



# BUK9880-55A

## N-channel TrenchMOS logic level FET

19 March 2014

Product data sheet

### 1. General description

Logic level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

### 2. Features and benefits

- Low conduction losses due to low on-state resistance
- Q101 compliant
- Suitable for logic level gate drive sources

### 3. Applications

- 12 V and 24 V loads
- Automotive and general purpose power switching
- Motors, lamps and solenoids

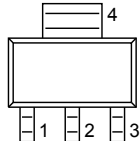
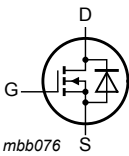
### 4. Quick reference data

Table 1. Quick reference data

| Symbol                        | Parameter                                    | Conditions  | Min | Typ | Max | Unit       |
|-------------------------------|--|---|-----|-----|-----|------------|
| $V_{DS}$                      | drain-source voltage                         | $T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$  | -   | -   | 55  | V          |
| $I_D$                         | drain current                                | $V_{GS} = 5\text{ V}$ ; $T_{sp} = 25\text{ °C}$ ; <a href="#">Fig. 3</a> ; <a href="#">Fig. 2</a>   | -   | -   | 7   | A          |
| $P_{tot}$                     | total power dissipation                      | $T_{sp} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>  | -   | -   | 8   | W          |
| <b>Static characteristics</b> |  |   |     |     |     |            |
| $R_{DS(on)}$                  | drain-source on-state resistance             | $V_{GS} = 10\text{ V}$ ; $I_D = 8\text{ A}$ ; $T_j = 25\text{ °C}$  | -   | 62  | 73  | m $\Omega$ |
|                               |  | $V_{GS} = 4.5\text{ V}$ ; $I_D = 8\text{ A}$ ; $T_j = 25\text{ °C}$   | -   | -   | 89  | m $\Omega$ |
|                               |  | $V_{GS} = 5\text{ V}$ ; $I_D = 8\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>                               | -   | 68  | 80  | m $\Omega$ |
| <b>Avalanche ruggedness</b>   |  |   |     |     |     |            |
| $E_{DS(AL)S}$                 | non-repetitive drain-source avalanche energy | $I_D = 6\text{ A}$ ; $V_{sup} \leq 55\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ;<br>$V_{GS} = 5\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; unclamped | -   | -   | 36  | mJ         |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline  | Graphic symbol  |
|-----|--------|-------------|---|---|
| 1   | G      | gate        |  <p>SC-73 (SOT223)</p> |  <p>mbb076</p> |
| 2   | D      | drain       |   |   |
| 3   | S      | source      |   |   |
| 4   | D      | drain       |   |   |

## 6. Ordering information

Table 3. Ordering information

| Type number    | Package |  |         |
|----------------|---------|--|---------|
|                | Name    | Description  | Version |
| BUK9880-55A    | SC-73   | plastic surface-mounted package with increased heatsink; 4 leads | SOT223  |
| BUK9880-55A/CU | SC-73   | plastic surface-mounted package with increased heatsink; 4 leads | SOT223  |

## 7. Marking

Table 4. Marking codes

| Type number    | Marking code |
|----------------|--------------|
| BUK9880-55A    | 988055A      |
| BUK9880-55A/CU | 988055       |

## 8. Limiting values

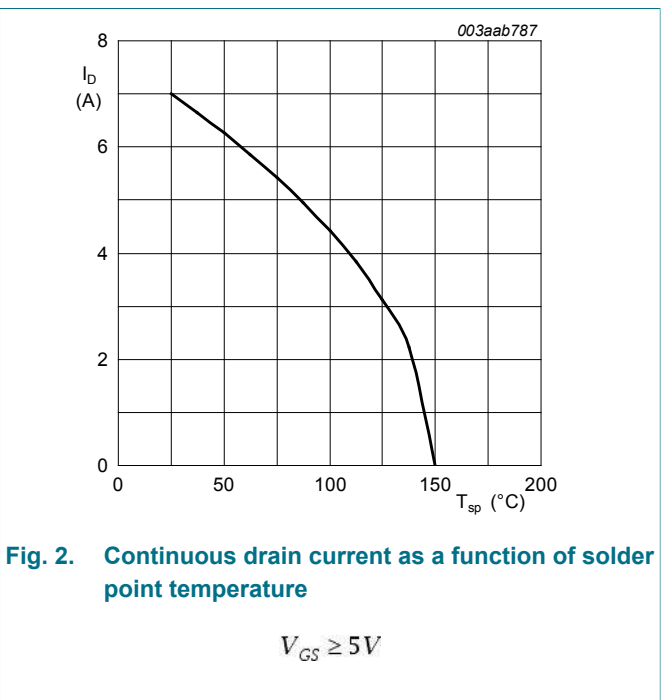
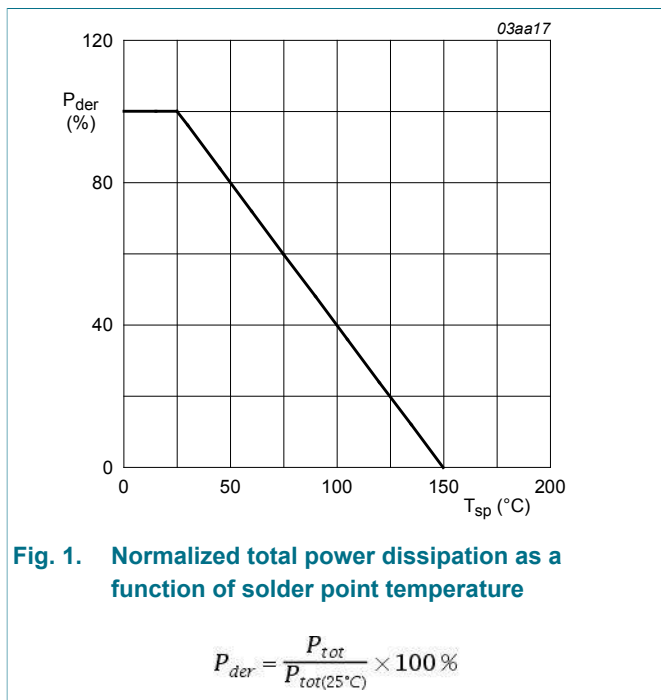
Table 5. Limiting values

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

| Symbol    | Parameter               | Conditions  | Min | Max | Unit |
|-----------|-------------------------|---|-----|-----|------|
| $V_{DS}$  | drain-source voltage    | $T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$  | -   | 55  | V    |
| $V_{DGR}$ | drain-gate voltage      | $R_{GS} = 20\text{ k}\Omega$  | -   | 55  | V    |
| $V_{GS}$  | gate-source voltage     |   | -15 | 15  | V    |
| $P_{tot}$ | total power dissipation | $T_{sp} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>  | -   | 8   | W    |
| $I_D$     | drain current           | $T_{sp} = 100\text{ °C}$ ; $V_{GS} = 5\text{ V}$ ; <a href="#">Fig. 2</a>                         | -   | 4   | A    |
|           |                         | $T_{sp} = 25\text{ °C}$ ; $V_{GS} = 5\text{ V}$ ; <a href="#">Fig. 3</a> ; <a href="#">Fig. 2</a> | -   | 7   | A    |
| $I_{DM}$  | peak drain current      | $T_{sp} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <a href="#">Fig. 3</a>       | -   | 30  | A    |

| Symbol                      | Parameter                                    | Conditions  | Min                          | Max | Unit |
|-----------------------------|--|---|------------------------------|-----|------|
| T <sub>stg</sub>            | storage temperature                          |   | -55                          | 150 | °C   |
| T <sub>j</sub>              | junction temperature                         |   | -55                          | 150 | °C   |
| V <sub>GSM</sub>            | peak gate-source voltage                     | pulsed; t <sub>p</sub> ≤ 50 μs  | -15                          | 15  | V    |
| <b>Source-drain diode</b>   |  |   |                              |     |      |
| I <sub>S</sub>              | source current                               | T <sub>sp</sub> = 25 °C   | -                            | 7   | A    |
| I <sub>SM</sub>             | peak source current                          | pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>sp</sub> = 25 °C   | -                            | 30  | A    |
| <b>Avalanche ruggedness</b> |  |   |                              |     |      |
| E <sub>DS(AL)S</sub>        | non-repetitive drain-source avalanche energy | I <sub>D</sub> = 6 A; V <sub>sup</sub> ≤ 55 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 5 V; T <sub>j(init)</sub> = 25 °C; unclamped | -                            | 36  | mJ   |
| E <sub>DS(AL)R</sub>        | repetitive drain-source avalanche energy     | <a href="#">Fig. 4</a>  | <a href="#">[1][2][3][4]</a> | -   | J    |

- [1] Maximum value not quoted. Repetitive rating defined in avalanche rating figure.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 150 °C.
- [3] Repetitive avalanche rating limited by an average junction temperature of 145 °C.
- [4] Refer to application note AN10273 for further information.



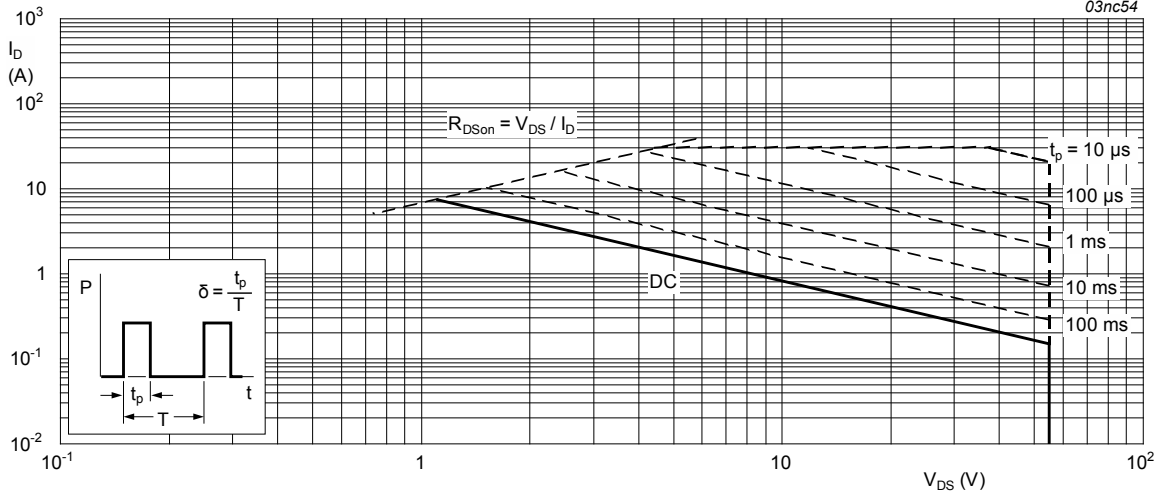


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

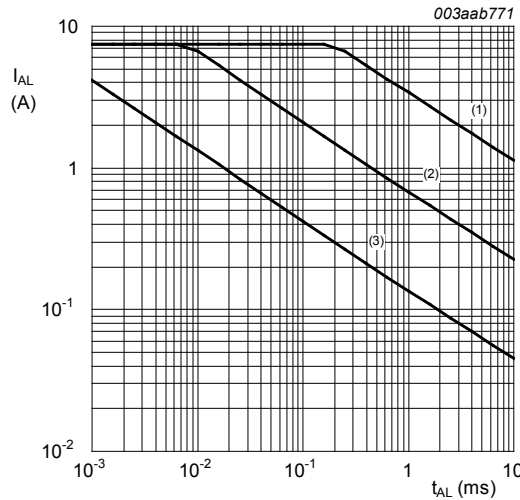


Fig. 4. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time.

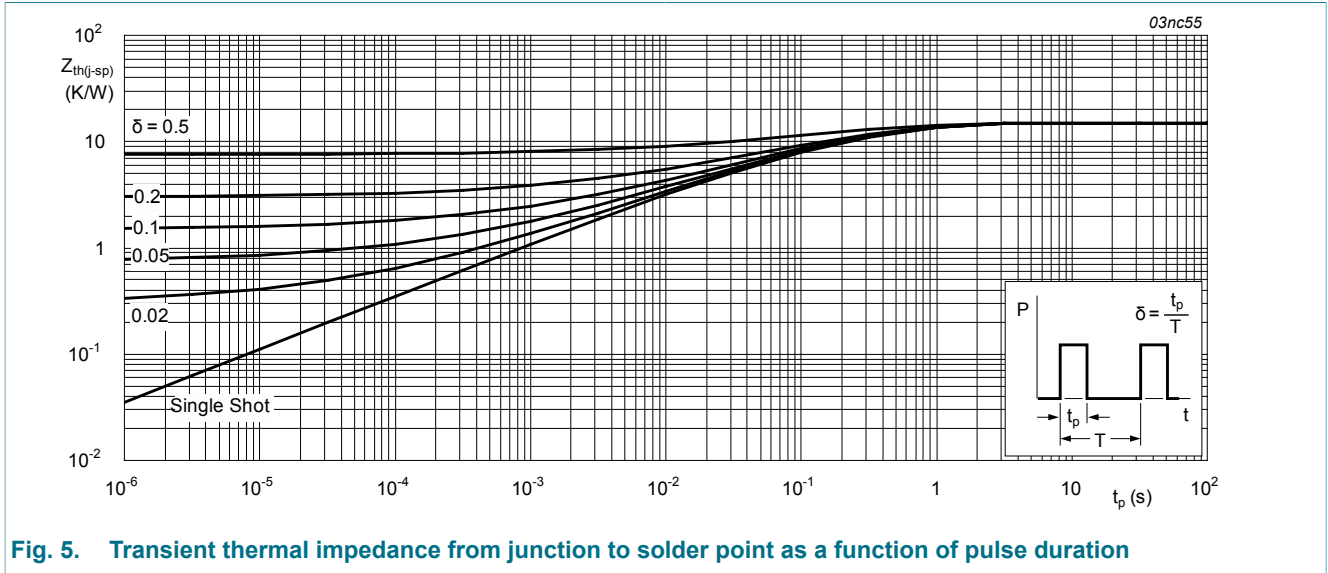
- (1) Single-pulse;  $T_j = 25^\circ C$ .
- (2) Single-pulse;  $T_j = 125^\circ C$ .
- (3) Repetitive.

## 9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter  | Conditions | Min | Typ | Max | Unit |
|----------------|--|------------|-----|-----|-----|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |            | -   | -   | 15  | K/W  |

| Symbol        | Parameter                                   | Conditions             | Min | Typ | Max | Unit |
|---------------|---|------------------------|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | <a href="#">Fig. 5</a> | -   | 120 | -   | K/W  |

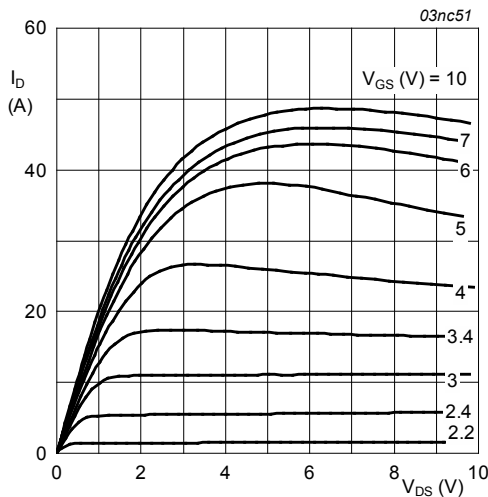


## 10. Characteristics

Table 7. Characteristics

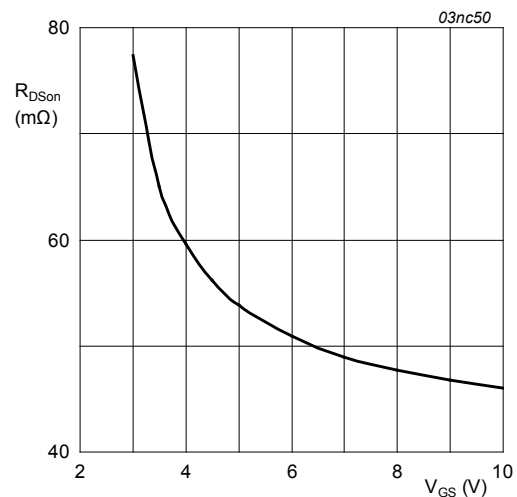
| Symbol                        | Parameter                        | Conditions   | Min | Typ  | Max | Unit          |
|-------------------------------|----------------------------------|--|-----|------|-----|---------------|
| <b>Static characteristics</b> |                                  |  |     |      |     |               |
| $V_{(BR)DSS}$                 | drain-source breakdown voltage   | $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$                                  | 50  | -    | -   | V             |
|                               |                                  | $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$                                   | 55  | -    | -   | V             |
| $V_{GS(th)}$                  | gate-source threshold voltage    | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$<br><a href="#">Fig. 12; Fig. 8</a>       | 1   | 1.5  | 2   | V             |
|                               |                                  | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 150 \text{ }^\circ\text{C};$<br><a href="#">Fig. 12; Fig. 8</a>      | 0.6 | -    | -   | V             |
|                               |                                  | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$<br><a href="#">Fig. 12; Fig. 8</a>      | -   | -    | 2.3 | V             |
| $I_{DSS}$                     | drain leakage current            | $V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$                                  | -   | -    | 500 | $\mu\text{A}$ |
|                               |                                  | $V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$                                   | -   | 0.05 | 10  | $\mu\text{A}$ |
| $I_{GSS}$                     | gate leakage current             | $V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$                                   | -   | 2    | 100 | nA            |
|                               |                                  | $V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$                                  | -   | 2    | 100 | nA            |
| $R_{DSon}$                    | drain-source on-state resistance | $V_{GS} = 5 \text{ V}; I_D = 8 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$<br><a href="#">Fig. 13; Fig. 14</a> | -   | -    | 147 | m $\Omega$    |
|                               |                                  | $V_{GS} = 10 \text{ V}; I_D = 8 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$                                      | -   | 62   | 73  | m $\Omega$    |
|                               |                                  | $V_{GS} = 4.5 \text{ V}; I_D = 8 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$                                     | -   | -    | 89  | m $\Omega$    |

| Symbol                         | Parameter                    | Conditions  | Min | Typ  | Max | Unit |
|--------------------------------|------------------------------|---|-----|------|-----|------|
|                                |                              | $V_{GS} = 5\text{ V}; I_D = 8\text{ A}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 13</a> ;<br><a href="#">Fig. 14</a>                     | -   | 68   | 80  | mΩ   |
| <b>Dynamic characteristics</b> |                              |   |     |      |     |      |
| $Q_{G(\text{tot})}$            | total gate charge            | $I_D = 10\text{ A}; V_{DS} = 44\text{ V}; V_{GS} = 5\text{ V};$<br><a href="#">Fig. 11</a>  | -   | 11   | -   | nC   |
| $Q_{GS}$                       | gate-source charge           |   | -   | 1.6  | -   | nC   |
| $Q_{GD}$                       | gate-drain charge            | $I_D = 10\text{ A}; V_{DS} = 44\text{ V}; V_{GS} = 5\text{ V};$<br><a href="#">Fig. 15</a>  | -   | 4.6  | -   | nC   |
| $C_{iss}$                      | 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. 16</a>                       | -   | 438  | 584 | pF   |
| $C_{oss}$                      | output capacitance           |   | -   | 87   | 104 | pF   |
| $C_{rss}$                      | reverse transfer capacitance |   | -   | 62   | 85  | pF   |
| $t_{d(\text{on})}$             | turn-on delay time           | $V_{DS} = 30\text{ V}; R_L = 1.2\text{ }^\Omega; V_{GS} = 5\text{ V};$<br>$R_{G(\text{ext})} = 10\text{ }^\Omega; T_j = 25\text{ }^\circ\text{C}$ | -   | 8    | -   | ns   |
| $t_r$                          | rise time                    |   | -   | 118  | -   | ns   |
| $t_{d(\text{off})}$            | turn-off delay time          |   | -   | 20   | -   | ns   |
| $t_f$                          | fall time                    |   | -   | 32   | -   | ns   |
| <b>Source-drain diode</b>      |                              |   |     |      |     |      |
| $V_{SD}$                       | source-drain voltage         | $I_S = 15\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 17</a>   | -   | 0.85 | 1.2 | V    |
| $t_{rr}$                       | reverse recovery time        | $I_S = 20\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s};$<br>$V_{GS} = -10\text{ V}; V_{DS} = 30\text{ V}; T_j = 25\text{ }^\circ\text{C}$        | -   | 33   | -   | ns   |
| $Q_r$                          | recovered charge             |   | -   | 60   | -   | nC   |



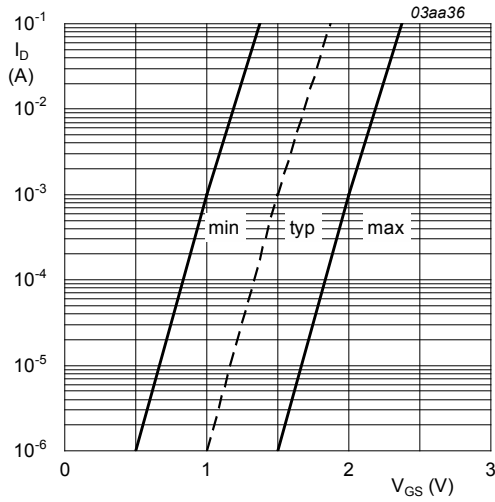
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**

$T_j = 25\text{ }^\circ\text{C}$



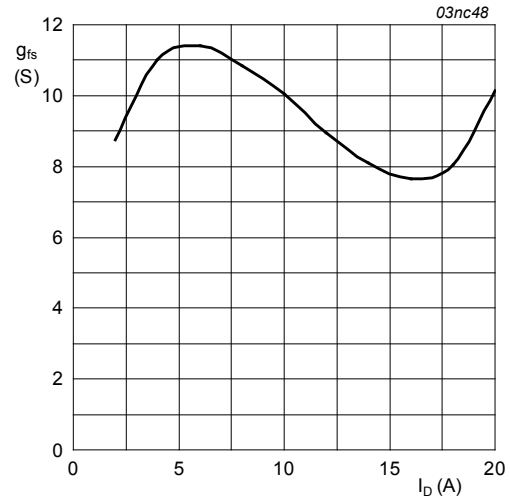
**Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**

$T_j = 25\text{ }^\circ\text{C}; I_D = 10\text{ A}$



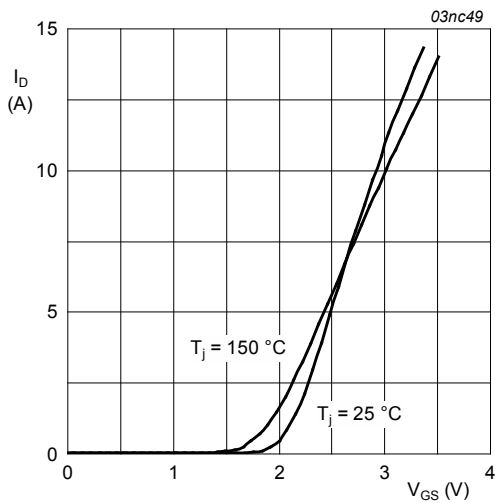
$T_j = 25\text{ }^\circ\text{C}; V_{DS} = 5\text{ V}$

**Fig. 8. Sub-threshold drain current as a function of gate-source voltage**



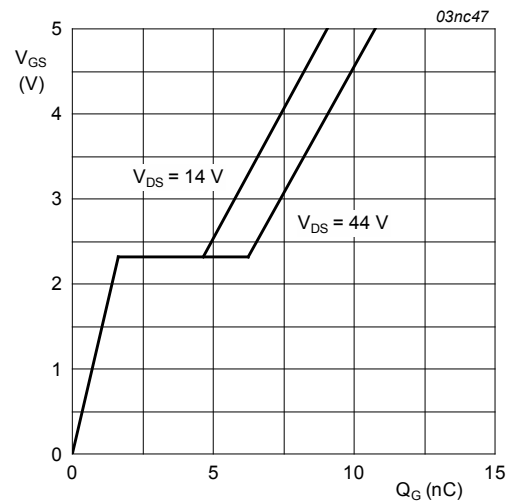
**Fig. 9. Forward transconductance as a function of drain current; typical values**

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



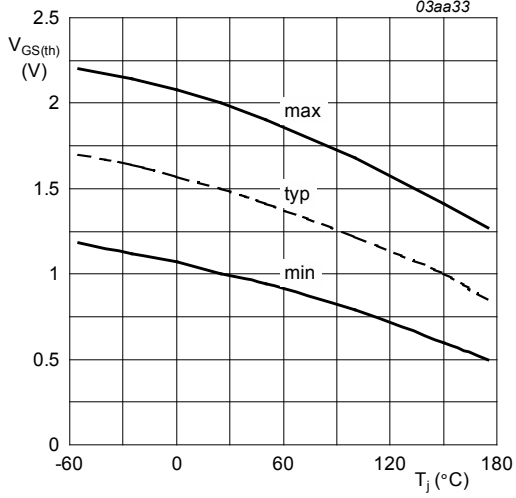
**Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values**

$V_{DS} = 25\text{ V}$



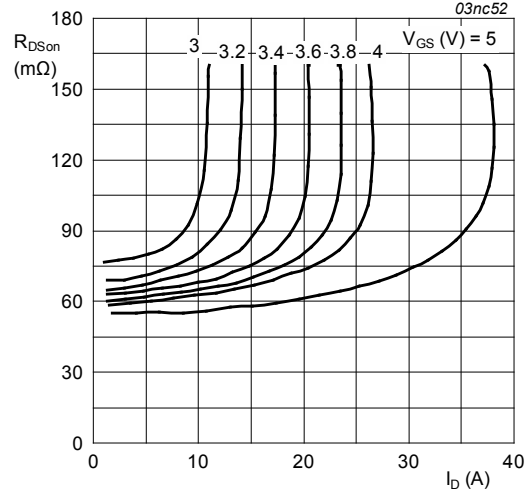
**Fig. 11. Gate-source voltage as a function of turn-on gate charge; typical values**

$T_j = 25\text{ }^\circ\text{C}; I_D = 10\text{ A}$



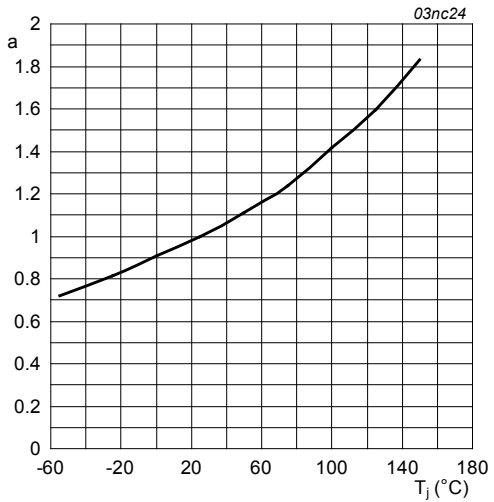
**Fig. 12. Gate-source threshold voltage as a function of junction temperature**

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



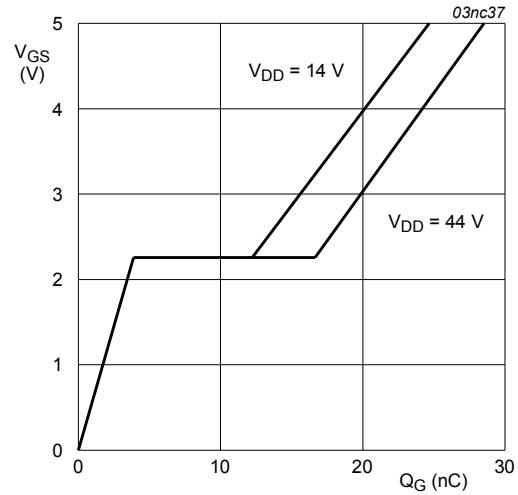
**Fig. 13. Drain-source on-state resistance as a function of drain current; typical values**

$$T_j = 25^\circ\text{C}$$



**Fig. 14. Normalized drain source on-state resistance factor as a function of junction temperature**

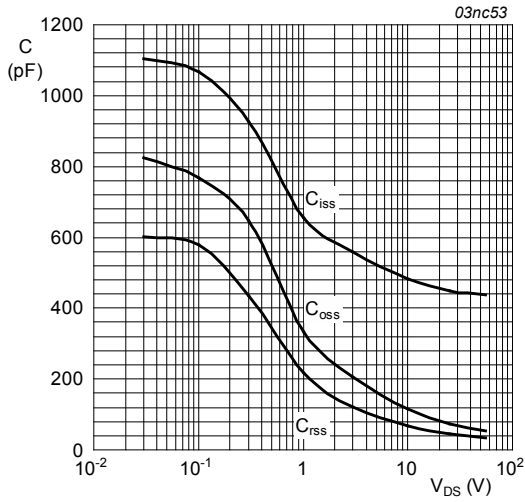
$$a = \frac{R_{DS(on)}}{R_{DS(on)@25^\circ\text{C}}}$$



**Fig. 15. Gate-source voltage as a function of turn-on gate charge; typical values**

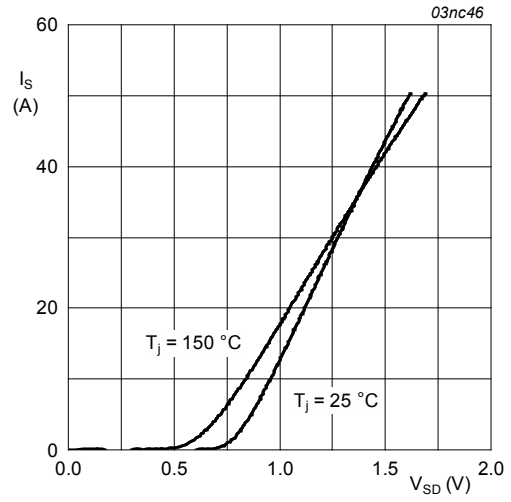
$$T_j = 25^\circ\text{C}; I_D = 15\text{A}$$





**Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

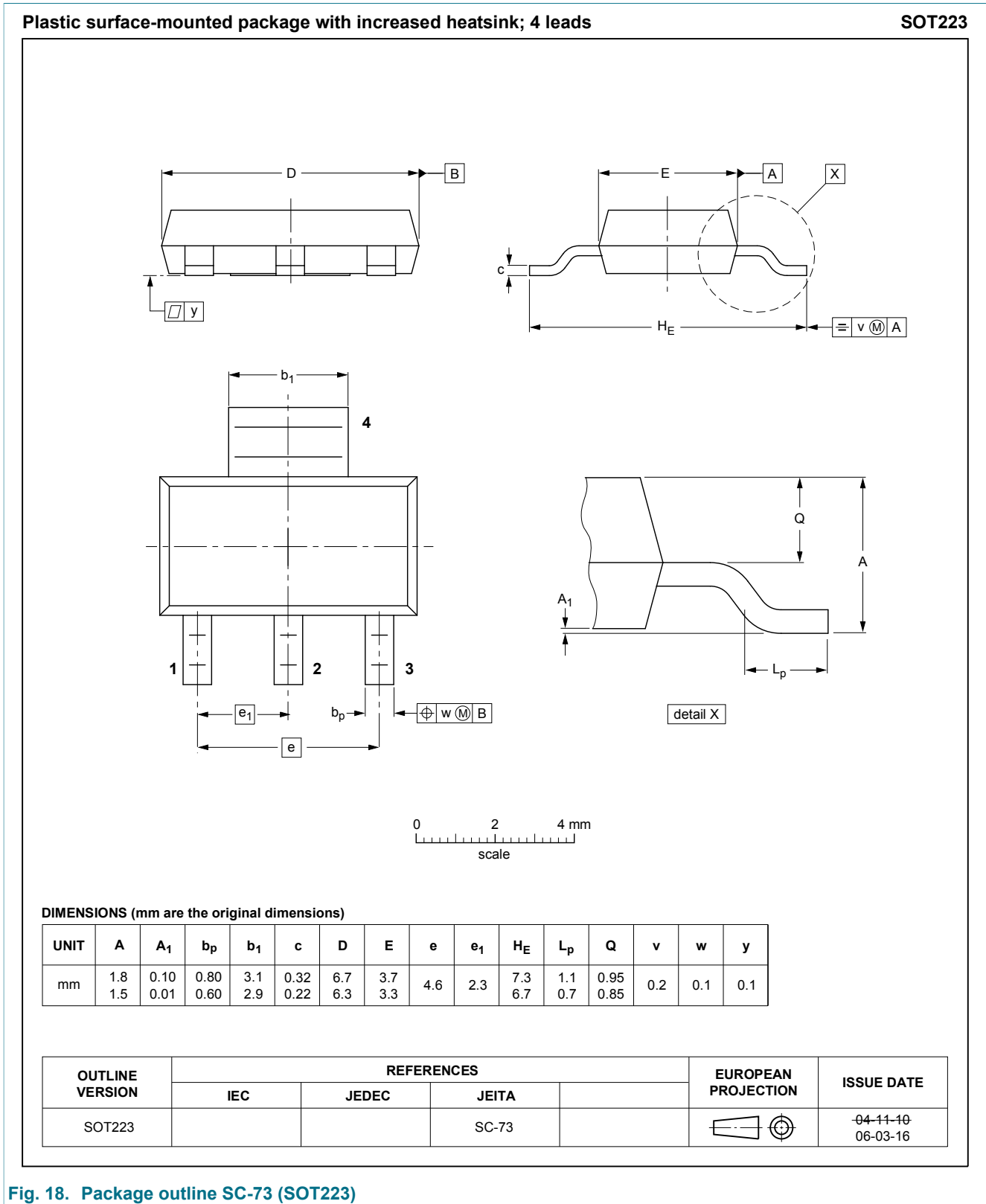
$$V_{GS} = 0V; f = 1MHz$$



**Fig. 17. Reverse diode current as a function of reverse diode voltage; typical value**

$$V_{GS} = 0V$$

### 11. Package outline



**Fig. 18. Package outline SC-73 (SOT223)**

## 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.                                     |

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- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

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