



# BUK7E5R2-100E

N-channel TrenchMOS standard level FET

11 September 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel MOSFET in a SOT226 package using TrenchMOS technology. This product has been designed and qualified to AEC Q101 standard for use in high performance automotive applications.

### 1.2 Features and benefits

- AEC Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True standard level gate with VGS(th) rating of greater than 1V at 175 °C

### 1.3 Applications

- 12V, 24V and 48V Automotive systems
- Electric and electro-hydraulic power steering
- Motors, lamps and solenoid control
- Start-Stop micro-hybrid applications
- Transmission control
- Ultra high performance power switching

### 1.4 Quick reference data

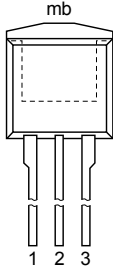
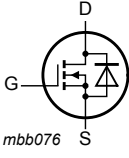
Table 1. Quick reference data

| Symbol                         | Parameter                        | Conditions   | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|--|-----|-----|-----|------|
| V <sub>DS</sub>                | drain-source voltage             | T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C  | -   | -   | 100 | V    |
| I <sub>D</sub>                 | drain current                    | V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>  | [1] | -   | 120 | A    |
| P <sub>tot</sub>               | total power dissipation          | T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>  | -   | -   | 349 | W    |
| <b>Static characteristics</b>  |                                  |  |     |     |     |      |
| R <sub>DSon</sub>              | drain-source on-state resistance | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>   | -   | 4.1 | 5.2 | mΩ   |
| <b>Dynamic characteristics</b> |                                  |  |     |     |     |      |
| Q <sub>GD</sub>                | gate-drain charge                | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; V <sub>DS</sub> = 80 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> | -   | 65  | -   | nC   |

[1] Continuous current is limited by package.

## 2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline  | Graphic symbol  |
|-----|--------|-----------------------------------|---|---|
| 1   | G      | gate                              |  <p>I2PAK (SOT226)</p> |  |
| 2   | D      | drain                             |   |   |
| 3   | S      | source                            |   |   |
| mb  | D      | mounting base; connected to drain |   |   |

## 3. Ordering information

Table 3. Ordering information

| Type number   | Package |  |         |
|---------------|---------|--|---------|
|               | Name    | Description                                  | Version |
| BUK7E5R2-100E | I2PAK   | plastic single-ended package (I2PAK); TO-262 | SOT226  |

## 4. Marking

Table 4. Marking codes

| Type number   | Marking code  |
|---------------|---------------|
| BUK7E5R2-100E | BUK7E5R2-100E |

## 5. Limiting values

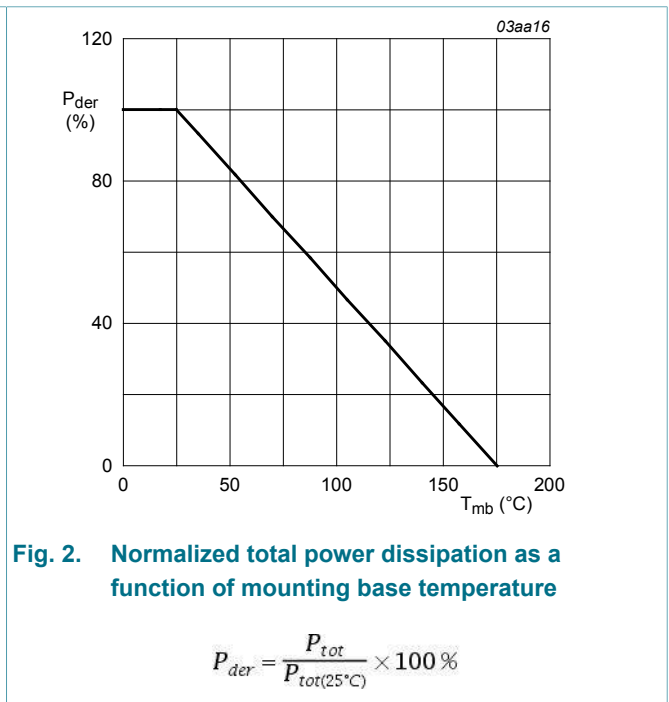
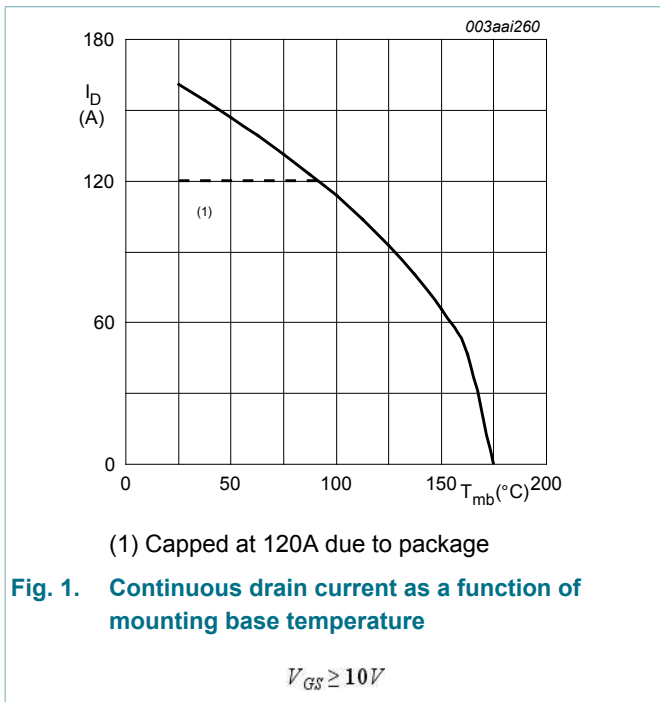
Table 5. Limiting values

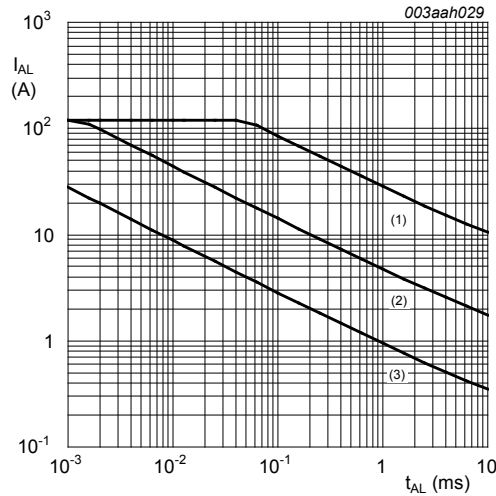
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter               | Conditions  | Min | Max | Unit |   |
|-----------|-------------------------|---|-----|-----|------|---|
| $V_{DS}$  | drain-source voltage    | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$                          | -   | 100 | V    |   |
| $V_{DGR}$ | drain-gate voltage      | $R_{GS} = 20\text{ k}\Omega$  | -   | 100 | V    |   |
| $V_{GS}$  | gate-source voltage     | $T_j \leq 175\text{ °C}$ ; DC   | -20 | 20  | V    |   |
| $I_D$     | drain current           | $T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; Fig. 1                   | [1] | -   | 120  | A |
|           |                         | $T_{mb} = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; Fig. 1                  |     | -   | 112  | A |
| $I_{DM}$  | peak drain current      | $T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; Fig. 4 | -   | 631 | A    |   |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ °C}$ ; Fig. 2  | -   | 349 | W    |   |
| $T_{stg}$ | storage temperature     |   | -55 | 175 | °C   |   |

| Symbol                      | Parameter                                    | Conditions  |        | Min | Max | Unit |
|-----------------------------|--|---|--------|-----|-----|------|
| T <sub>j</sub>              | junction temperature                         |   |        | -55 | 175 | °C   |
| <b>Source-drain diode</b>   |  |   |        |     |     |      |
| I <sub>S</sub>              | source current                               | T <sub>mb</sub> = 25 °C   | [1]    | -   | 120 | A    |
| I <sub>SM</sub>             | peak source current                          | pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C   |        | -   | 631 | A    |
| <b>Avalanche ruggedness</b> |  |   |        |     |     |      |
| E <sub>DS(AL)S</sub>        | non-repetitive drain-source avalanche energy | I <sub>D</sub> = 120 A; V <sub>sup</sub> ≤ 100 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; <a href="#">Fig. 3</a> | [2][3] | -   | 387 | mJ   |

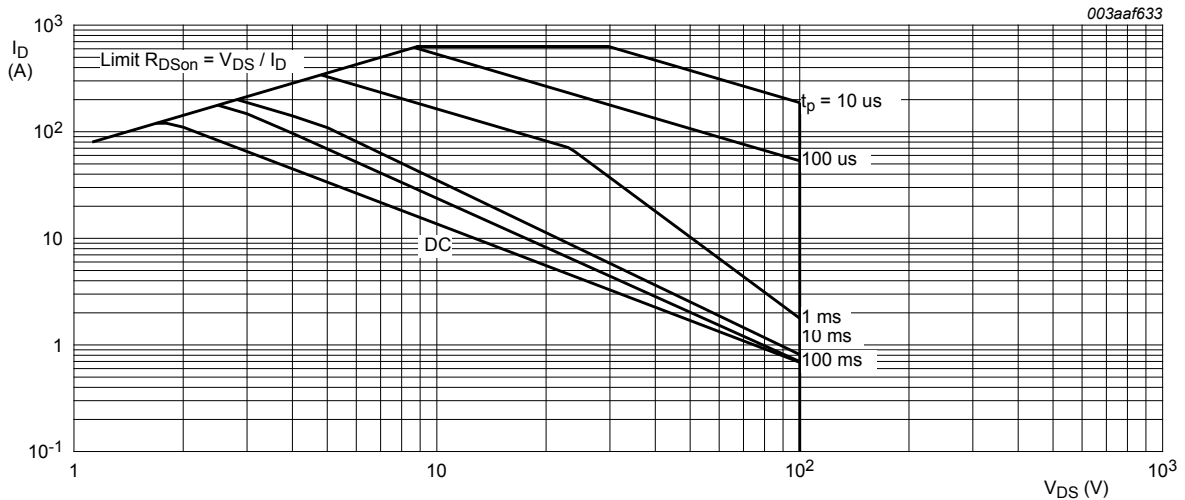
- [1] Continuous current is limited by package.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.





**Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time**

(1)  $T_{j (init)} = 25^{\circ}C$ ; (2)  $T_{j (init)} = 150^{\circ}C$ ; (3) Repetitive Avalanche



**Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

$T_{mb} = 25^{\circ}C$ ;  $I_{DM}$  is a single pulse

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol         | Parameter   | Conditions             | Min | Typ | Max  | Unit |
|----------------|---|------------------------|-----|-----|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | <a href="#">Fig. 5</a> | -   | -   | 0.43 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | vertical in still air  | -   | 65  | -    | K/W  |

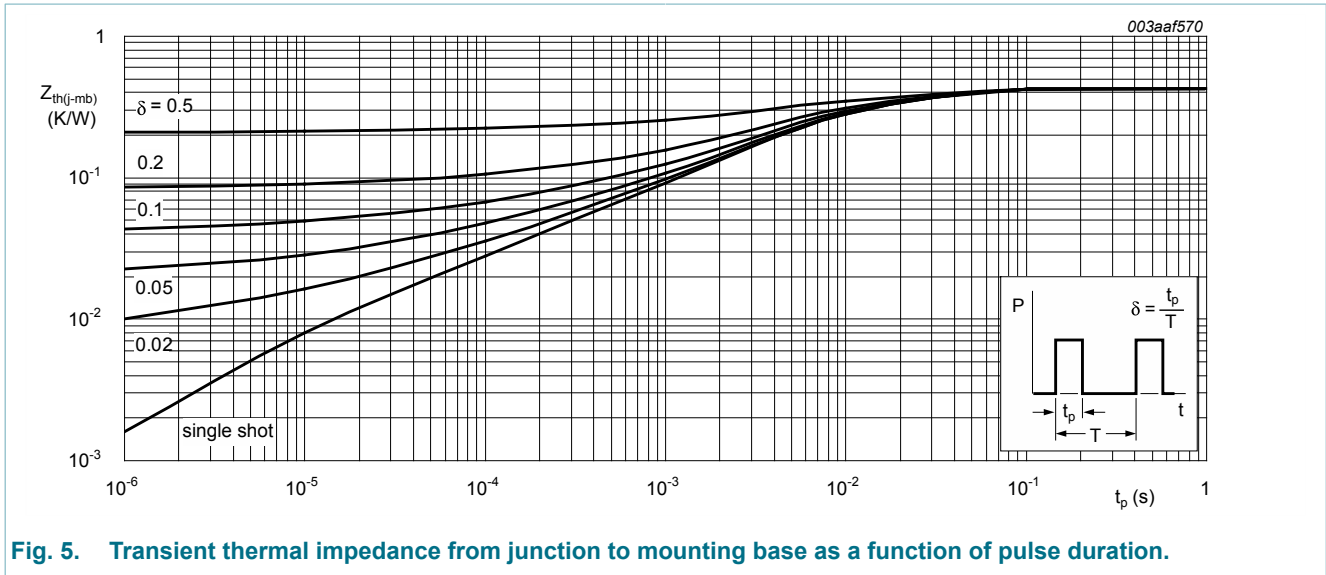


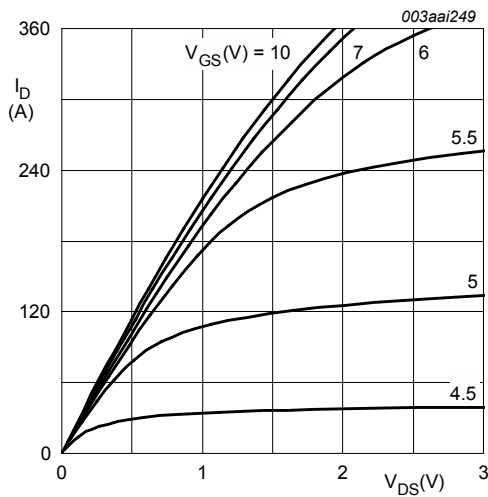
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

## 7. Characteristics

Table 7. Characteristics

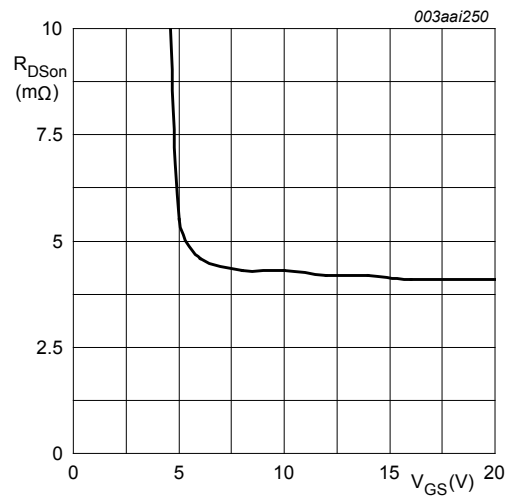
| Symbol                         | Parameter                        | Conditions   | Min | Typ  | Max | Unit       |
|--------------------------------|----------------------------------|--|-----|------|-----|------------|
| <b>Static characteristics</b>  |                                  |  |     |      |     |            |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage   | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$   | 100 | -    | -   | V          |
|                                |                                  | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$  | 90  | -    | -   | V          |
| $V_{GS(th)}$                   | gate-source threshold voltage    | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$<br><a href="#">Fig. 9; Fig. 10</a>                                 | 2.4 | 3    | 4   | V          |
|                                |                                  | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$<br><a href="#">Fig. 9</a>   | -   | -    | 4.5 | V          |
| $V_{GS(th)}$                   | gate-source threshold voltage    | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$<br><a href="#">Fig. 9</a>   | 1   | -    | -   | V          |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$  | -   | 0.15 | 2   | $\mu A$    |
|                                |                                  | $V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$   | -   | -    | 500 | $\mu A$    |
| $I_{GSS}$                      | gate leakage current             | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$   | -   | 2    | 100 | nA         |
|                                |                                  | $V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$  | -   | 2    | 100 | nA         |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C;$<br><a href="#">Fig. 11</a>                                   | -   | 4.1  | 5.2 | m $\Omega$ |
|                                |                                  | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ C;$<br><a href="#">Fig. 11; Fig. 12</a>                         | -   | -    | 14  | m $\Omega$ |
| <b>Dynamic characteristics</b> |                                  |  |     |      |     |            |
| $Q_{G(tot)}$                   | total gate charge                | $I_D = 25 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 10 \text{ V};$<br>$T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 13; Fig. 14</a> | -   | 180  | -   | nC         |
| $Q_{GS}$                       | gate-source charge               |  | -   | 34   | -   | nC         |
| $Q_{GD}$                       | gate-drain charge                |  | -   | 65   | -   | nC         |

| Symbol                    | Parameter                    | Conditions  | Min | Typ  | Max   | Unit |
|---------------------------|------------------------------|---|-----|------|-------|------|
| $C_{iss}$                 | input capacitance            | $V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$                        | -   | 8860 | 11810 | pF   |
| $C_{oss}$                 | output capacitance           | $T_j = 25\text{ °C};$ <a href="#">Fig. 15</a>   | -   | 770  | 925   | pF   |
| $C_{rss}$                 | reverse transfer capacitance |   | -   | 546  | 750   | pF   |
| $t_{d(on)}$               | turn-on delay time           | $V_{DS} = 80\text{ V}; R_L = 3.2\text{ }\Omega; V_{GS} = 10\text{ V};$                | -   | 37   | -     | ns   |
| $t_r$                     | rise time                    | $R_{G(ext)} = 5\text{ }\Omega$  | -   | 62   | -     | ns   |
| $t_{d(off)}$              | turn-off delay time          |   | -   | 158  | -     | ns   |
| $t_f$                     | fall time                    |   | -   | 80   | -     | ns   |
| $L_D$                     | internal drain inductance    | from upper edge of drain mounting base to centre of die                               | -   | 2.5  | -     | nH   |
|                           |                              | from drain lead 6mm from package to centre of die                                     | -   | 4.5  | -     | nH   |
| $L_S$                     | internal source inductance   | measured from source lead to source bond pad  | -   | 7.5  | -     | nH   |
| <b>Source-drain diode</b> |                              |   |     |      |       |      |
| $V_{SD}$                  | source-drain voltage         | $I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C};$ <a href="#">Fig. 16</a> | -   | 0.77 | 1.2   | V    |
| $t_{rr}$                  | reverse recovery time        | $I_S = 20\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$        | -   | 65   | -     | ns   |
| $Q_r$                     | recovered charge             | $V_{DS} = 25\text{ V}$  | -   | 191  | -     | nC   |



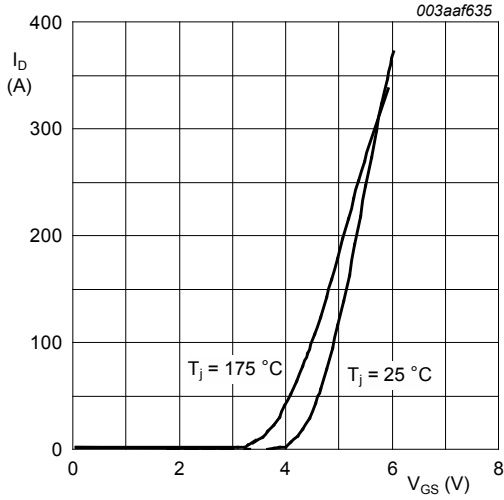
$T_j = 25\text{ °C}; t_p = 300\text{ }\mu\text{s}$

**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**



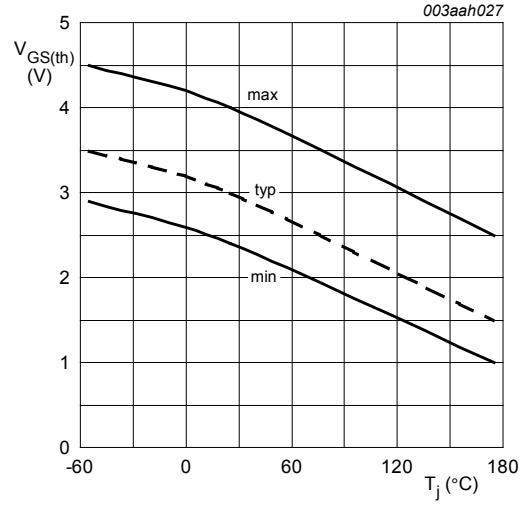
**Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**

$T_j = 25\text{ °C}; I_D = 25\text{ A}$



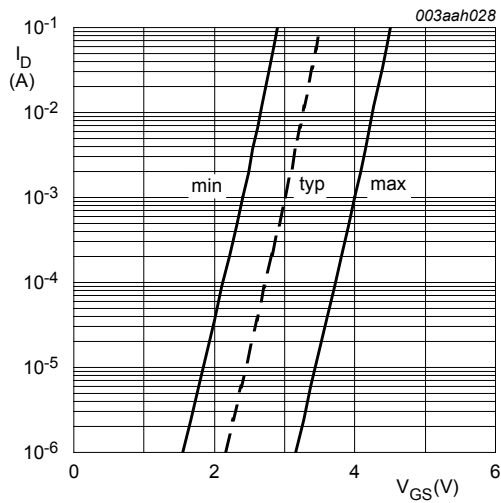
**Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values**

$V_{DS} = 12V$



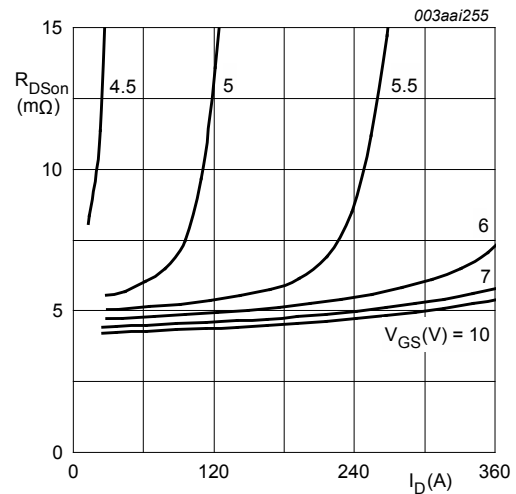
**Fig. 9. Gate-source threshold voltage as a function of junction temperature**

$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$



**Fig. 10. Sub-threshold drain current as a function of gate-source voltage**

$T_j = 25^\circ\text{C}; V_{DS} = 5V$



$T_j = 25^\circ\text{C}; t_p = 300 \mu\text{s}$

**Fig. 11. Drain-source on-state resistance as a function of drain current; typical values**

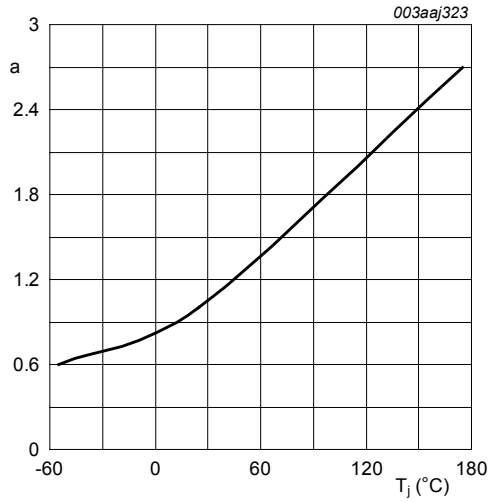
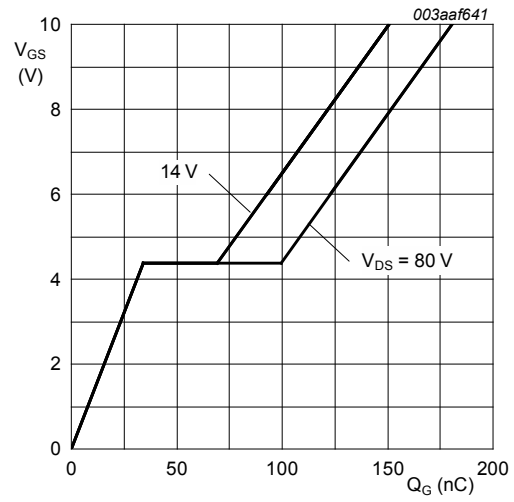


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

$$a = \frac{R_{DS(on)}}{R_{DS(on)}(25^\circ\text{C})}$$



$T_j = 25^\circ\text{C}$ ;  $I_D = 25\text{ A}$

Fig. 13. Gate-source voltage as a function of gate charge; typical values

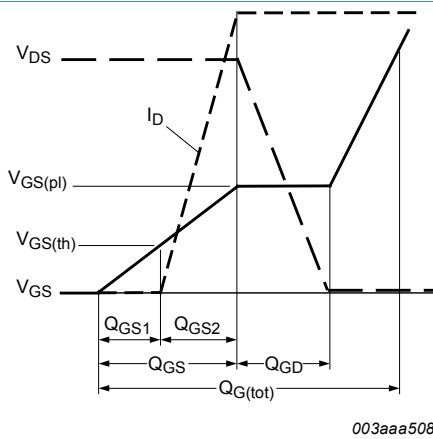
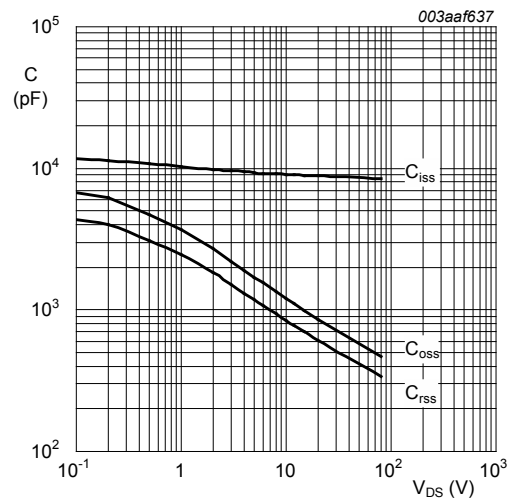


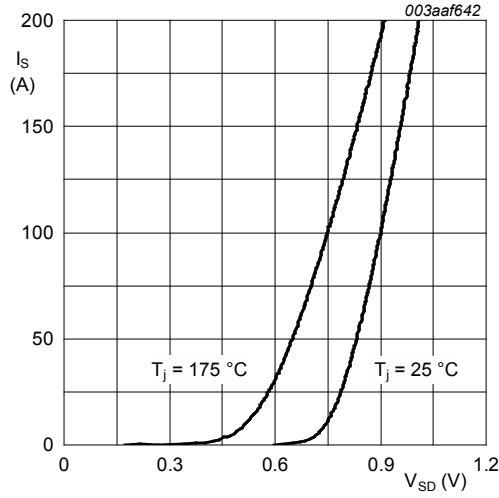
Fig. 14. Gate charge waveform definitions



$V_{GS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values





$V_{GS} = 0\text{ V}$

**Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values**

## 8. Package outline

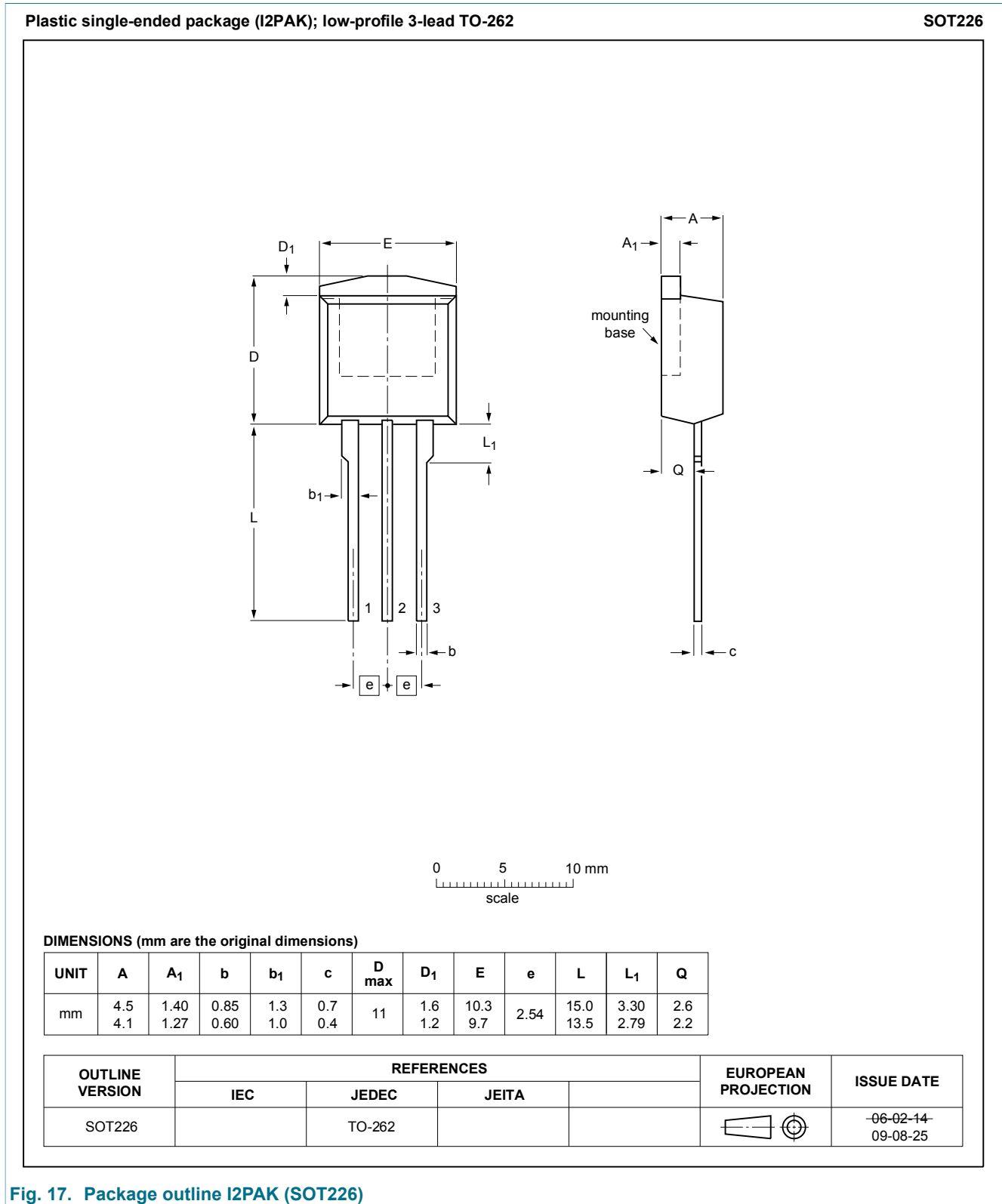


Fig. 17. Package outline I2PAK (SOT226)

## 9. Legal information

### 9.1 Data sheet status

| Document status [1][2]         | Product status [3] | Definition  |
|--------------------------------|--------------------|---|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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