

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## CoolMOS™ C6 650V

650V CoolMOS™ C6 Power Transistor  
IPW65R037C6

## 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™ C6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. 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.

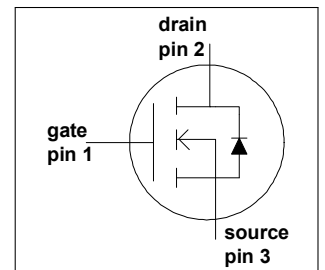
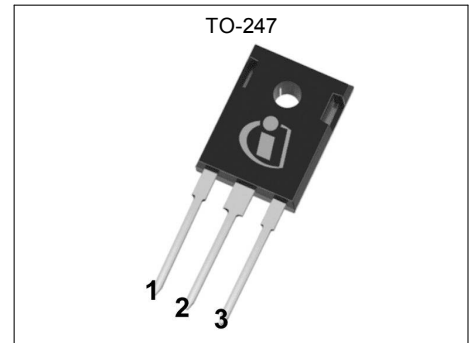
### Features

- 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
- 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, Adapter, LCD & PDP TV, Lighting, 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       |
|-----------------------|-------|------------|
| $V_{DS} @ T_{j \max}$ | 700   | V          |
| $R_{DS(on),max}$      | 0.037 | $\Omega$   |
| $Q_g,typ$             | 330   | nC         |
| $I_D,pulse$           | 297   | A          |
| $E_{oss} @ 400V$      | 24.5  | $\mu J$    |
| Body diode $di/dt$    | 300   | A/ $\mu s$ |

| Type / Ordering Code | Package   | Marking | Related Links  |
|----------------------|-----------|---------|----------------|
| IPW65R037C6          | PG-TO 247 | 65C6037 | see Appendix A |



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## 2 Maximum ratings

at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                                 | Symbol         | Values |      |       | Unit             | Note / Test Condition  |
|---|----------------|--------|------|-------|------------------|--|
|   |                | Min.   | Typ. | Max.  |                  |  |
| Continuous drain current <sup>1)</sup>    | $I_D$          |        |      | 83.2  | A                | $T_C = 25^\circ\text{C}$   |
|   |                |        |      | 52.6  |                  | $T_C = 100^\circ\text{C}$  |
| Pulsed drain current <sup>2)</sup>        | $I_{D,pulse}$  |        |      | 297   | A                | $T_C = 25^\circ\text{C}$   |
| Avalanche energy, single pulse            | $E_{AS}$       |        |      | 2185  | mJ               | $t_b = 14.4\mu\text{s}$ , $V_{DD} = 50\text{V}$                                  |
| Avalanche energy, repetitive              | $E_{AR}$       |        |      | 3.31  | mJ               | $t_b = 14.4\mu\text{s}$ , $V_{DD} = 50\text{V}$                                  |
| Avalanche current, repetitive             | $I_{AR}$       |        |      | 14.4  | 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 (non FullPAK)<br>TO-247 | $P_{tot}$      |        |      | 500.0 | W                | $T_C = 25^\circ\text{C}$   |
| Operating and storage temperature         | $T_j, T_{stg}$ | -55    |      | 150   | $^\circ\text{C}$ |  |
| Mounting torque (non FullPAK)<br>TO-247   |                |        |      | 60    | Ncm              | M3 and M3.5 screws   |
| Continuous diode forward current          | $I_S$          |        |      | 72.1  | A                | $T_C = 25^\circ\text{C}$   |
| Diode pulse current                       | $I_{S,pulse}$  |        |      | 297   | A                | $T_C = 25^\circ\text{C}$   |
| Reverse diode dv/dt <sup>3)</sup>         | dv/dt          |        |      | 15    | V/ns             | $V_{DS} = 0 \dots 400\text{V}$ , $t_{SD} \leq t_b$ ,<br>$T_j = 25^\circ\text{C}$ |
| Maximum diode commutation speed           | $di_f/dt$      |        |      | 300   | A/ $\mu\text{s}$ |  |

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

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup>  $V_{peak} < V_{(BR)DSS}$ ,  $T_j < T_{j,max}$ , identical low and high side switch with same  $R_g$

### 3 Thermal characteristics

**Table 3 Thermal characteristics TO-247**

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition                |
|--|------------|--------|------|------|------|--------------------------------------|
|  |            | Min.   | Typ. | Max. |      |                                      |
| Thermal resistance, junction - case                        | $R_{thJC}$ |        |      | 0.25 | °C/W |                                      |
| Thermal resistance, junction - ambient                     | $R_{thJA}$ |        |      | 62   | °C/W | leaded                               |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ |        |      | 260  | °C   | 1.6 mm (0.063 in.) from case for 10s |

## 4 Electrical characteristics

at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |       |       | Unit     | Note / Test Condition                           |
|----------------------------------|---------------|--------|-------|-------|----------|---|
|                                  |               | Min.   | Typ.  | Max.  |          |   |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 650    |       |       | V        | $V_{GS} = 0V, I_D = 1mA$                        |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.5    | 3     | 3.5   | V        | $V_{DS} = V_{GS}, I_D = 3.3mA$                  |
| Zero gate voltage drain current  | $I_{DSS}$     |        |       | 2     | $\mu A$  | $V_{DS} = 650V, V_{GS} = 0V, T_j = 25^\circ C$  |
|                                  |               |        | 50    |       |          | $V_{DS} = 650V, V_{GS} = 0V, T_j = 150^\circ C$ |
| Gate-source leakage current      | $I_{GSS}$     |        |       | 100   | nA       | $V_{GS} = 20V, V_{DS} = 0V$                     |
| Drain-source on-state resistance | $R_{DS(on)}$  |        | 0.033 | 0.037 | $\Omega$ | $V_{GS} = 10V, I_D = 33.1A, T_j = 25^\circ C$   |
|                                  |               |        | 0.086 |       |          | $V_{GS} = 10V, I_D = 33.1A, T_j = 150^\circ C$  |
| Gate resistance                  | $R_G$         |        | 0.7   |       | $\Omega$ | $f = 1MHz, \text{open drain}$                   |

**Table 5 Dynamic characteristics**

| Parameter  | Symbol       | Values |      |      | Unit | Note / Test Condition                                       |
|--|--------------|--------|------|------|------|---|
|  |              | Min.   | Typ. | Max. |      |   |
| Input capacitance  | $C_{iss}$    |        | 7240 |      | pF   | $V_{GS} = 0V, V_{DS} = 100V, f = 1MHz$                      |
| Output capacitance   | $C_{oss}$    |        | 380  |      | pF   |   |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  |        | 270  |      | pF   | $V_{GS} = 0V, V_{DS} = 0 \dots 480V$                        |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  |        | 1360 |      | pF   | $I_D = \text{constant}, V_{GS} = 0V, V_{DS} = 0 \dots 480V$ |
| Turn-on delay time   | $t_{d(on)}$  |        | 22   |      | ns   | $V_{DD} = 400V, V_{GS} = 13V, I_D = 49.6A, R_G = 1.7\Omega$ |
| Rise time  | $t_r$        |        | 32   |      | ns   |   |
| Turn-off delay time  | $t_{d(off)}$ |        | 140  |      | ns   |   |
| Fall time  | $t_f$        |        | 7    |      | ns   |   |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                                    |
|-----------------------|---------------|--------|------|------|------|--|
|                       |               | Min.   | Typ. | Max. |      |  |
| Gate to source charge | $Q_{gs}$      |        | 40   |      | nC   | $V_{DD} = 480V, I_D = 49.6A, V_{GS} = 0 \text{ to } 10V$ |
| Gate to drain charge  | $Q_{gd}$      |        | 170  |      | nC   |  |
| Gate charge total     | $Q_g$         |        | 330  |      | nC   |  |
| Gate plateau voltage  | $V_{plateau}$ |        | 5.5  |      | V    |  |

<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 480V

<sup>2)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 480V

**Table 7 Reverse diode characteristics**

| Parameter                     | Symbol    | Values |      |      | Unit    | Note / Test Condition                       |
|-------------------------------|-----------|--------|------|------|---------|---|
|                               |           | Min.   | Typ. | Max. |         |   |
| Diode forward voltage         | $V_{SD}$  |        | 0.85 |      | V       | $V_{GS} = 0V, f = 49.6A, T_j = 25^\circ C$  |
| Reverse recovery time         | $t_{rr}$  |        | 1020 |      | ns      | $V_R = 400V, f = 49.6A, dI/dt = 100A/\mu s$ |
| Reverse recovery charge       | $Q_{rr}$  |        | 36   |      | $\mu C$ |   |
| Peak reverse recovery current | $I_{rrm}$ |        | 67   |      | A       |   |

### 5 Electrical characteristics diagrams

Table 8

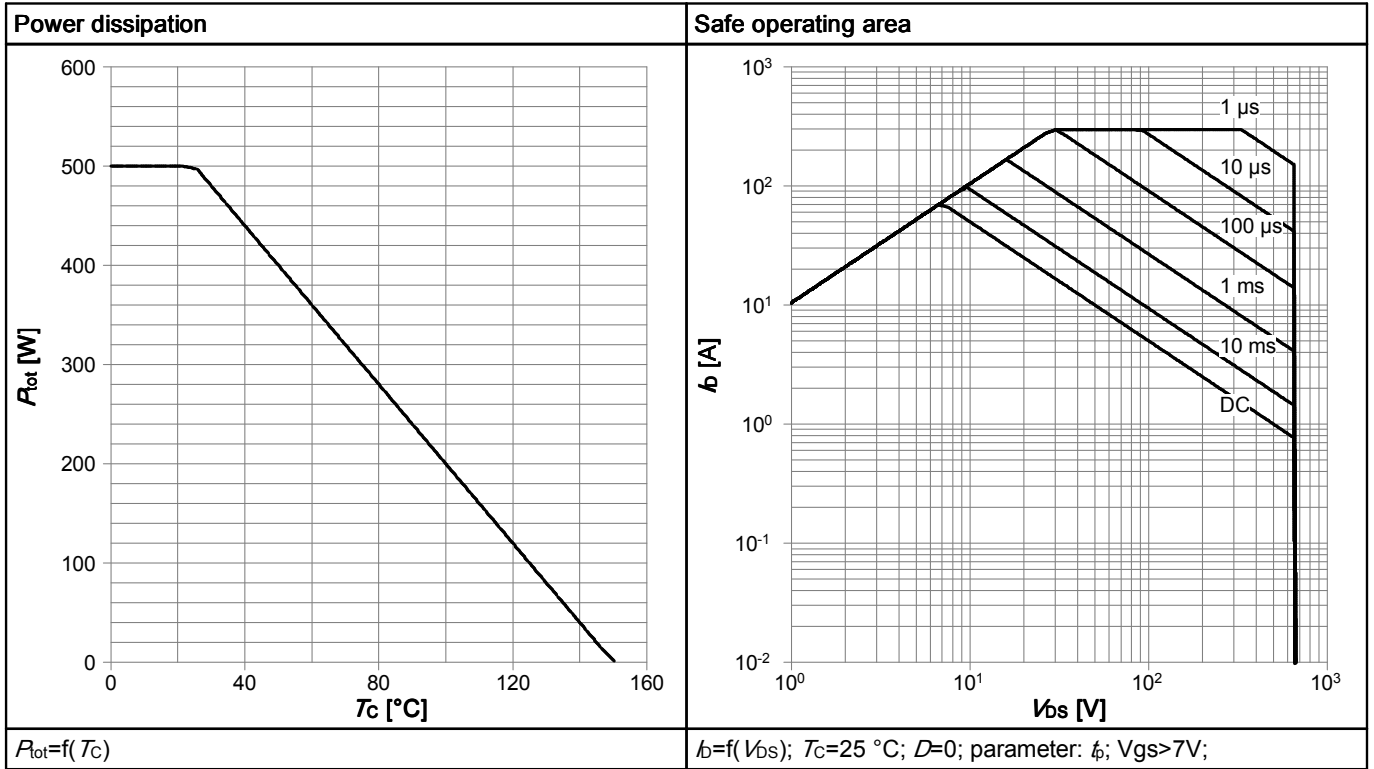


Table 9

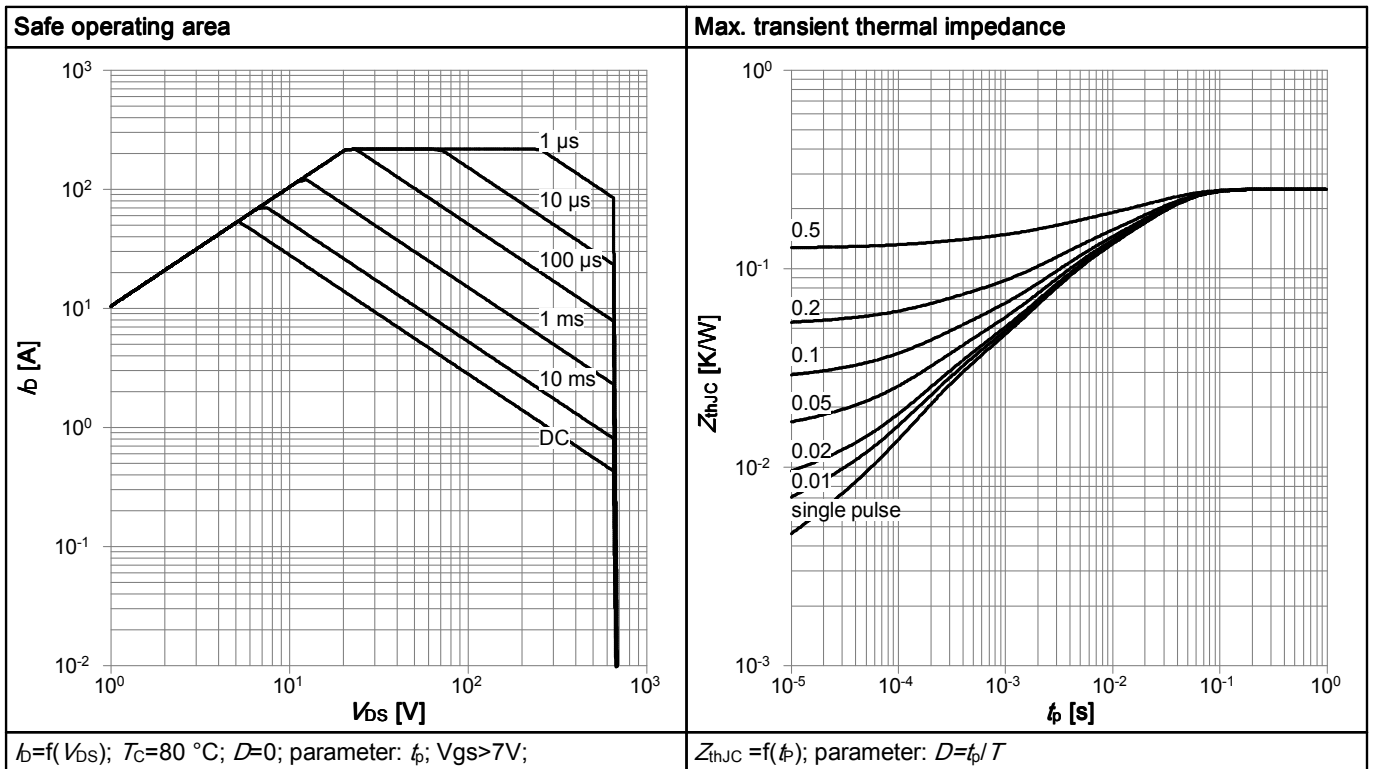




Table 10

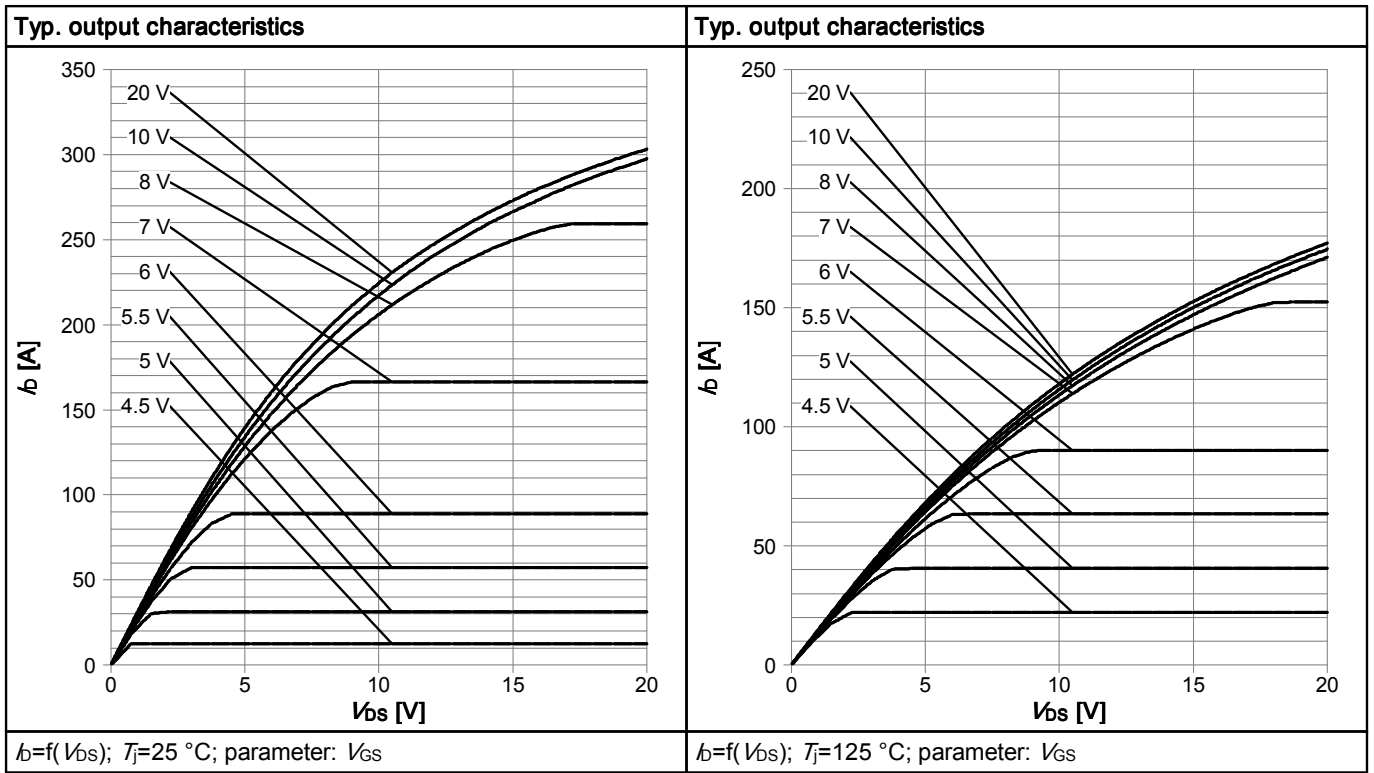


Table 11

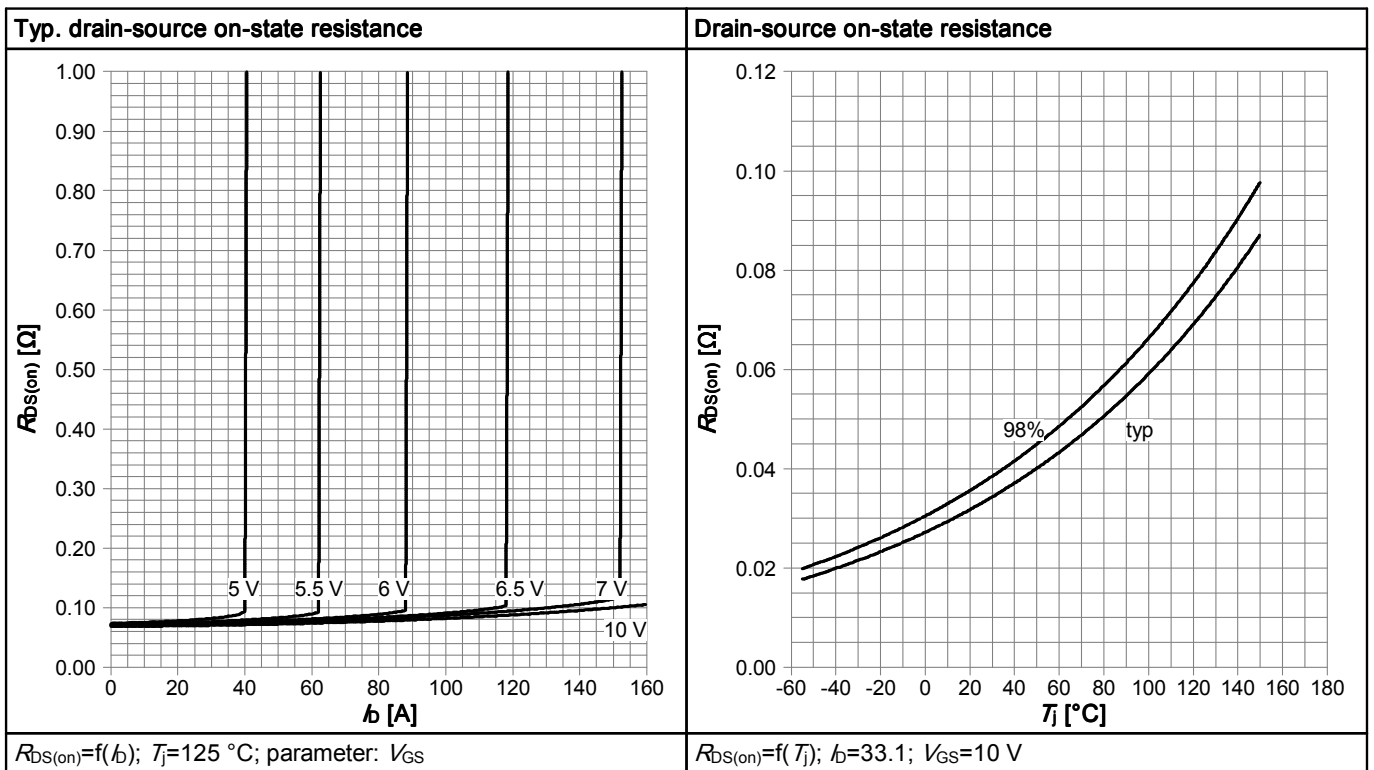


Table 12

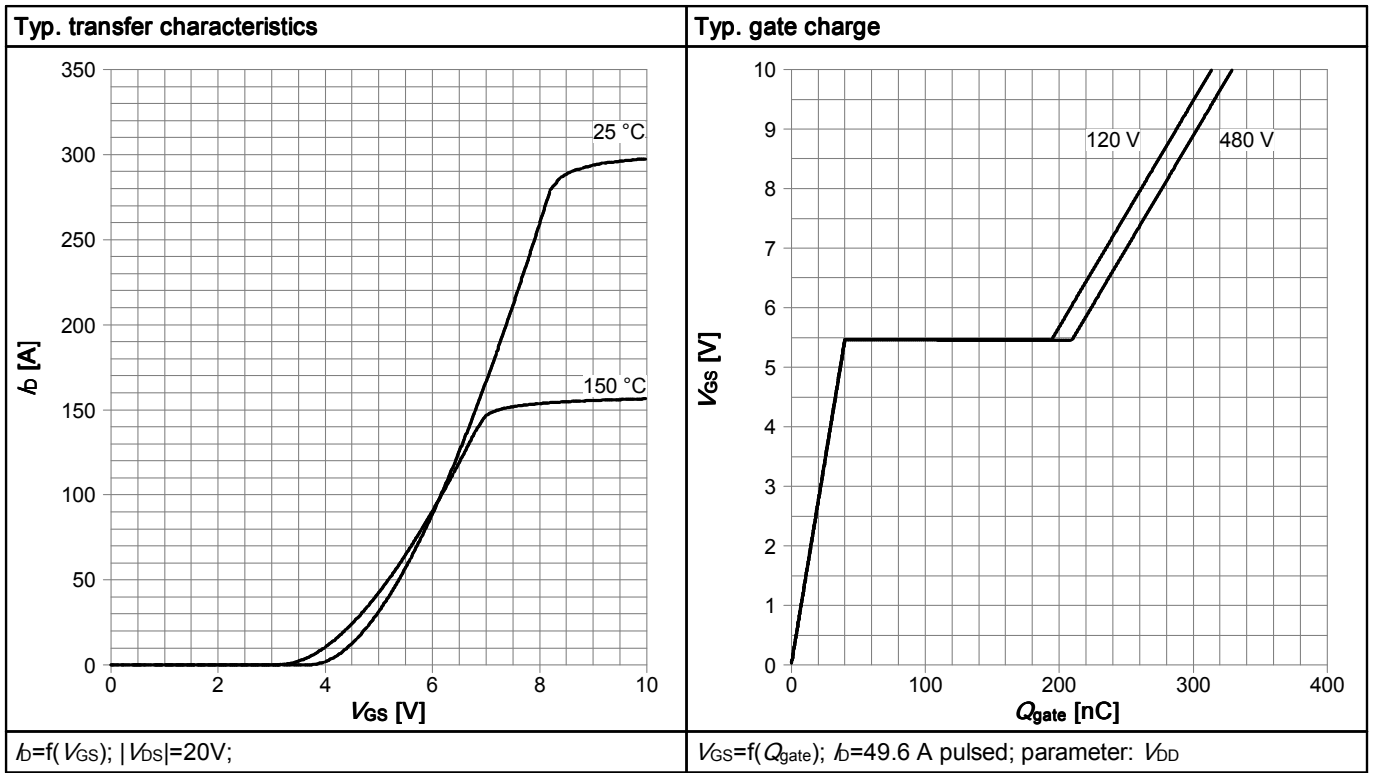
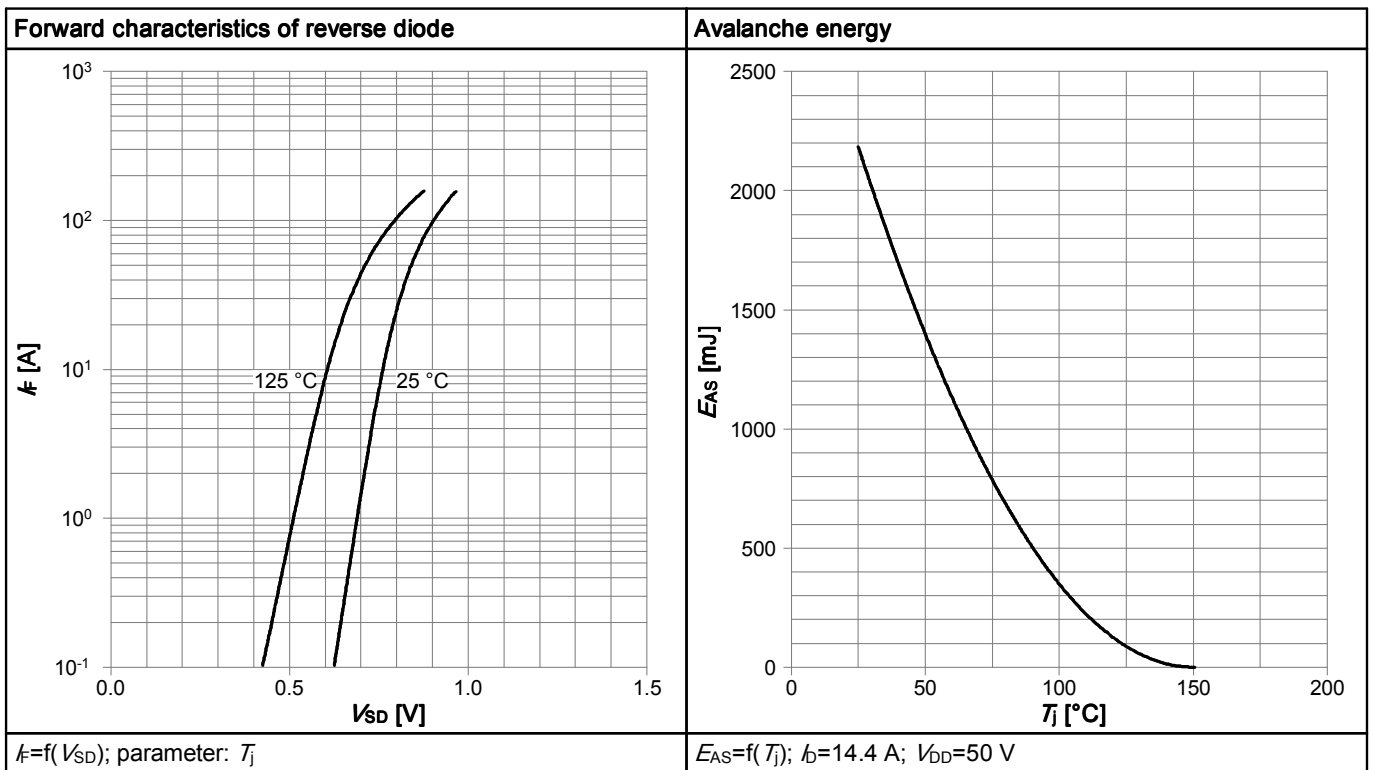
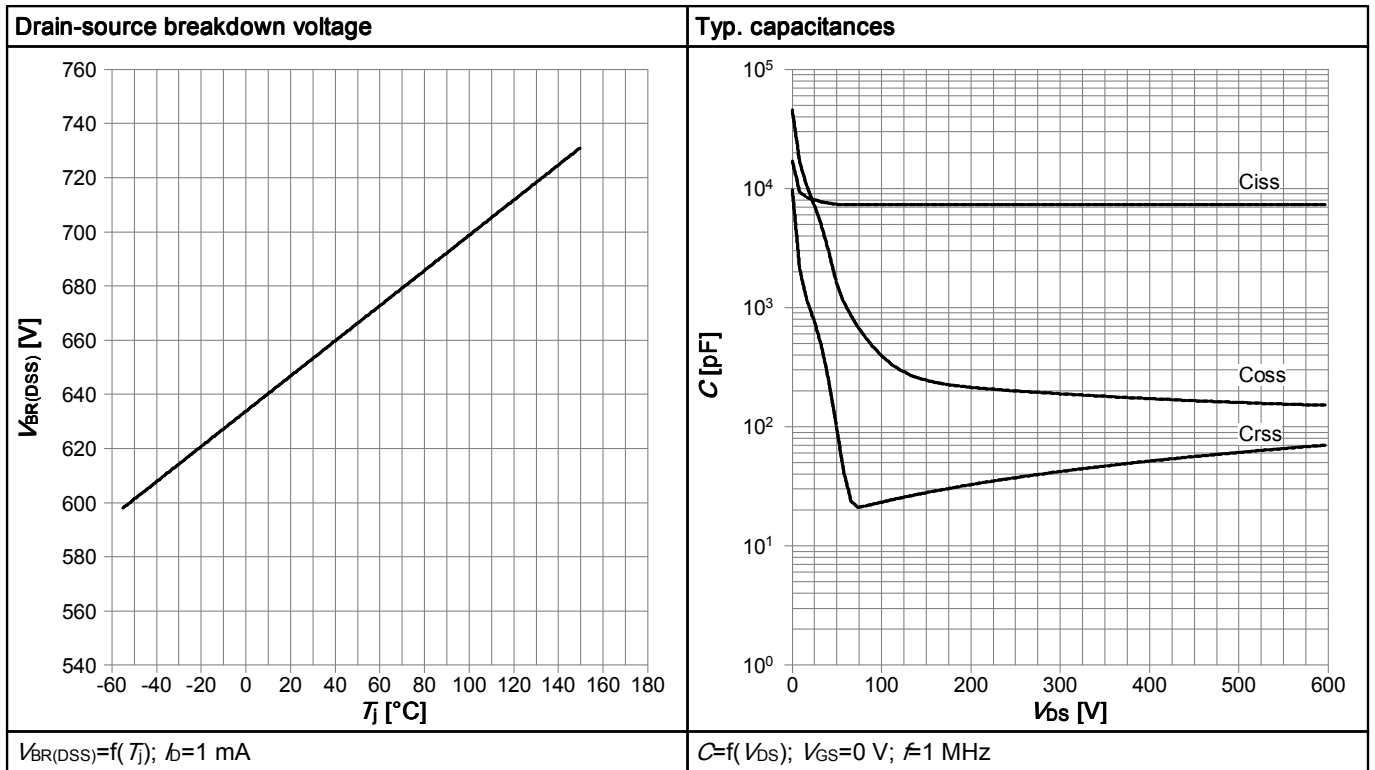


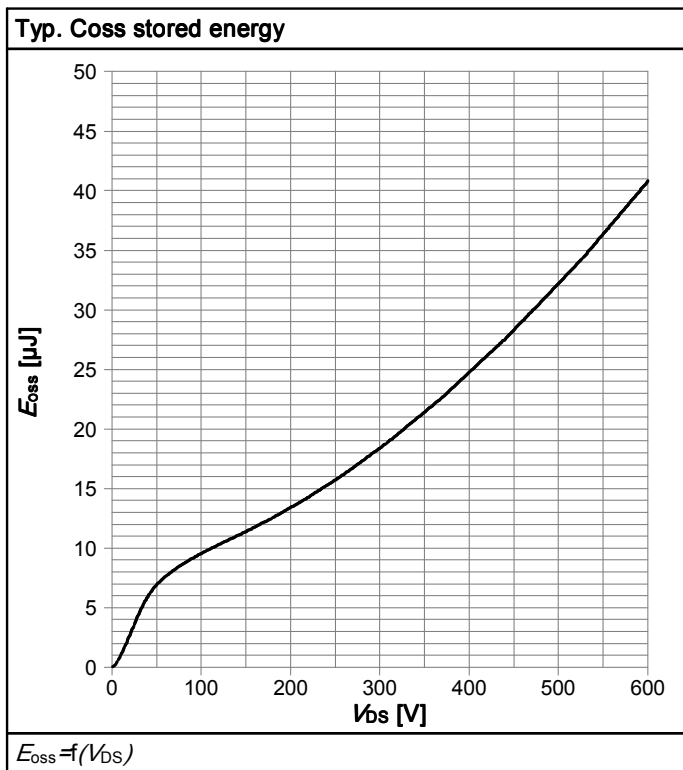
Table 13



**Table 14**



**Table 15**

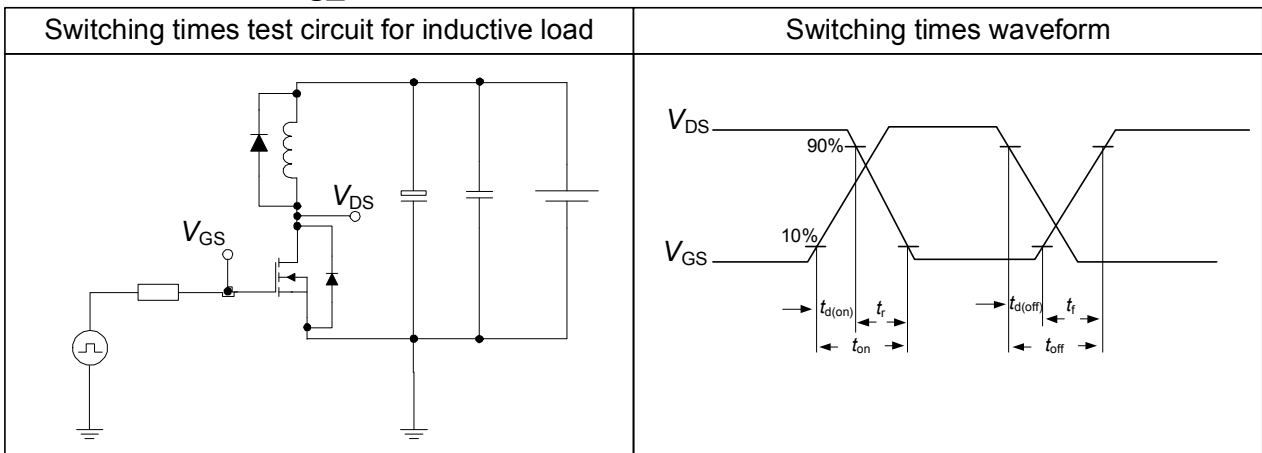


## 6 Test Circuits

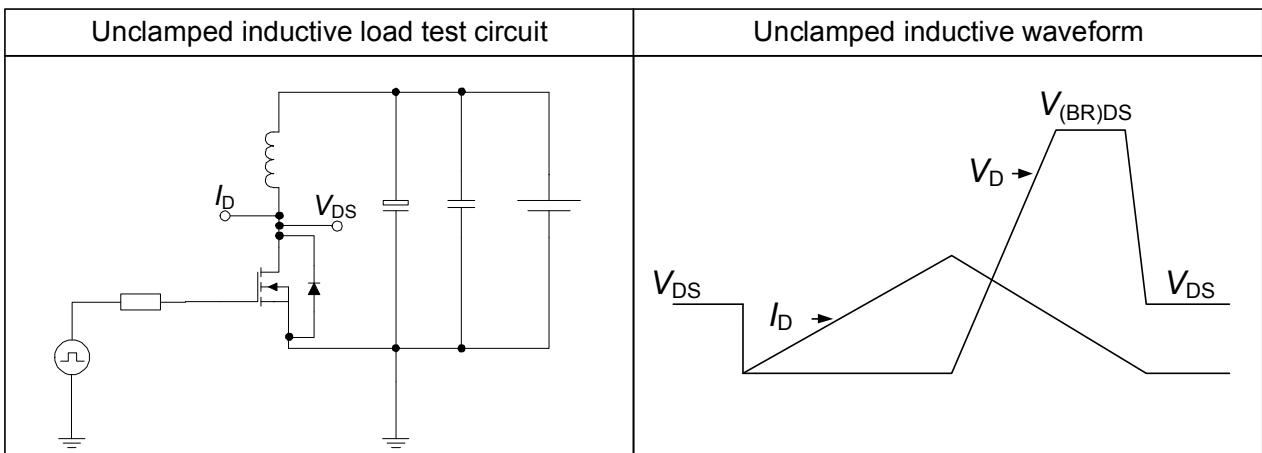
**Table 16 Diode\_characteristics**



**Table 17 Switching\_times**



**Table 18 Unclamped\_inductive**



### 7 Package Outlines

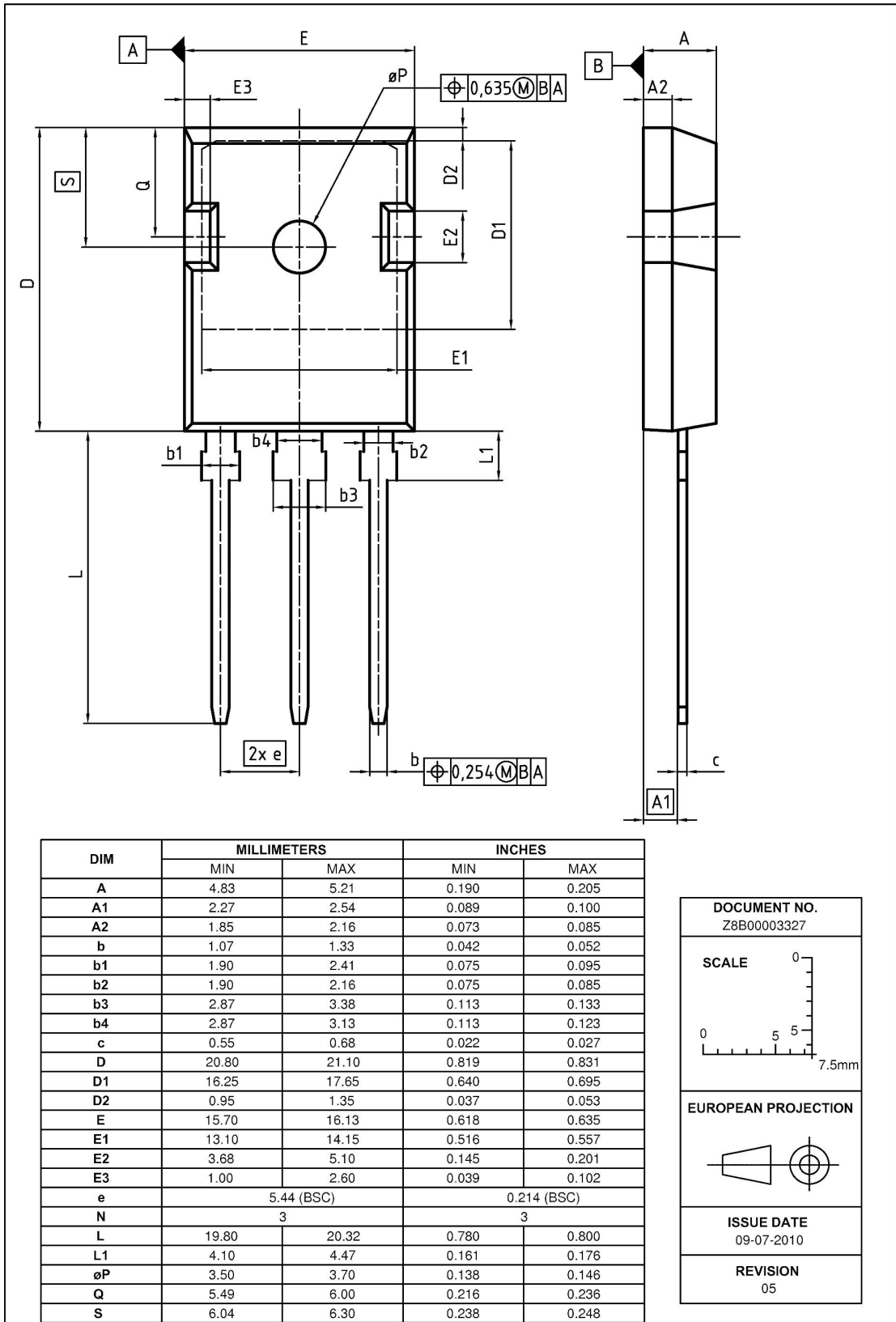


Figure 1 Outline PG-TO 247, dimensions in mm/inches

## 8 Appendix A

### Table 19 Related Links

- **IFX C6 Product Brief:**

<http://www.infineon.com/dgdl/Product+Brief+600V+CoolMOS+C6+.pdf?folderId=db3a3043156fd5730115939eb6b506db>

- **IFX C6 Portfolio:**

[http://www.infineon.com/cms/en/product/findProductTypeByName.html?q=ip\\*c6](http://www.infineon.com/cms/en/product/findProductTypeByName.html?q=ip*c6)

- **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

IPW65R037C6

**Revision: 2011-10-13, Rev. 2.0**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 1.9      | 2011-09-29 | release of preliminary datasheet             |
| 2.0      | 2011-10-13 | release of final datasheet                   |

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