



# BUK761R6-40E

N-channel TrenchMOS standard level FET

5 September 2013

Product data sheet

## 1. General description

Standard level N-channel MOSFET in a SOT404A package using TrenchMOS technology. This product has been designed and qualified to AEC Q101 standard for use in high performance automotive applications.

## 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  $V_{GS(th)}$  rating of greater than 1 V at 175 °C

## 3. Applications

- 12 V 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

## 4. Quick reference data

Table 1. Quick reference data

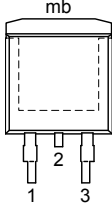
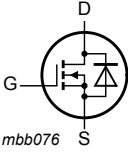
| Symbol                         | Parameter                        | Conditions                                                                                                                | Min | Typ  | Max  | Unit |
|--------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| $V_{DS}$                       | drain-source voltage             | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$                                                                        | -   | -    | 40   | V    |
| $I_D$                          | drain current                    | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>                                                 | [1] | -    | 120  | A    |
| $P_{tot}$                      | total power dissipation          | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>                                                                          | -   | -    | 349  | W    |
| <b>Static characteristics</b>  |                                  |                                                                                                                           |     |      |      |      |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a>                             | -   | 1.3  | 1.57 | mΩ   |
| <b>Dynamic characteristics</b> |                                  |                                                                                                                           |     |      |      |      |
| $Q_{GD}$                       | gate-drain charge                | $V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 32\text{ V}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> | -   | 48.2 | -    | nC   |

[1] Continuous current is limited by package.



## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline                                                                                   | Graphic symbol                                                                                |
|-----|--------|-----------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1   | G      | gate                              | <br>D2PAK (SOT404A) | <br>mbb076 |
| 2   | D      | drain                             |                                                                                                      |                                                                                               |
| 3   | S      | source                            |                                                                                                      |                                                                                               |
| mb  | D      | mounting base; connected to drain |                                                                                                      |                                                                                               |

## 6. Ordering information

Table 3. Ordering information

| Type number  | Package |                                                                                  |         |
|--------------|---------|----------------------------------------------------------------------------------|---------|
|              | Name    | Description                                                                      | Version |
| BUK761R6-40E | D2PAK   | plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) | SOT404A |

## 7. Marking

Table 4. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| BUK761R6-40E | BUK761R6-40E |

## 8. Limiting values

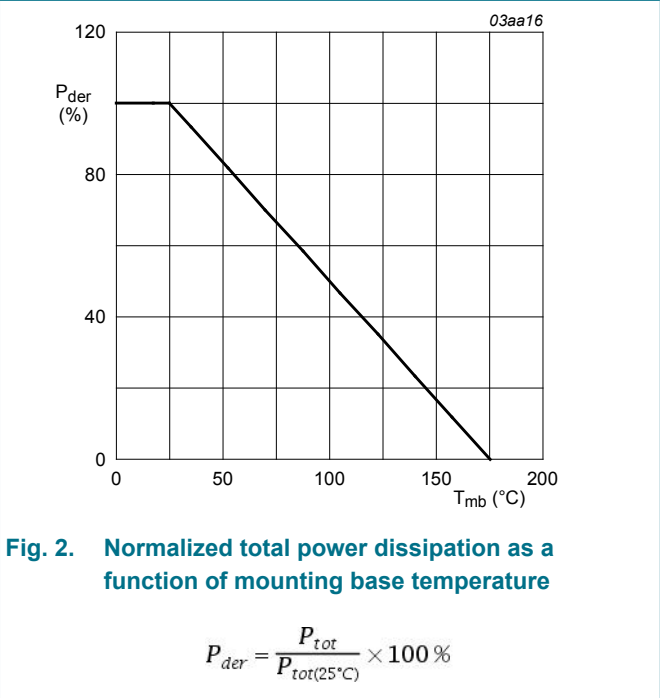
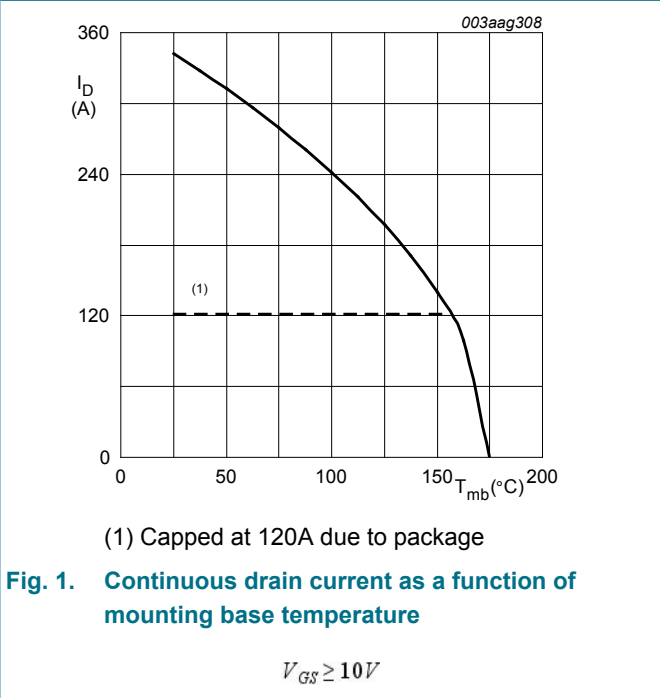
Table 5. Limiting values

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

| Symbol    | Parameter               | Conditions                                                                                |     | Min | Max  | Unit               |
|-----------|-------------------------|-------------------------------------------------------------------------------------------|-----|-----|------|--------------------|
| $V_{DS}$  | drain-source voltage    | $T_j \geq 25\text{ }^{\circ}\text{C}$ ; $T_j \leq 175\text{ }^{\circ}\text{C}$            |     | -   | 40   | V                  |
| $V_{DGR}$ | drain-gate voltage      | $R_{GS} = 20\text{ k}\Omega$                                                              |     | -   | 40   | V                  |
| $V_{GS}$  | gate-source voltage     | $T_j \leq 175\text{ }^{\circ}\text{C}$ ; DC                                               |     | -20 | 20   | V                  |
| $I_D$     | drain current           | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; $V_{GS} = 10\text{ V}$ ; Fig. 1                   | [1] | -   | 120  | A                  |
|           |                         | $T_{mb} = 100\text{ }^{\circ}\text{C}$ ; $V_{GS} = 10\text{ V}$ ; Fig. 1                  | [1] | -   | 120  | A                  |
| $I_{DM}$  | peak drain current      | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; Fig. 4 |     | -   | 1355 | A                  |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; Fig. 2                                            |     | -   | 349  | W                  |
| $T_{stg}$ | storage temperature     |                                                                                           |     | -55 | 175  | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature    |                                                                                           |     | -55 | 175  | $^{\circ}\text{C}$ |

| Symbol               | Parameter                                    | Conditions                                                                                                                                                                                          |        | Min | Max  | Unit |
|----------------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|------|------|
| Source-drain diode   |                                              |                                                                                                                                                                                                     |        |     |      |      |
| $I_S$                | source current                               | $T_{mb} = 25\text{ }^{\circ}\text{C}$                                                                                                                                                               | [1]    | -   | 120  | A    |
| $I_{SM}$             | peak source current                          | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^{\circ}\text{C}$                                                                                                                    |        | -   | 1355 | A    |
| Avalanche ruggedness |                                              |                                                                                                                                                                                                     |        |     |      |      |
| $E_{DS(AL)S}$        | non-repetitive drain-source avalanche energy | $I_D = 120\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; unclamped;<br><a href="#">Fig. 3</a> | [2][3] | -   | 1008 | 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.



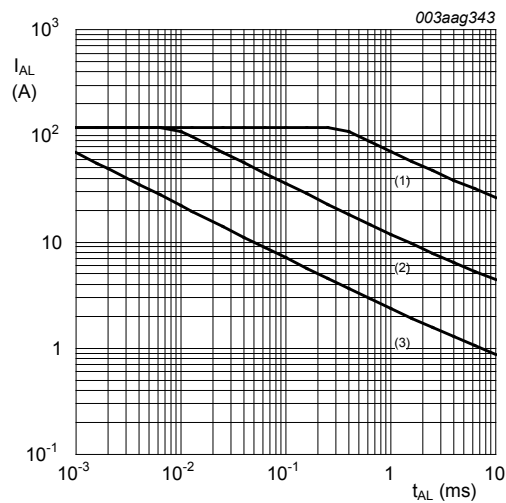


Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

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

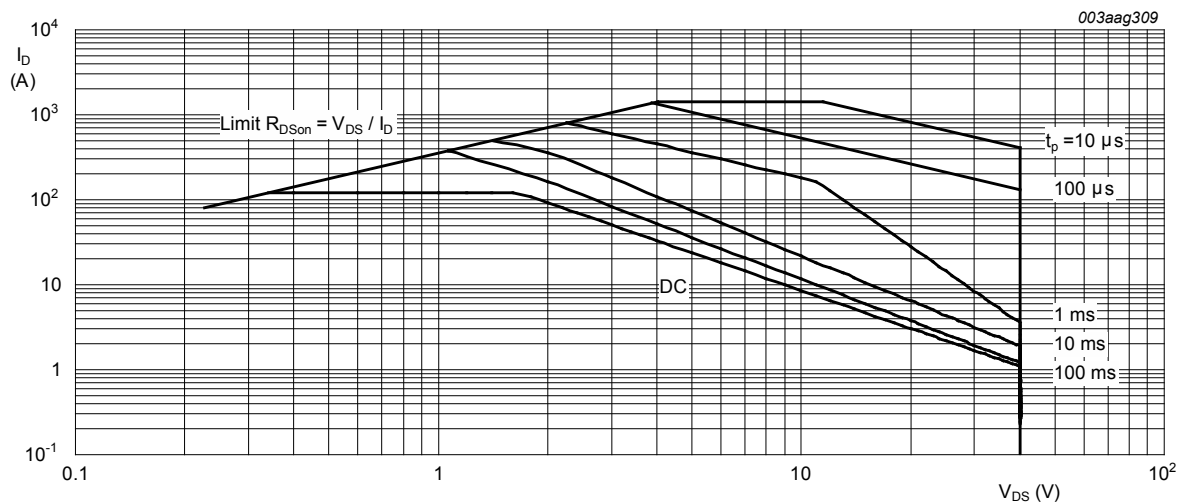


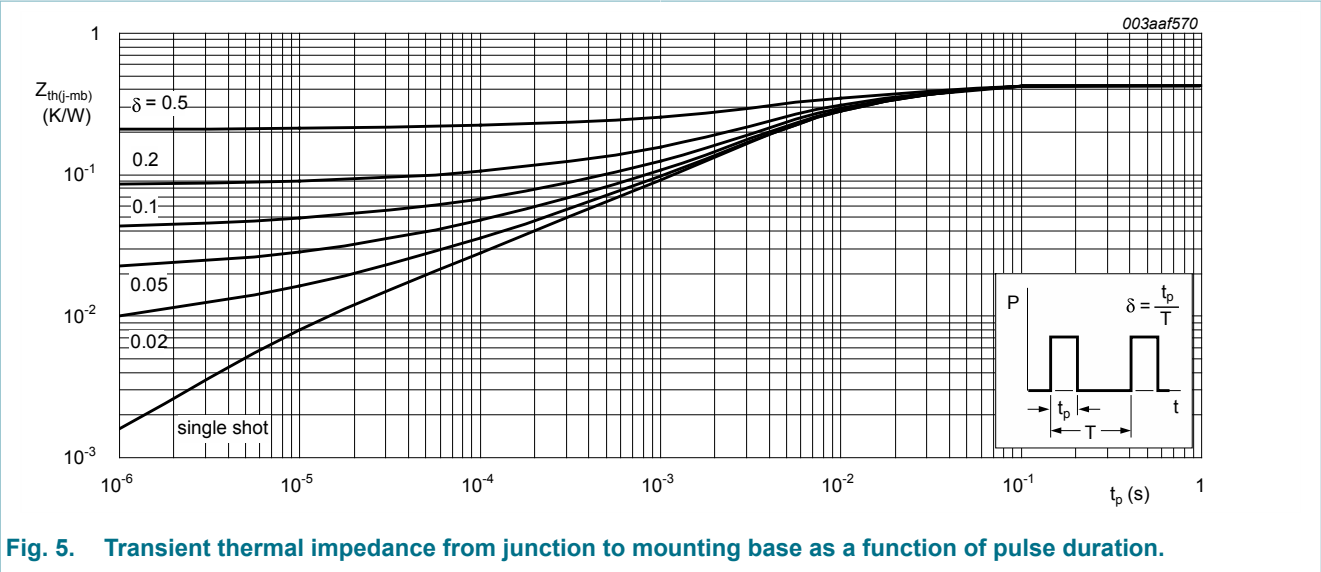
Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter                                         | Conditions                                             | Min | Typ | Max  | Unit |
|----------------|---------------------------------------------------|--------------------------------------------------------|-----|-----|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 5                                                 | -   | -   | 0.43 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | minimum footprint ; mounted on a printed-circuit board | -   | 50  | -    | K/W  |

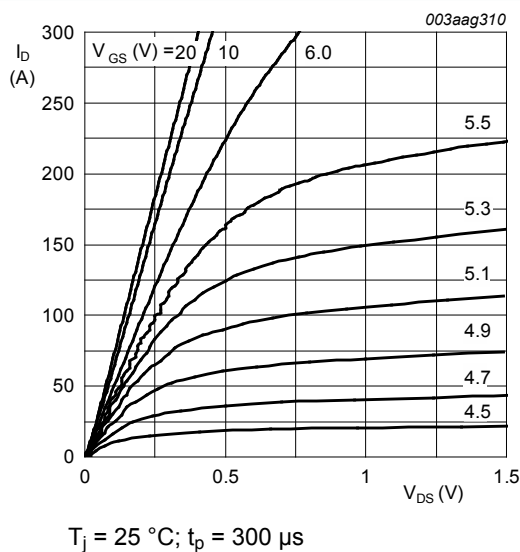


10. Characteristics

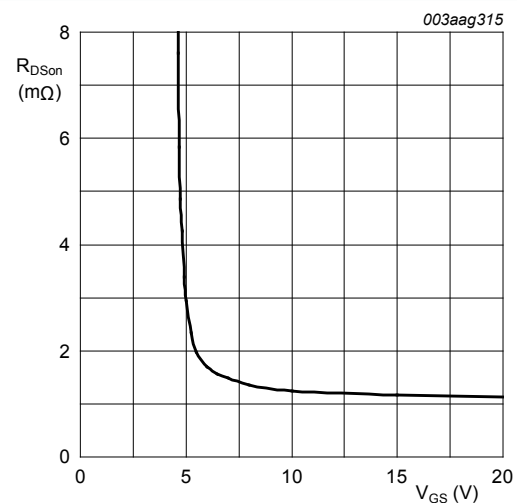
Table 7. Characteristics

| Symbol                  | Parameter                        | Conditions                                                                                                                          |  | Min | Typ  | Max  | Unit |
|-------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--|-----|------|------|------|
| Static characteristics  |                                  |                                                                                                                                     |  |     |      |      |      |
| V <sub>(BR)DSS</sub>    | drain-source breakdown voltage   | I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                              |  | 40  | -    | -    | V    |
|                         |                                  | I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>J</sub> = -55 °C                                                             |  | 36  | -    | -    | V    |
| V <sub>GS(th)</sub>     | gate-source threshold voltage    | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>J</sub> = 25 °C; <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a> |  | 2.4 | 3    | 4    | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>J</sub> = -55 °C; <a href="#">Fig. 10</a>                         |  | -   | -    | 4.5  | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>J</sub> = 175 °C; <a href="#">Fig. 10</a>                         |  | 1   | -    | -    | V    |
| I <sub>DSS</sub>        | drain leakage current            | V <sub>DS</sub> = 40 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                               |  | -   | 0.25 | 2    | μA   |
|                         |                                  | V <sub>DS</sub> = 40 V; V <sub>GS</sub> = 0 V; T <sub>J</sub> = 175 °C                                                              |  | -   | -    | 500  | μA   |
| I <sub>GSS</sub>        | gate leakage current             | V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                               |  | -   | 2    | 100  | nA   |
|                         |                                  | V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V; T <sub>J</sub> = 25 °C                                                              |  | -   | 2    | 100  | nA   |
| 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>                                      |  | -   | 1.3  | 1.57 | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>J</sub> = 175 °C; <a href="#">Fig. 12</a> ; <a href="#">Fig. 11</a>           |  | -   | -    | 3    | mΩ   |
| Dynamic characteristics |                                  |                                                                                                                                     |  |     |      |      |      |
| Q <sub>G(tot)</sub>     | total gate charge                | I <sub>D</sub> = 25 A; V <sub>DS</sub> = 32 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>            |  | -   | 145  | -    | nC   |
| Q <sub>GS</sub>         | gate-source charge               |                                                                                                                                     |  | -   | 35.7 | -    | nC   |
| Q <sub>GD</sub>         | gate-drain charge                |                                                                                                                                     |  | -   | 48.2 | -    | nC   |

| Symbol                    | Parameter                    | Conditions                                                                                                                    | Min | Typ  | Max   | Unit |
|---------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----|------|-------|------|
| $C_{iss}$                 | input capacitance            | $V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$<br>$T_j = 25\text{ }^{\circ}\text{C};$ <a href="#">Fig. 15</a> | -   | 8500 | 11340 | pF   |
| $C_{oss}$                 | output capacitance           |                                                                                                                               | -   | 1620 | 1950  | pF   |
| $C_{rss}$                 | reverse transfer capacitance |                                                                                                                               | -   | 985  | 1350  | pF   |
| $t_{d(on)}$               | turn-on delay time           | $V_{DS} = 30\text{ V}; R_L = 1.2\text{ }\Omega; V_{GS} = 10\text{ V};$<br>$R_{G(ext)} = 5\text{ }\Omega$                      | -   | 42   | -     | ns   |
| $t_r$                     | rise time                    |                                                                                                                               | -   | 60   | -     | ns   |
| $t_{d(off)}$              | turn-off delay time          |                                                                                                                               | -   | 121  | -     | ns   |
| $t_f$                     | fall time                    |                                                                                                                               | -   | 83   | -     | ns   |
| $L_D$                     | internal drain inductance    | from upper edge of drain mounting base to center of die                                                                       | -   | 2.5  | -     | nH   |
| $L_S$                     | internal source inductance   | from source lead to source bonding pad                                                                                        | -   | 7.5  | -     | nH   |
| <b>Source-drain diode</b> |                              |                                                                                                                               |     |      |       |      |
| $V_{SD}$                  | source-drain voltage         | $I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C};$ <a href="#">Fig. 16</a>                           | -   | 0.77 | 1.2   | V    |
| $t_{rr}$                  | reverse recovery time        | $I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$<br>$V_{DS} = 25\text{ V}$                      | -   | 56   | -     | ns   |
| $Q_r$                     | recovered charge             |                                                                                                                               | -   | 94   | -     | nC   |



**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**

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

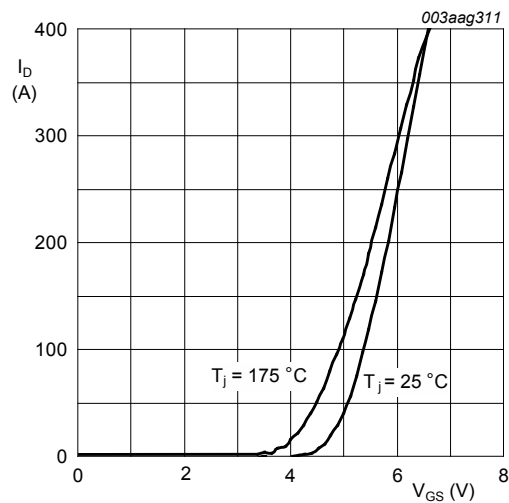


Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 12\text{ V}$

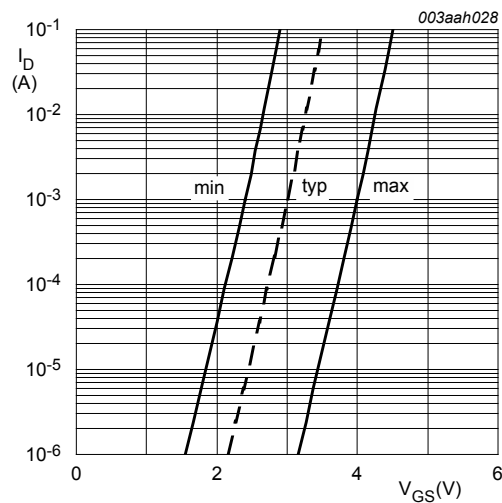


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

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

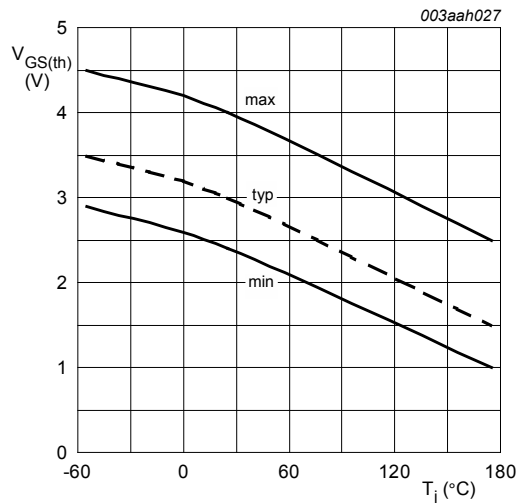


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

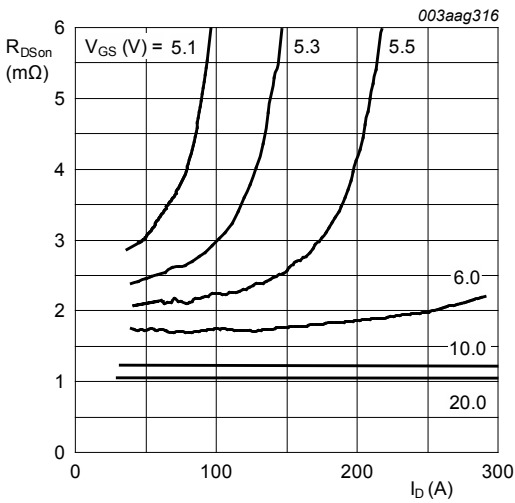


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

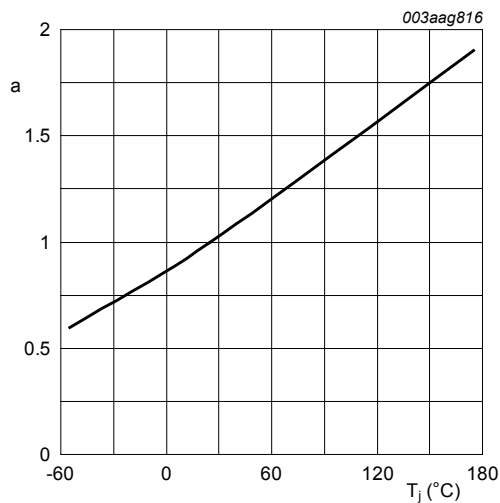


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

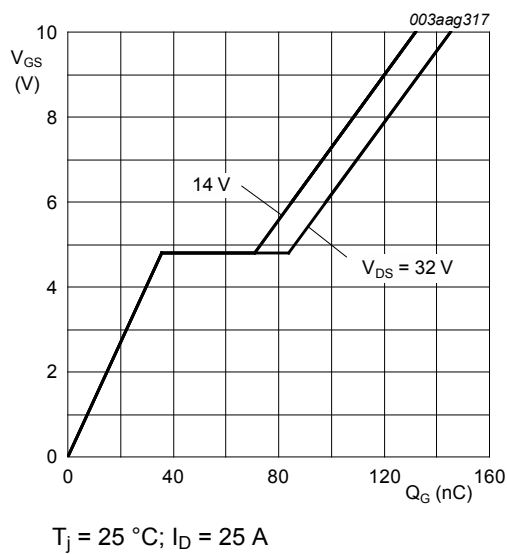


Fig. 14. Gate-source voltage as a function of gate charge; typical values

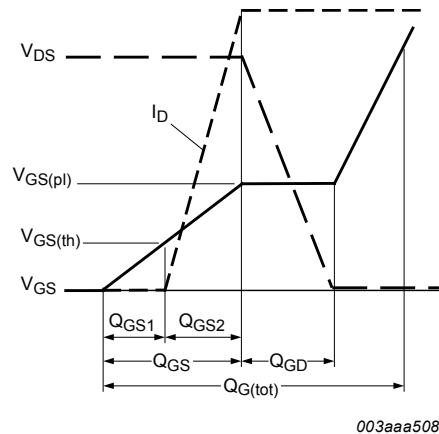


Fig. 13. Gate charge waveform definitions

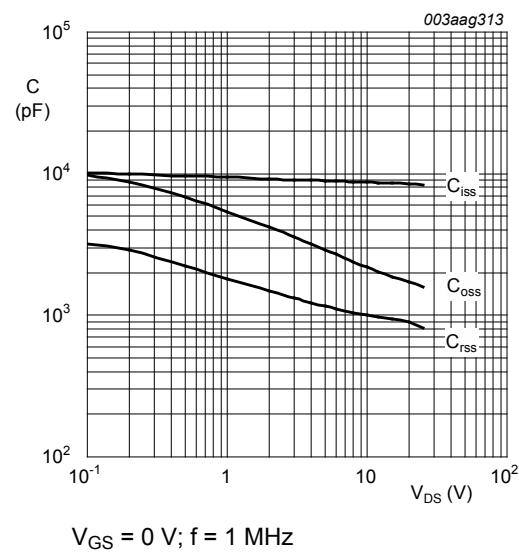
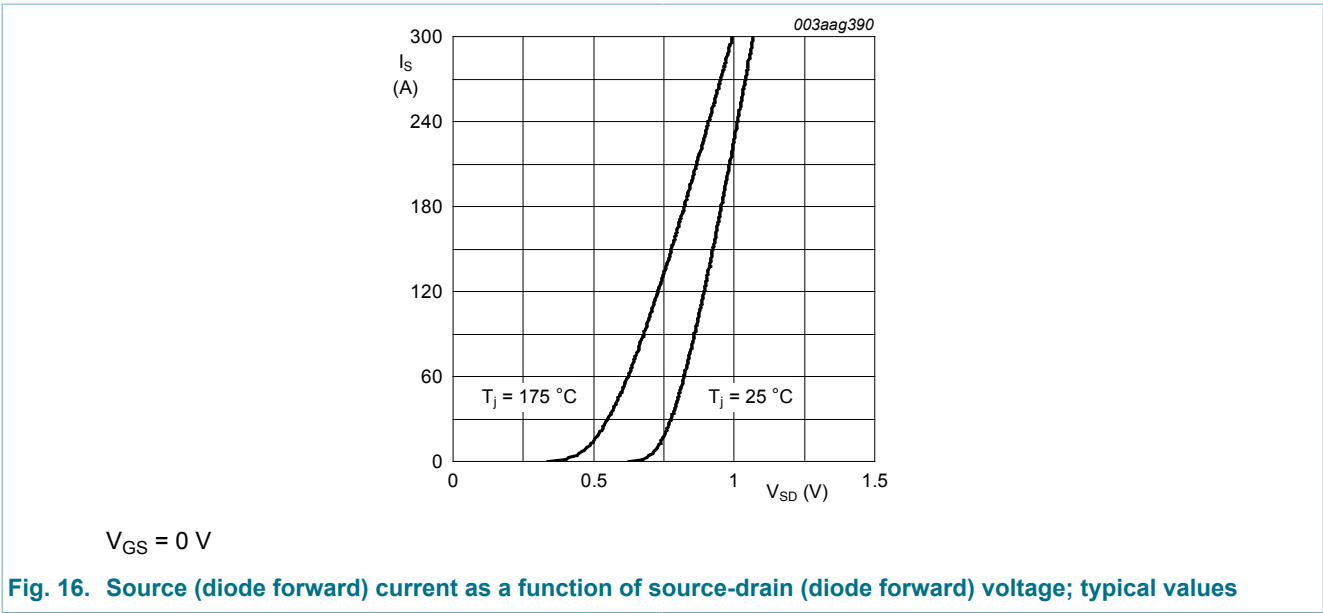


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values





11. Package outline

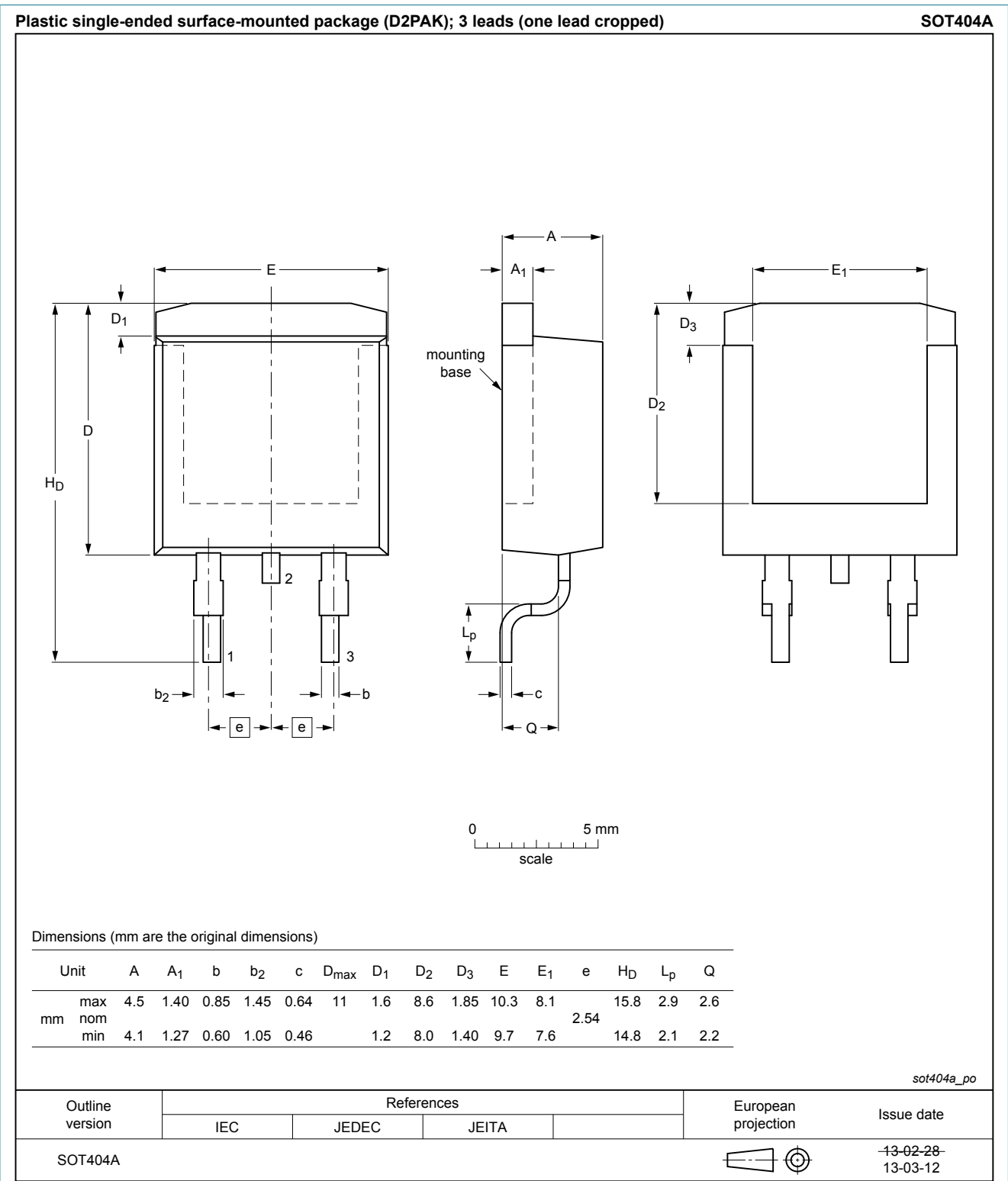


Fig. 17. Package outline D2PAK (SOT404A)

## 12. Legal information

### 12.1 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.                                     |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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13. Contents

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