

# BUK9230-55A

## N-channel TrenchMOS logic level FET

Rev. 04 — 15 June 2010

Product data sheet

## 1. Product profile

### 1.1 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.

### 1.2 Features and benefits

- Low conduction losses due to low on-state resistance
- Q101 compliant
- Suitable for logic level gate drive sources
- Suitable for thermally demanding environments due to 175 °C rating

### 1.3 Applications

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

### 1.4 Quick reference data

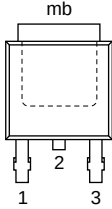
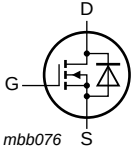
Table 1. Quick reference data

| 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                                                                                        | -   | -   | 55   | V    |
| I <sub>D</sub>         | drain current                                | V <sub>GS</sub> = 5 V; T <sub>mb</sub> = 25 °C; see <a href="#">Figure 1</a> ; see <a href="#">Figure 3</a>                            | -   | -   | 38   | A    |
| P <sub>tot</sub>       | total power dissipation                      | T <sub>mb</sub> = 25 °C; see <a href="#">Figure 2</a>                                                                                  | -   | -   | 88   | W    |
| Static characteristics |                                              |                                                                                                                                        |     |     |      |      |
| R <sub>DSon</sub>      | drain-source on-state resistance             | V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C                                                                 | -   | -   | 33   | mΩ   |
|                        |                                              | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C                                                                  | -   | 23  | 27   | mΩ   |
|                        |                                              | V <sub>GS</sub> = 5 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>    | -   | 26  | 30   | mΩ   |
| Avalanche ruggedness   |                                              |                                                                                                                                        |     |     |      |      |
| E <sub>DS(AL)S</sub>   | non-repetitive drain-source avalanche energy | I <sub>D</sub> = 34 A; V <sub>sup</sub> ≤ 55 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 5 V; T <sub>i(init)</sub> = 25 °C; unclamped | -   | -   | 57.8 | mJ   |



2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline                                                                | Graphic symbol                                                                      |
|-----|--------|-----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1   | G      | gate                              |  |  |
| 2   | D      | drain                             |                                                                                   |                                                                                     |
| 3   | S      | source                            |                                                                                   |                                                                                     |
| mb  | D      | mounting base; connected to drain |                                                                                   |                                                                                     |

SOT428 (DPAK)

3. Ordering information

Table 3. Ordering information

| Type number | Package |                                                                                 | Version |
|-------------|---------|---------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                     |         |
| BUK9230-55A | DPAK    | plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) | SOT428  |

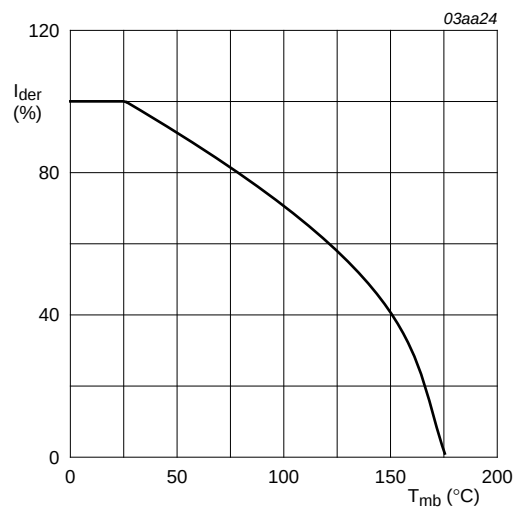
## 4. Limiting values

**Table 4. Limiting values**

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

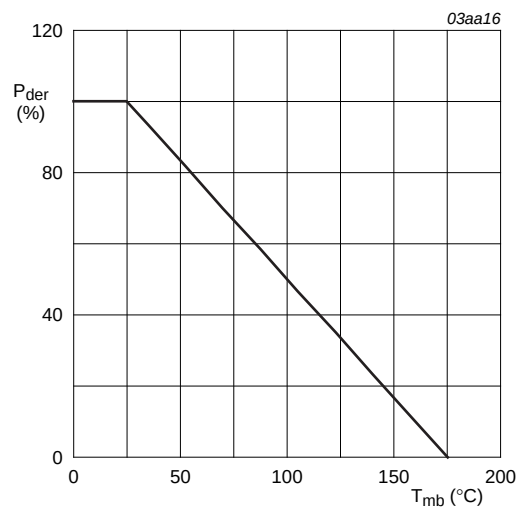
| Symbol                      | Parameter                                    | Conditions                                                                                                                                     | Min | Typ | Max  | Unit |
|-----------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|
| $V_{DS}$                    | drain-source voltage                         | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$                                                                                             | -   | -   | 55   | V    |
| $V_{DGR}$                   | drain-gate voltage                           | $R_{GS} = 20\ \Omega$                                                                                                                          | -   | -   | 55   | V    |
| $V_{GS}$                    | gate-source voltage                          |                                                                                                                                                | -10 | -   | 10   | V    |
| $I_D$                       | drain current                                | $T_{mb} = 25\text{ °C}$ ; $V_{GS} = 5\text{ V}$ ; see <a href="#">Figure 1</a> ;<br>see <a href="#">Figure 3</a>                               | -   | -   | 38   | A    |
|                             |                                              | $T_{mb} = 100\text{ °C}$ ; $V_{GS} = 5\text{ V}$ ; see <a href="#">Figure 1</a>                                                                | -   | -   | 27   | A    |
| $I_{DM}$                    | peak drain current                           | $T_{mb} = 25\text{ °C}$ ; $t_p \leq 10\ \mu\text{s}$ ; pulsed;<br>see <a href="#">Figure 3</a>                                                 | [1] | -   | 154  | A    |
| $P_{tot}$                   | total power dissipation                      | $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>                                                                                         | -   | -   | 88   | W    |
| $T_{stg}$                   | storage temperature                          |                                                                                                                                                | -55 | -   | 175  | °C   |
| $T_j$                       | junction temperature                         |                                                                                                                                                | -55 | -   | 175  | °C   |
| $V_{GSM}$                   | peak gate-source voltage                     | pulsed; $t_p \leq 50\ \mu\text{s}$                                                                                                             | -15 | -   | 15   | V    |
| <b>Source-drain diode</b>   |                                              |                                                                                                                                                |     |     |      |      |
| $I_S$                       | source current                               | $T_{mb} = 25\text{ °C}$                                                                                                                        | -   | -   | 38   | A    |
| $I_{SM}$                    | peak source current                          | $t_p \leq 10\ \mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$                                                                                   | -   | -   | 154  | A    |
| <b>Avalanche ruggedness</b> |                                              |                                                                                                                                                |     |     |      |      |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $I_D = 34\text{ A}$ ; $V_{sup} \leq 55\text{ V}$ ; $R_{GS} = 50\ \Omega$ ;<br>$V_{GS} = 5\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; unclamped | -   | -   | 57.8 | mJ   |

[1] Peak drain current is limited by chip, not package.



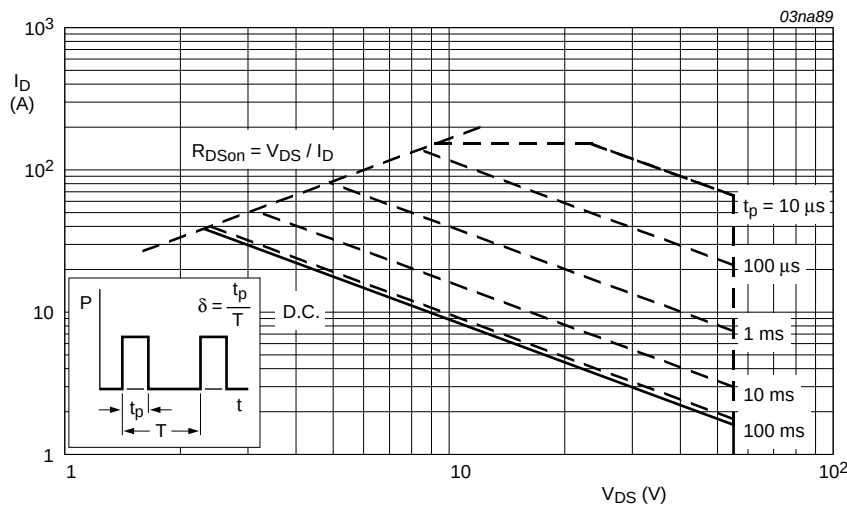
$$I_{der} = \frac{I_D}{I_{D(25^\circ C)}} \times 100\%$$

Fig 1. Normalized continuous drain current as a function of mounting base temperature



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

Fig 2. Normalized total power dissipation as a function of mounting base temperature



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

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

5. Thermal characteristics

Table 5. Thermal characteristics

| Symbol         | Parameter                                         | Conditions                   | Min | Typ  | Max | Unit |
|----------------|---------------------------------------------------|------------------------------|-----|------|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base |                              | -   | -    | 1.7 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | see <a href="#">Figure 4</a> | -   | 71.4 | -   | K/W  |

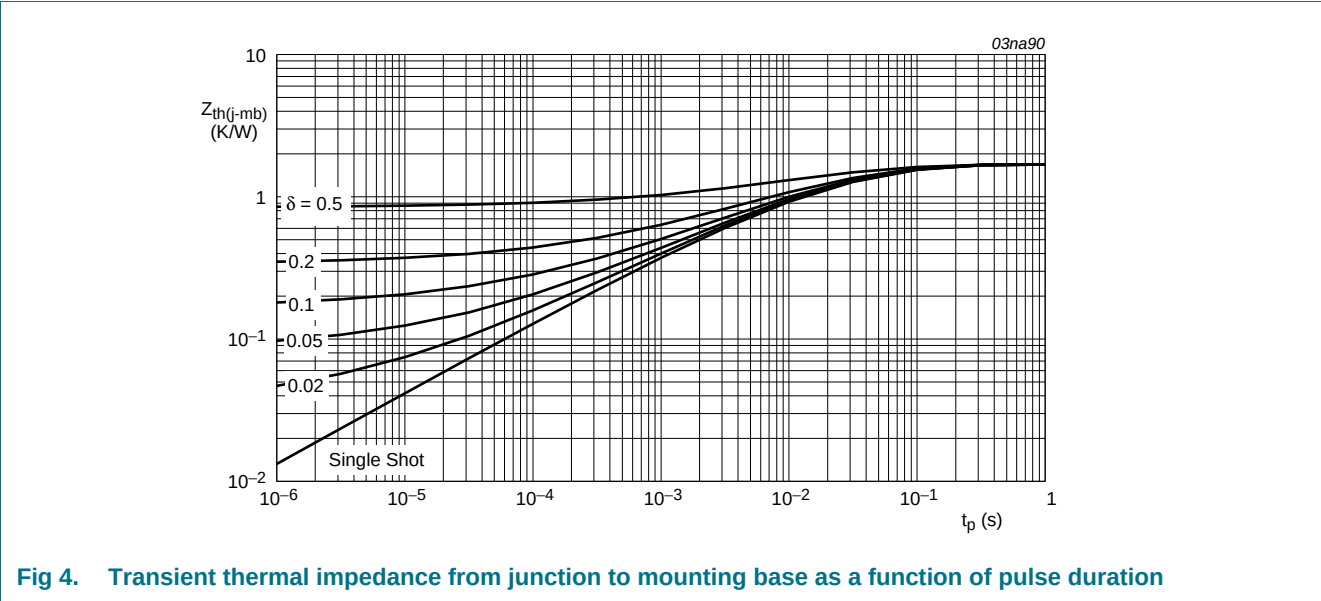


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 6. Characteristics

Table 6. Characteristics

| Symbol                  | Parameter                        | Conditions                                                                                                                           | Min | Typ  | Max  | Unit |
|-------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Static characteristics  |                                  |                                                                                                                                      |     |      |      |      |
| V <sub>(BR)DSS</sub>    | drain-source breakdown voltage   | I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                              | 55  | -    | -    | V    |
|                         |                                  | I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = -55 °C                                                             | 50  | -    | -    | 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> = -55 °C; see <a href="#">Figure 11</a>                    | -   | -    | 2.3  | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 25 °C; see <a href="#">Figure 11</a>                     | 1   | 1.5  | 2    | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 175 °C; see <a href="#">Figure 11</a>                    | 0.5 | -    | -    | V    |
| I <sub>DSS</sub>        | drain leakage current            | V <sub>DS</sub> = 55 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 175 °C                                                               | -   | -    | 500  | μA   |
|                         |                                  | V <sub>DS</sub> = 55 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                                | -   | 0.05 | 10   | μA   |
| I <sub>GSS</sub>        | gate leakage current             | V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C                                                                | -   | 2    | 100  | nA   |
|                         |                                  | V <sub>DS</sub> = 0 V; V <sub>GS</sub> = -10 V; T <sub>j</sub> = 25 °C                                                               | -   | 2    | 100  | nA   |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C                                                               | -   | -    | 33   | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C                                                                | -   | 23   | 27   | mΩ   |
|                         |                                  | V <sub>GS</sub> = 5 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 175 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a> | -   | -    | 60   | mΩ   |
|                         |                                  | V <sub>GS</sub> = 5 V; I <sub>D</sub> = 15 A; T <sub>j</sub> = 25 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>  | -   | 26   | 30   | mΩ   |
| Dynamic characteristics |                                  |                                                                                                                                      |     |      |      |      |
| C <sub>iss</sub>        | input capacitance                | V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz;                                                                            | -   | 1294 | 1725 | pF   |
| C <sub>oss</sub>        | output capacitance               | T <sub>j</sub> = 25 °C; see <a href="#">Figure 14</a>                                                                                | -   | 210  | 252  | pF   |
| C <sub>rss</sub>        | reverse transfer capacitance     |                                                                                                                                      | -   | 142  | 195  | pF   |
| t <sub>d(on)</sub>      | turn-on delay time               | V <sub>DS</sub> = 30 V; R <sub>L</sub> = 1.2 Ω; V <sub>GS</sub> = 5 V; R <sub>G(ext)</sub> = 10 Ω; T <sub>j</sub> = 25 °C            | -   | 14   | -    | ns   |
| t <sub>r</sub>          | rise time                        |                                                                                                                                      | -   | 125  | -    | ns   |
| t <sub>d(off)</sub>     | turn-off delay time              |                                                                                                                                      | -   | 64   | -    | ns   |
| t <sub>f</sub>          | fall time                        |                                                                                                                                      | -   | 68   | -    | ns   |
| L <sub>D</sub>          | internal drain inductance        | measured from drain lead from package to centre of die ; T <sub>j</sub> = 25 °C                                                      | -   | 2.5  | -    | nH   |
| L <sub>S</sub>          | internal source inductance       | measured from source lead from package to source bond pad ; T <sub>j</sub> = 25 °C                                                   | -   | 7.5  | -    | nH   |
| Source-drain diode      |                                  |                                                                                                                                      |     |      |      |      |
| V <sub>SD</sub>         | source-drain voltage             | I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; see <a href="#">Figure 15</a>                                  | -   | 0.85 | 1.2  | V    |
| t <sub>rr</sub>         | reverse recovery time            | I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs;                                                                              | -   | 35   | -    | ns   |
| Q <sub>r</sub>          | recovered charge                 | V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 30 V; T <sub>j</sub> = 25 °C                                                              | -   | 70   | -    | nC   |

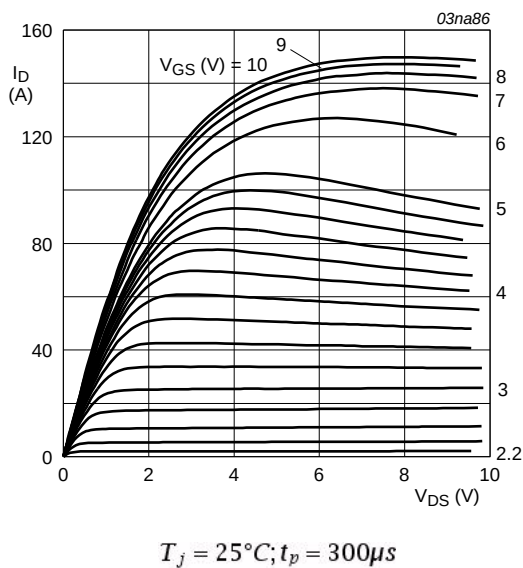


Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

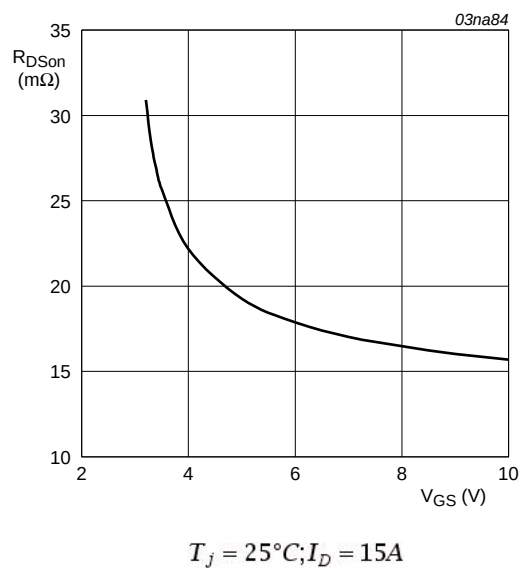


Fig 6. Drain-source on-state resistance as a function of gate-source voltage; typical values

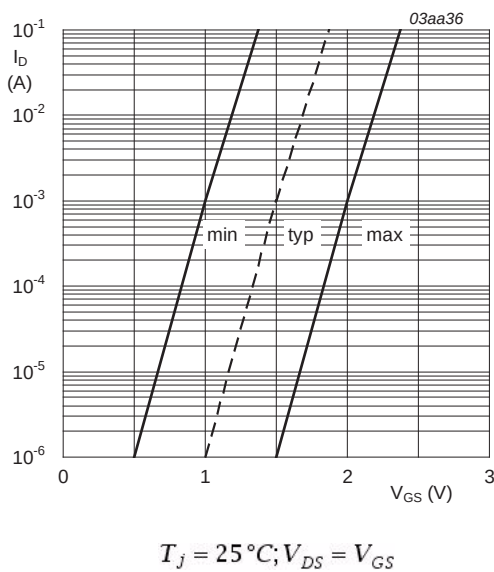


Fig 7. Sub-threshold drain current as a function of gate-source voltage

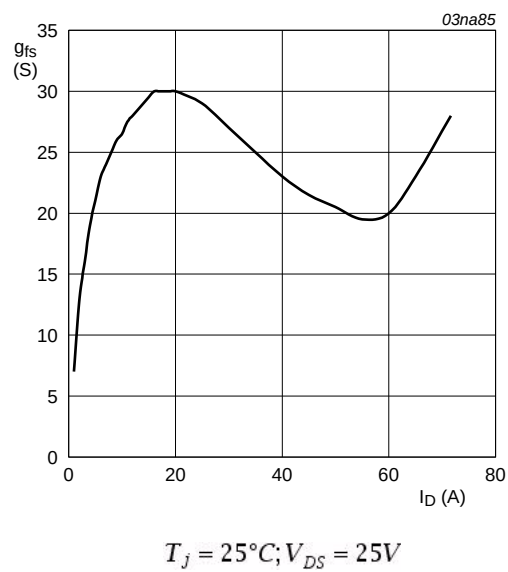


Fig 8. Forward transconductance as a function of drain current; typical values

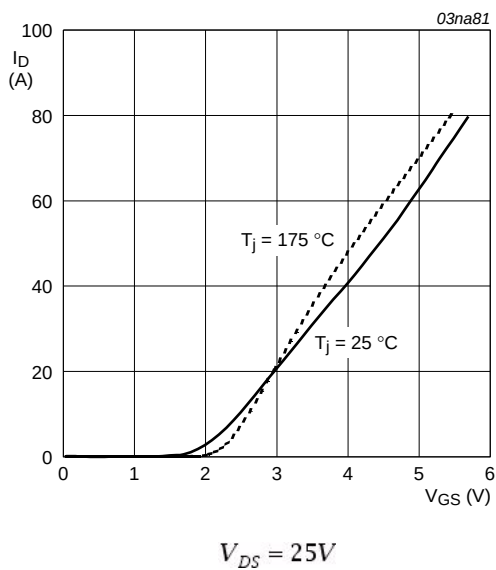


Fig 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

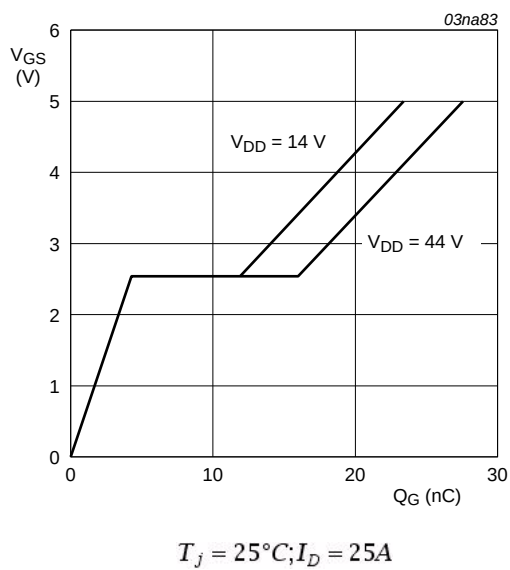


Fig 10. Gate-source voltage as a function of turn-on gate charge; typical values

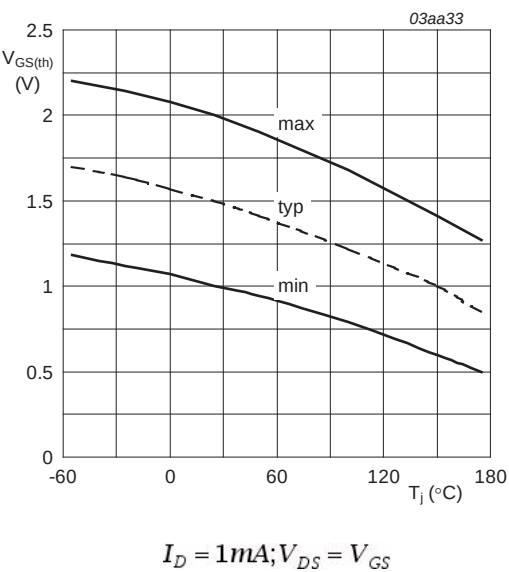


Fig 11. Gate-source threshold voltage as a function of junction temperature

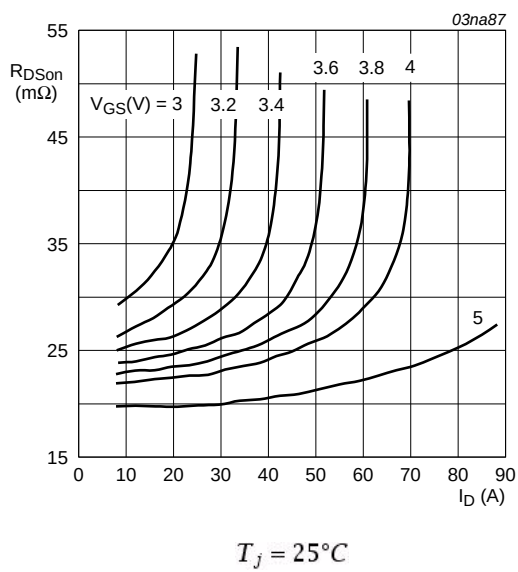
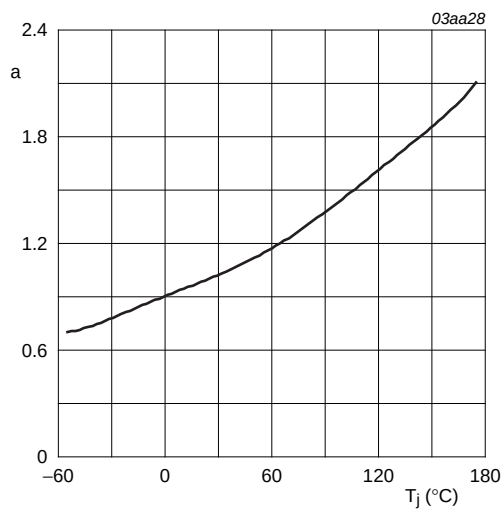


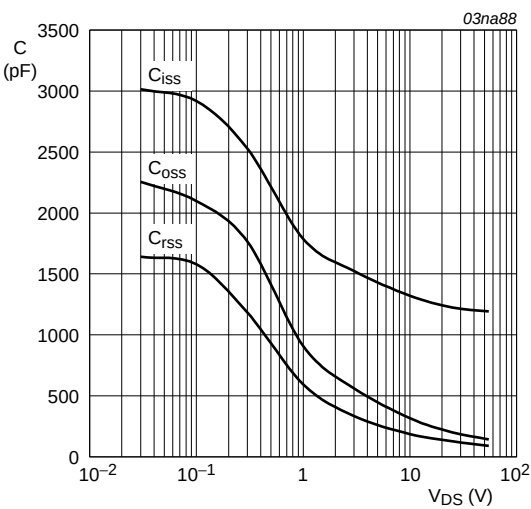
Fig 12. Drain-source on-state resistance as a function of drain current; typical values





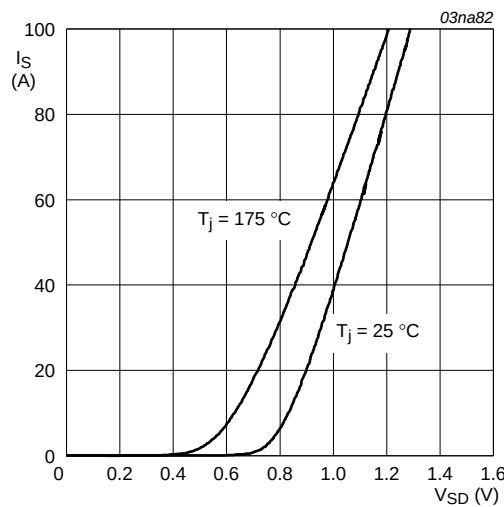
$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}C)}}$$

Fig 13. Normalized drain-source on-state resistance factor as a function of junction temperature



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

Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$$V_{GS} = 0V$$

Fig 15. Reverse diode current as a function of reverse diode voltage; typical values

7. Package outline

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

SOT428

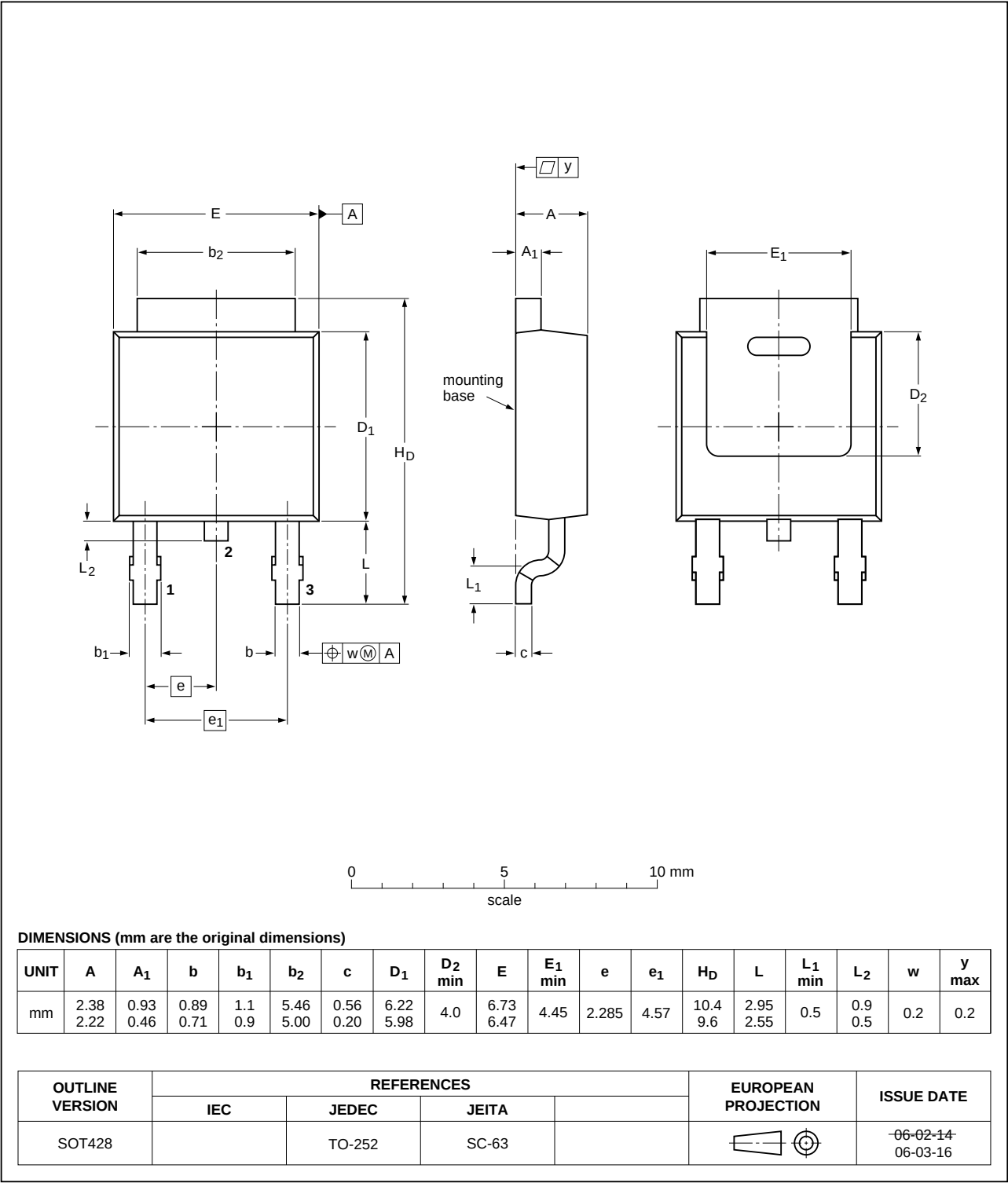


Fig 16. Package outline SOT428 (DPAK)

## 8. Revision history

Table 7. Revision history

| Document ID                         | Release date                                                                                                                                                                                                                                         | Data sheet status     | Change notice | Supersedes      |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|-----------------|
| BUK9230-55A v.4                     | 20100615                                                                                                                                                                                                                                             | Product data sheet    | -             | BUK9230-55A v.3 |
| Modifications:                      | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>Legal texts have been adapted to the new company name where appropriate.</li></ul> |                       |               |                 |
| BUK9230-55A v.3<br>(9397 750 07741) | 20010130                                                                                                                                                                                                                                             | Product Specification | -             | -               |

## 9. Legal information

### 9.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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".

[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.nxp.com>.

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