



# BUK764R4-60E

N-channel TrenchMOS standard level FET

28 July 2016

Product data sheet

## 1. General description

Standard level N-channel MOSFET in a SOT404 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 VGS(th) rating of greater than 1V at 175 °C

## 3. Applications

- 12 V Automotive systems
- 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 <sub>DS</sub>                | drain-source voltage             | T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C  | -   | -    | 60  | V    |
| I <sub>D</sub>                 | drain current                    | V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>  | [1] | -    | 100 | A    |
| P <sub>tot</sub>               | total power dissipation          | T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>  | -   | -    | 234 | 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>                           | -   | 3.23 | 4.5 | mΩ   |
| <b>Dynamic characteristics</b> |                                  |  |     |      |     |      |
| Q <sub>GD</sub>                | gate-drain charge                | I <sub>D</sub> = 25 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> | -   | 26.1 | -   | 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                              |  <p>D2PAK (SOT404)</p> |  <p>mbb076</p> |
| 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 |
| BUK764R4-60E | D2PAK   | plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) | SOT404  |

## 7. Marking

Table 4. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| BUK764R4-60E | BUK764R4-60E |

## 8. Limiting values

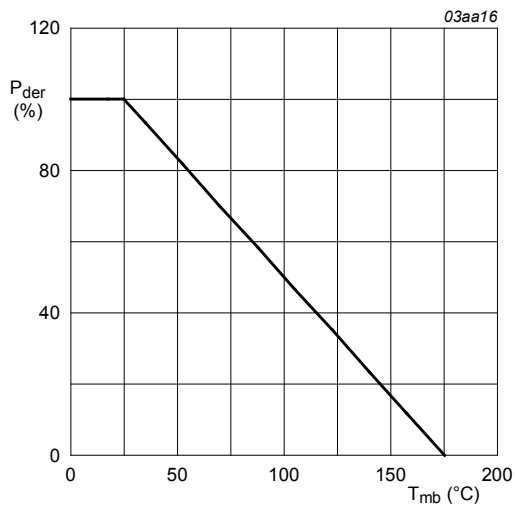
Table 5. Limiting values

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

| Symbol    | Parameter               | Conditions  |     | Min | Max | Unit |
|-----------|-------------------------|---|-----|-----|-----|------|
| $V_{DS}$  | drain-source voltage    | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$  |     | -   | 60  | V    |
| $V_{DGR}$ | drain-gate voltage      | $R_{GS} = 20\text{ k}\Omega$  |     | -   | 60  | V    |
| $V_{GS}$  | gate-source voltage     | $T_j \leq 175\text{ °C}$ ; DC   |     | -20 | 20  | V    |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>  |     | -   | 234 | W    |
| $I_D$     | drain current           | $T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 2</a>                   | [1] | -   | 100 | A    |
|           |                         | $T_{mb} = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 2</a>                  | [1] | -   | 100 | A    |
| $I_{DM}$  | peak drain current      | $T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <a href="#">Fig. 3</a> |     | -   | 620 | A    |
| $T_{stg}$ | storage temperature     |   |     | -55 | 175 | °C   |
| $T_j$     | junction temperature    |   |     | -55 | 175 | °C   |

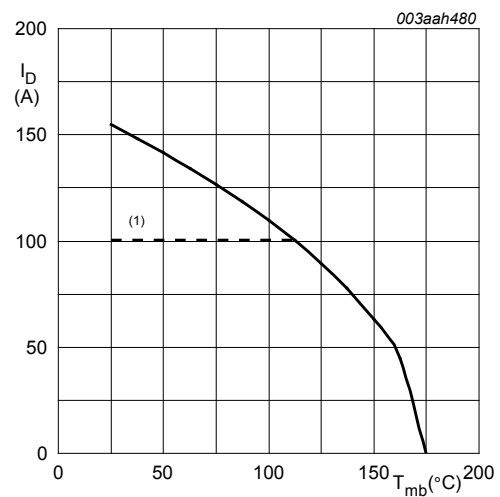
| Symbol                      | Parameter                                    | Conditions   |        | Min | Max | Unit |
|-----------------------------|--|--|--------|-----|-----|------|
| <b>Source-drain diode</b>   |  |  |        |     |     |      |
| $I_S$                       | source current                               | $T_{mb} = 25\text{ °C}$  | [1]    | -   | 100 | A    |
| $I_{SM}$                    | peak source current                          | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$   |        | -   | 620 | A    |
| <b>Avalanche ruggedness</b> |  |  |        |     |     |      |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $I_D = 100\text{ A}$ ; $V_{sup} \leq 60\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ;<br>$V_{GS} = 60\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; unclamped;<br><a href="#">Fig. 4</a> | [2][3] | -   | 273 | 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. 1. Normalized total power dissipation as a function of mounting base temperature**

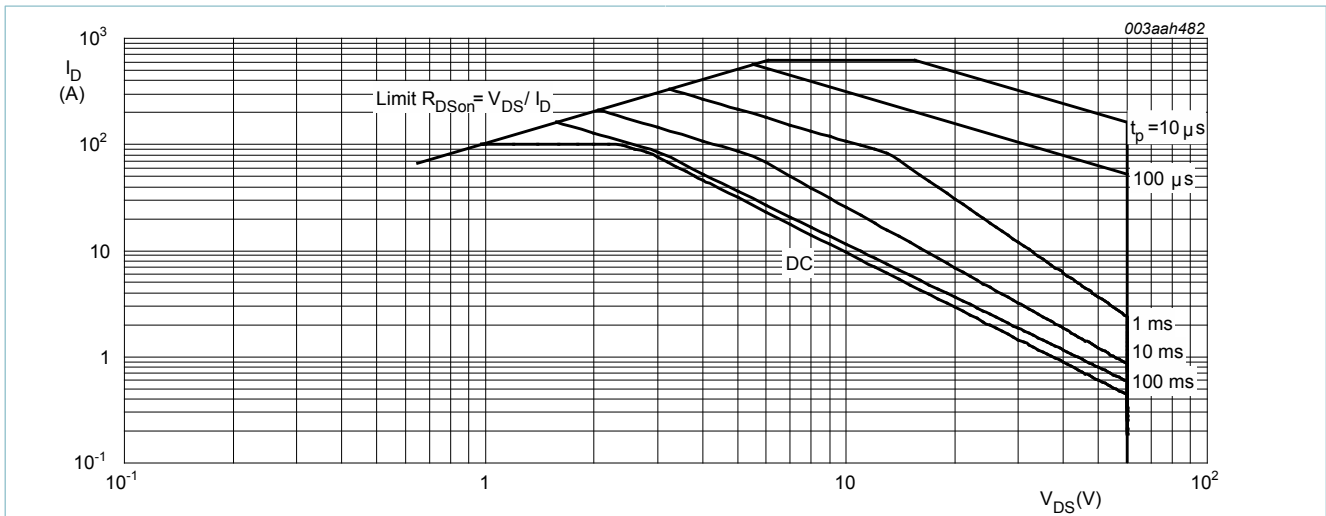
$$P_{der} = \frac{P_{tot}}{P_{tot(25\text{°C})}} \times 100\%$$



(1) Capped at 100A due to package

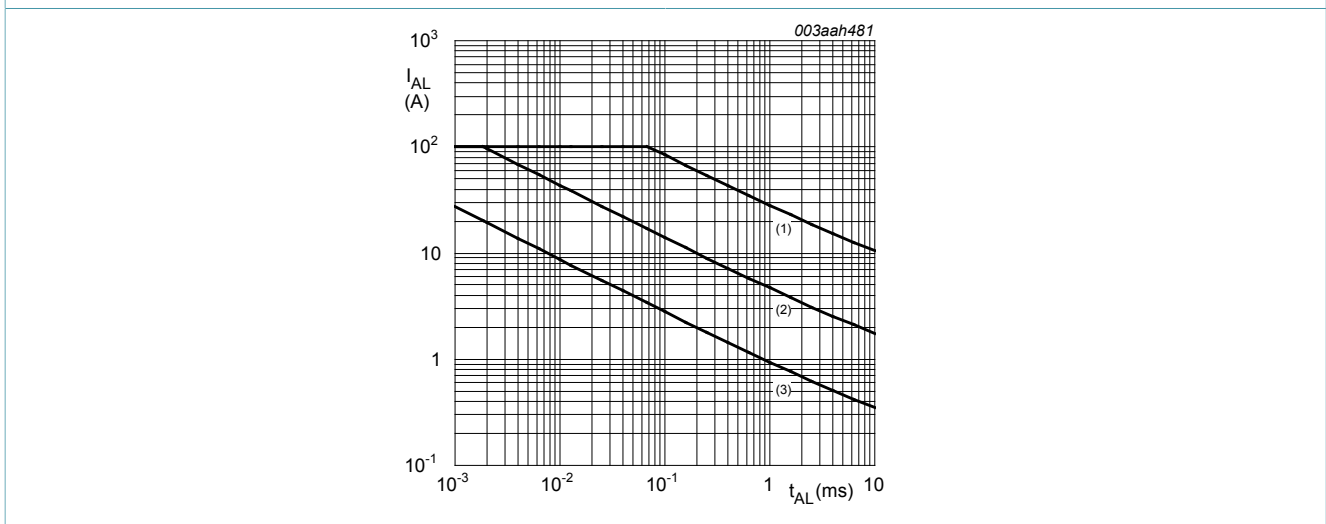
**Fig. 2. Continuous drain current as a function of mounting base temperature**

$$V_{GS} \geq 10V$$



**Fig. 3. 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



**Fig. 4. Single pulse 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

## 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 | <a href="#">Fig. 5</a>                                 | -   | -   | 0.64 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | minimum footprint ; mounted on a printed-circuit board | -   | 50  | -    | K/W  |

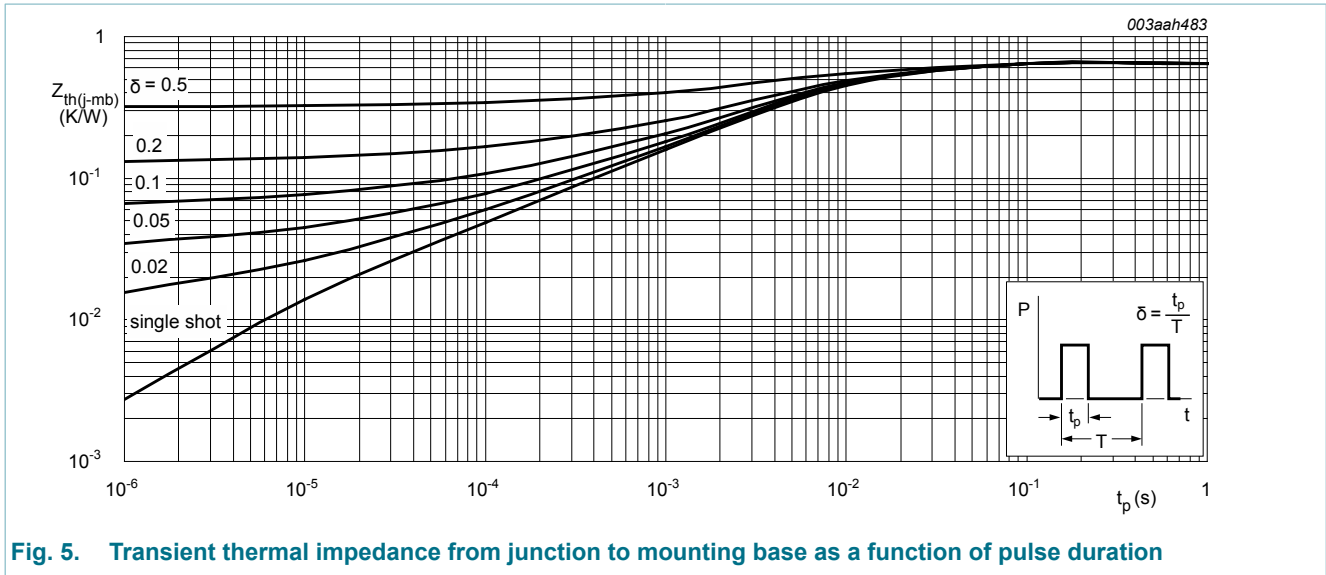


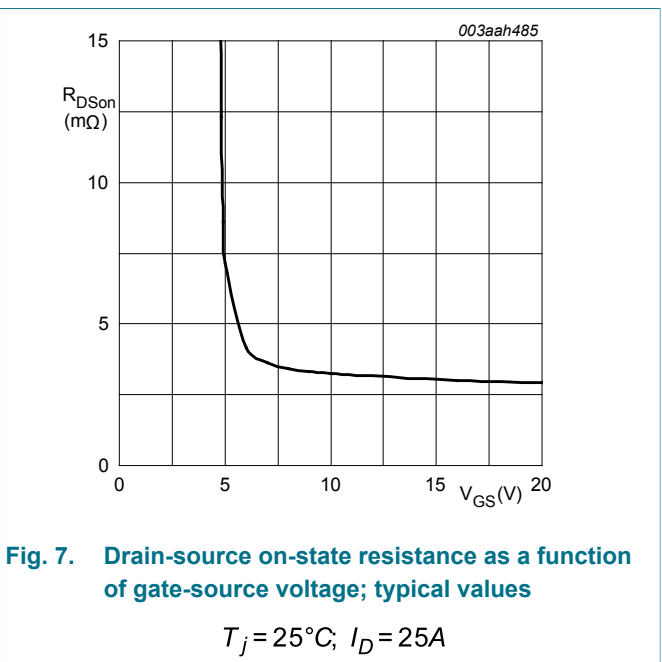
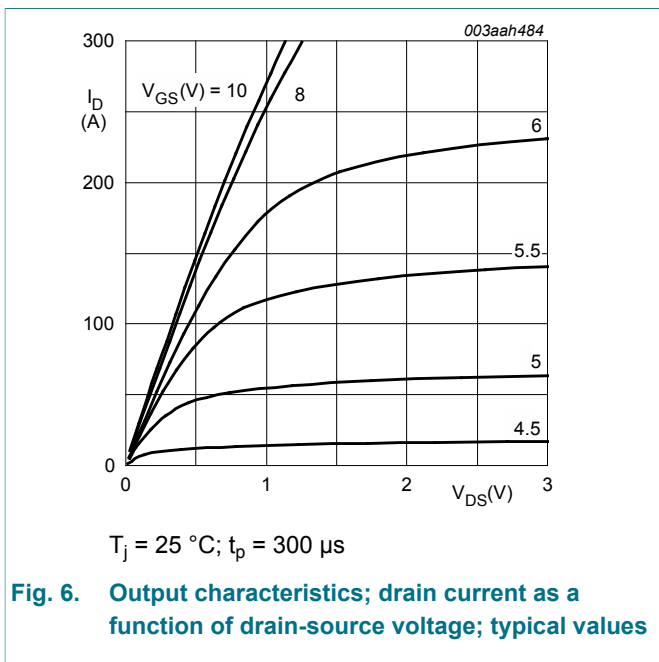
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

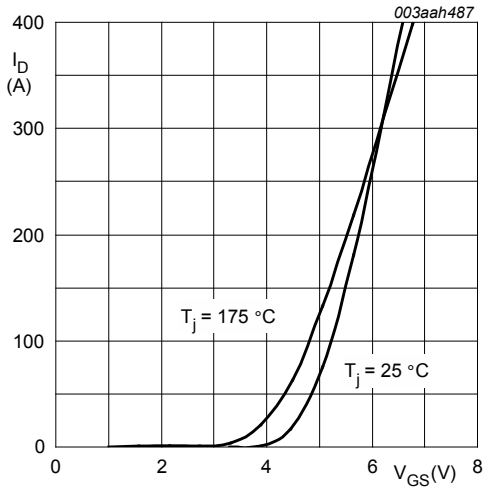
## 10. Characteristics

Table 7. Characteristics

| Symbol                         | Parameter                        | Conditions   | Min | Typ  | Max | Unit       |
|--------------------------------|----------------------------------|--|-----|------|-----|------------|
| <b>Static characteristics</b>  |                                  |  |     |      |     |            |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage   | $I_D = 250 \mu A; V_{GS} = 0 V; T_J = 25 \text{ }^\circ C$   | 60  | -    | -   | V          |
|                                |                                  | $I_D = 250 \mu A; V_{GS} = 0 V; T_J = -55 \text{ }^\circ C$  | 54  | -    | -   | 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          |
|                                |                                  | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_J = 175 \text{ }^\circ C;$<br><a href="#">Fig. 9</a>                 | 1   | -    | -   | 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          |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 25 \text{ }^\circ C$                                     | -   | 0.08 | 1   | $\mu A$    |
|                                |                                  | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 175 \text{ }^\circ C$                                    | -   | -    | 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>           | -   | 3.23 | 4.5 | 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> | -   | -    | 9.8 | m $\Omega$ |
| <b>Dynamic characteristics</b> |                                  |  |     |      |     |            |
| $Q_{G(tot)}$                   | total gate charge                | $I_D = 25 \text{ A}; V_{DS} = 48 \text{ V}; V_{GS} = 10 \text{ V};$<br><a href="#">Fig. 13; Fig. 14</a>      | -   | 82   | -   | nC         |
| $Q_{GS}$                       | gate-source charge               |  | -   | 18.5 | -   | nC         |
| $Q_{GD}$                       | gate-drain charge                |  | -   | 26.1 | -   | nC         |

| Symbol                    | Parameter                    | Conditions  | Min | Typ  | Max  | Unit |
|---------------------------|------------------------------|---|-----|------|------|------|
| $C_{iss}$                 | input capacitance            | $V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$                        | -   | 4670 | 6230 | pF   |
| $C_{oss}$                 | output capacitance           | $T_j = 25\text{ °C};$ <a href="#">Fig. 15</a>   | -   | 637  | 765  | pF   |
| $C_{rss}$                 | reverse transfer capacitance |   | -   | 377  | 516  | pF   |
| $t_{d(on)}$               | turn-on delay time           | $V_{DS} = 45\text{ V}; R_L = 1.8\text{ }\Omega; V_{GS} = 10\text{ V};$                | -   | 23   | -    | ns   |
| $t_r$                     | rise time                    | $R_{G(ext)} = 5\text{ }\Omega$  | -   | 39   | -    | ns   |
| $t_{d(off)}$              | turn-off delay time          |   | -   | 50   | -    | ns   |
| $t_f$                     | fall time                    |   | -   | 40   | -    | ns   |
| $L_D$                     | internal drain inductance    | from upper edge of mounting base to centre of die                                     | -   | 2.5  | -    | 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> | -   | 0.81 | 1.2  | V    |
| $t_{rr}$                  | reverse recovery time        | $I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$        | -   | 38.2 | -    | ns   |
| $Q_r$                     | recovered charge             | $V_{DS} = 25\text{ V}$  | -   | 49.6 | -    | nC   |





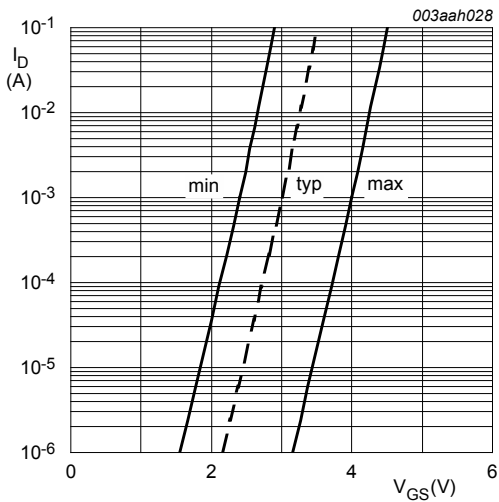
**Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values**

$V_{DS} = 10V$



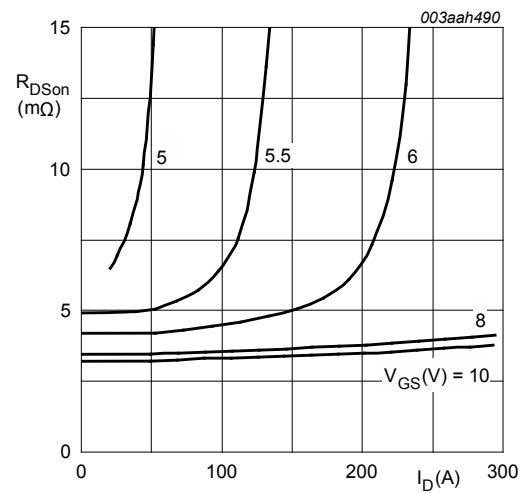
**Fig. 9. Gate-source threshold voltage as a function of junction temperature**

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



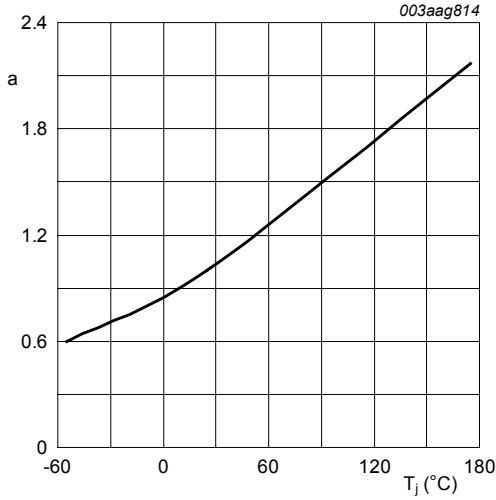
**Fig. 10. Sub-threshold drain current as a function of gate-source voltage**

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



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

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

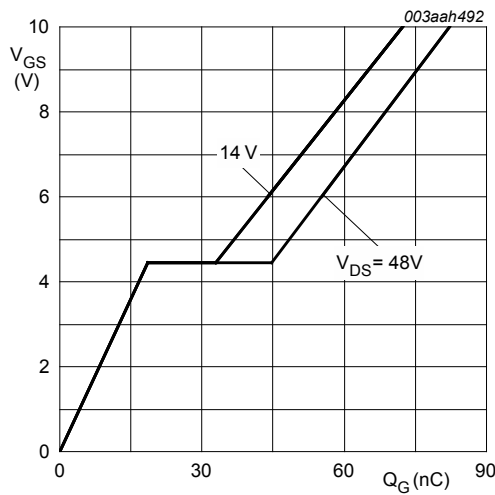


**Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature**

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

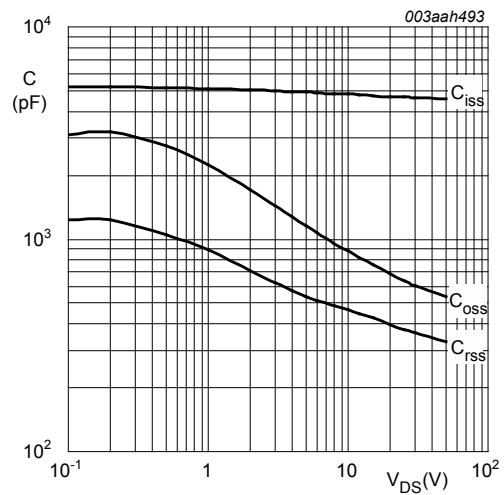


**Fig. 13. Gate charge waveform definitions**



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

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



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

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



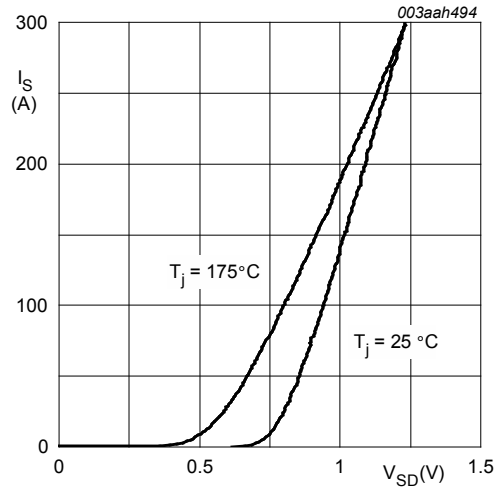


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

### 11. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) SOT404



Dimensions (mm are the original dimensions)

| Unit | A   | A <sub>1</sub> | b    | b <sub>2</sub> | c    | D  | D <sub>1</sub> | E    | e    | H <sub>D</sub> | L <sub>p</sub> | Q   |
|------|-----|----------------|------|----------------|------|----|----------------|------|------|----------------|----------------|-----|
| max  | 4.5 | 1.40           | 0.85 | 1.45           | 0.64 | 11 | 1.6            | 10.3 |      | 15.8           | 2.9            | 2.6 |
| nom  |     |                |      |                |      |    |                |      | 2.54 |                |                |     |
| min  | 4.1 | 1.27           | 0.60 | 1.05           | 0.46 |    | 1.2            | 9.7  |      | 14.8           | 2.1            | 2.2 |

sot404\_po

| Outline version | References |       |       | European projection | Issue date             |
|-----------------|------------|-------|-------|---------------------|------------------------|
|                 | IEC        | JEDEC | JEITA |                     |                        |
| SOT404          |            |       |       |                     | -06-03-16-<br>13-02-25 |

**Fig. 17. Package outline D2PAK (SOT404)**

## 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. |
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- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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