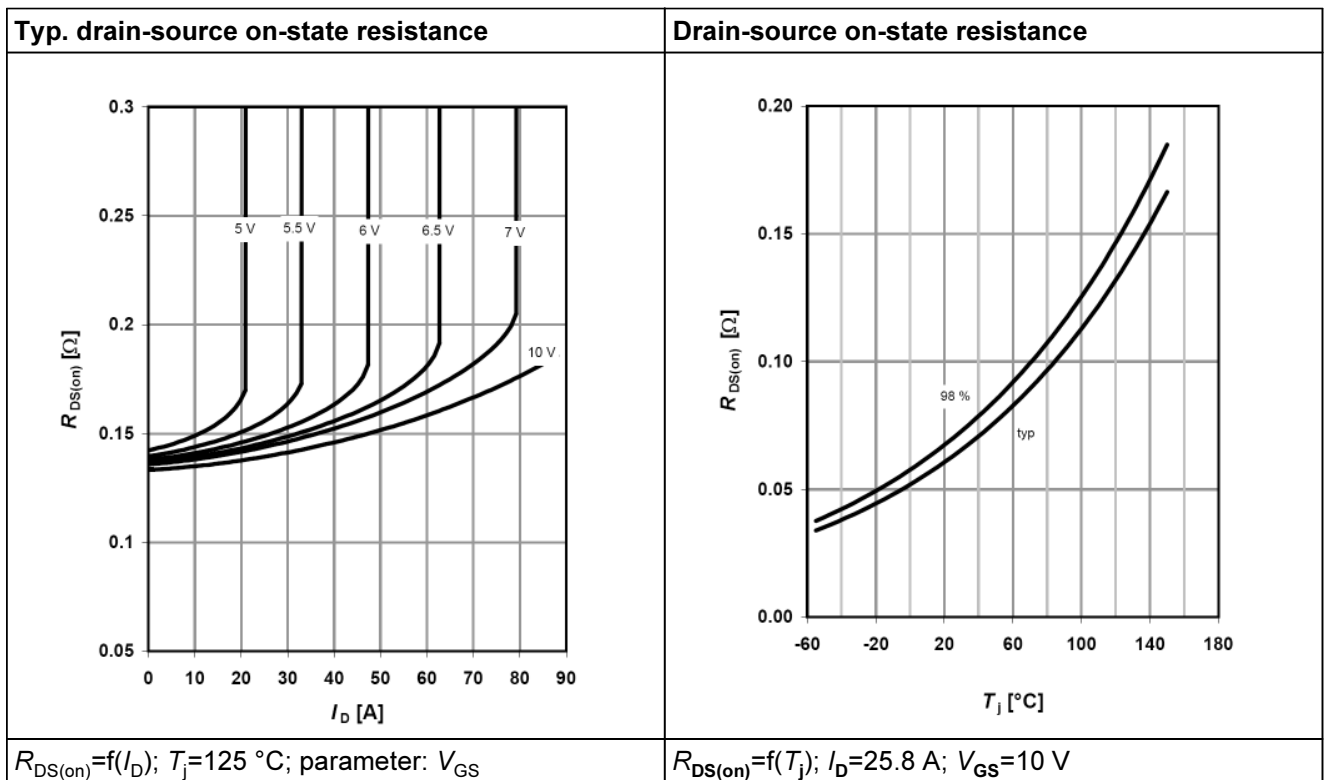




Table 12

| Typ. transfer characteristics   | Typ. gate charge                                    |
|---------------------------------|---|
|                                 |   |
| $I_D = f(V_{GS}); V_{DS} = 20V$ | $V_{GS} = f(Q_{gate}); I_D = 25.8 \text{ A pulsed}$ |

Table 13

| Avalanche energy  | Drain-source breakdown voltage                |
|---|---|
|   |   |
| $E_{AS} = f(T_j); I_D = 9.3 \text{ A}; V_{DD} = 50 \text{ V}$ | $V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$ |

Table 14

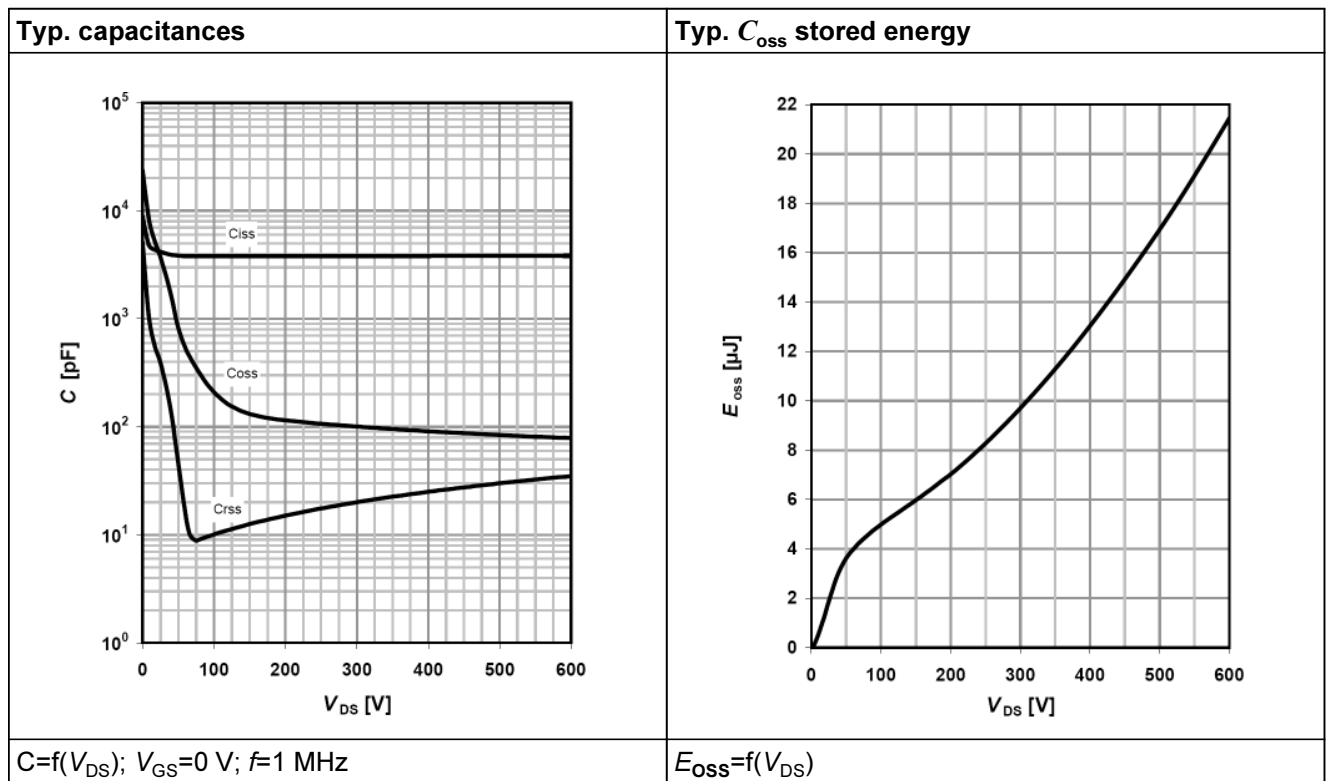
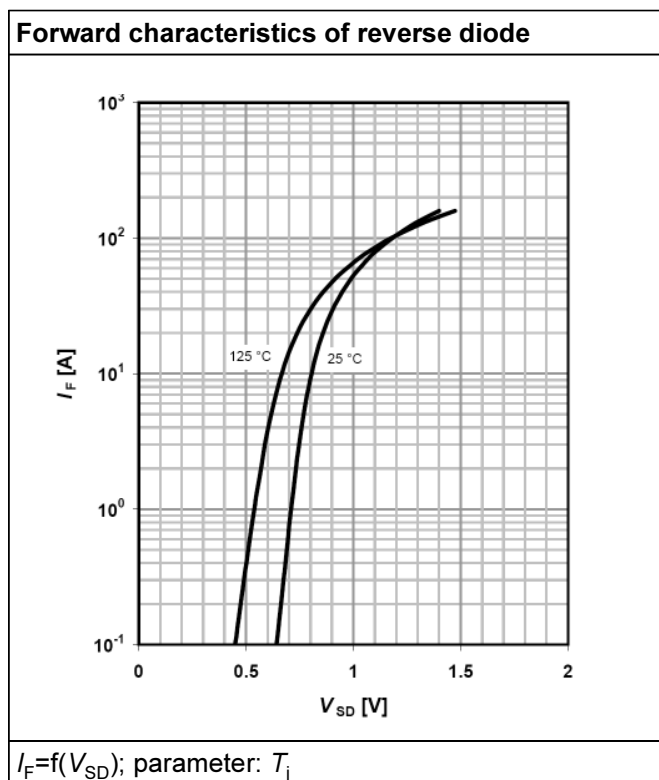


Table 15



## 6 Test circuits

Table 16 Switching times test circuit and waveform for inductive load

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

Table 17 Unclamped inductive load test circuit and waveform

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

Table 18 Test circuit and waveform for diode recovery times

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

7 Package outlines

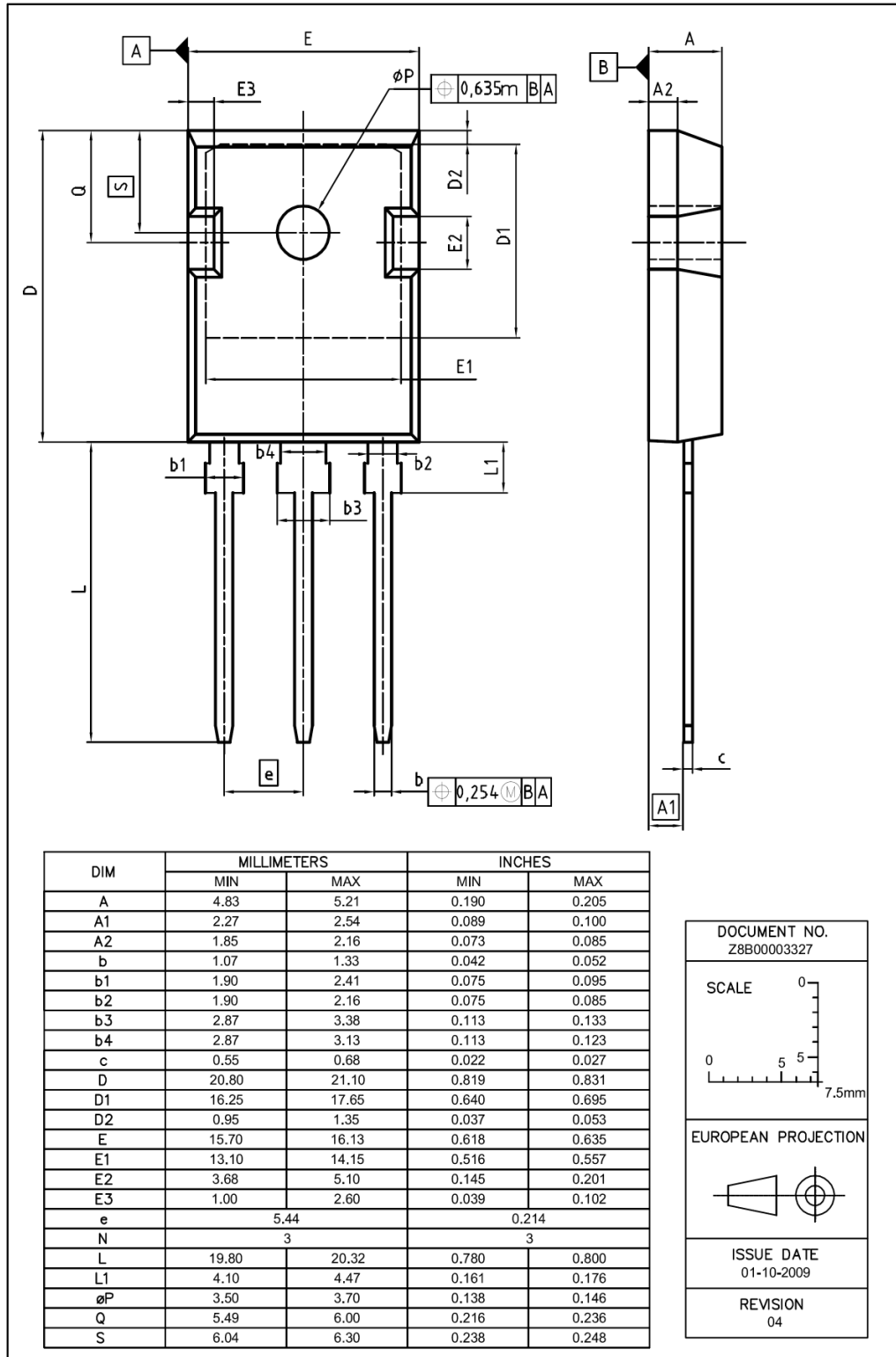


Figure 1 Outlines TO-247, dimensions in mm/inches

## 8 Revision History

### CoolMOS C6 600V CoolMOS™ C6 Power Transistor

Revision History: 2010-02-09, Rev. 2.1

Previous Revision:

| Revision | Subjects (major changes since last revision) |
|----------|--|
| 2.0      | Release of final data sheet                  |
| 2.1      | New package outlines TO-247                  |
|          |  |

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