



BUK9Y12-55B

N-channel TrenchMOS logic level FET

Rev. 04 — 7 April 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
- Advanced braking systems (ABS)
- Automotive systems
- General purpose power switching
- Motors, lamps and solenoids

1.4 Quick reference data

Table 1. Quick reference data

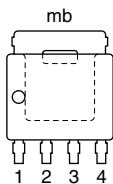
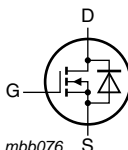
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|--|-----|-----|------|------|
| V_{DS} | drain-source voltage | $T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$ | - | - | 55 | V |
| I_D | drain current | $V_{GS} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; see Figure 1 ; see Figure 4 | - | - | 61.8 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; see Figure 2 | - | - | 106 | W |
| Static characteristics | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10\text{ V}$; $I_D = 20\text{ A}$; $T_j = 25\text{ °C}$ | - | 8.1 | 11 | mΩ |
| | | $V_{GS} = 5\text{ V}$; $I_D = 20\text{ A}$; $T_j = 25\text{ °C}$; see Figure 12 ; see Figure 13 | - | 9.1 | 12 | mΩ |

Table 1. Quick reference data ...continued

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--|--|-----|-----|-----|------|
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 61.8\text{ A}$; $V_{sup} \leq 55\text{ V}$; $R_{GS} = 50\ \Omega$; $V_{GS} = 5\text{ V}$; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; unclamped | - | - | 129 | mJ |
| Dynamic characteristics | | | | | | |
| Q_{GD} | gate-drain charge | $V_{GS} = 5\text{ V}$; $I_D = 20\text{ A}$; $V_{DS} = 44\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$; see Figure 14 | - | 13 | - | nC |

2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|--|--|
| 1 | S | source |  |  |
| 2 | S | source | | |
| 3 | S | source | | |
| 4 | G | gate | | |
| mb | D | mounting base; connected to drain | | |

SOT669 (LFAK)

3. Ordering information

Table 3. Ordering information

| Type number | Package | | Version |
|-------------|---------|--|---------|
| | Name | Description | |
| BUK9Y12-55B | LFAK | plastic single-ended surface-mounted package (LFAK); 4 leads | SOT669 |

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 | $R_{GS} = 20\text{ k}\Omega$ | - | - | 55 | V |
| V_{GS} | gate-source voltage | | -15 | - | 15 | V |
| I_D | drain current | $T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V};$ see Figure 1 ; see Figure 4 | - | - | 61.8 | A |
| | | $T_{mb} = 100\text{ °C}; V_{GS} = 5\text{ V};$ see Figure 1 | - | - | 43.8 | A |
| I_{DM} | peak drain current | $T_{mb} = 25\text{ °C}; t_p \leq 10\text{ }\mu\text{s};$ pulsed; see Figure 4 | - | - | 247 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C};$ see Figure 2 | - | - | 106 | W |
| T_{stg} | storage temperature | | -55 | - | 175 | °C |
| T_j | junction temperature | | -55 | - | 175 | °C |
| Source-drain diode | | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | - | - | 61.8 | A |
| I_{SM} | peak source current | $t_p \leq 10\text{ }\mu\text{s};$ pulsed; $T_{mb} = 25\text{ °C}$ | - | - | 247 | A |
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 61.8\text{ A}; V_{sup} \leq 55\text{ V}; R_{GS} = 50\text{ }\Omega;$ $V_{GS} = 5\text{ V}; T_{j(init)} = 25\text{ °C};$ unclamped | - | - | 129 | mJ |
| $E_{DS(AL)R}$ | repetitive drain-source avalanche energy | see Figure 3 | [1] [2] [3] | - | - | J |

[1] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.

[2] Repetitive avalanche rating limited by average junction temperature of 170 °C.

[3] Refer to application note AN10273 for further information.

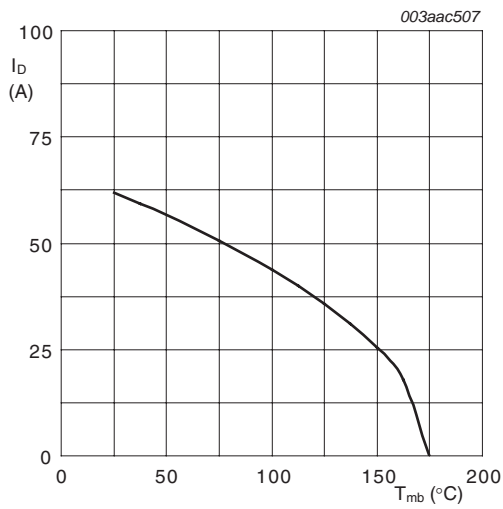
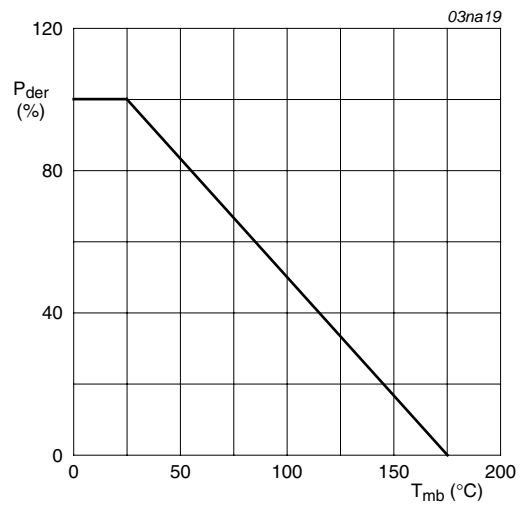


Fig 1. Continuous drain current as a function of mounting base temperature



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

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

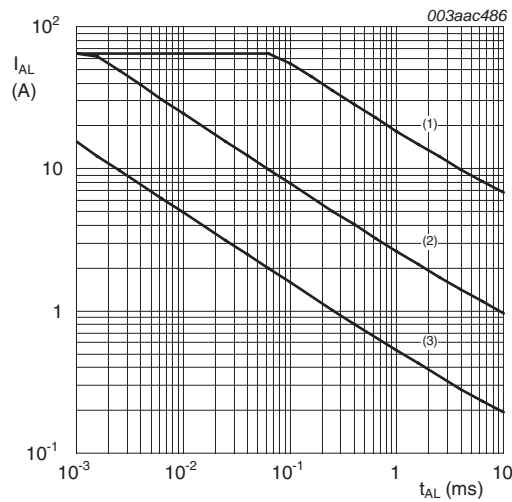


Fig 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

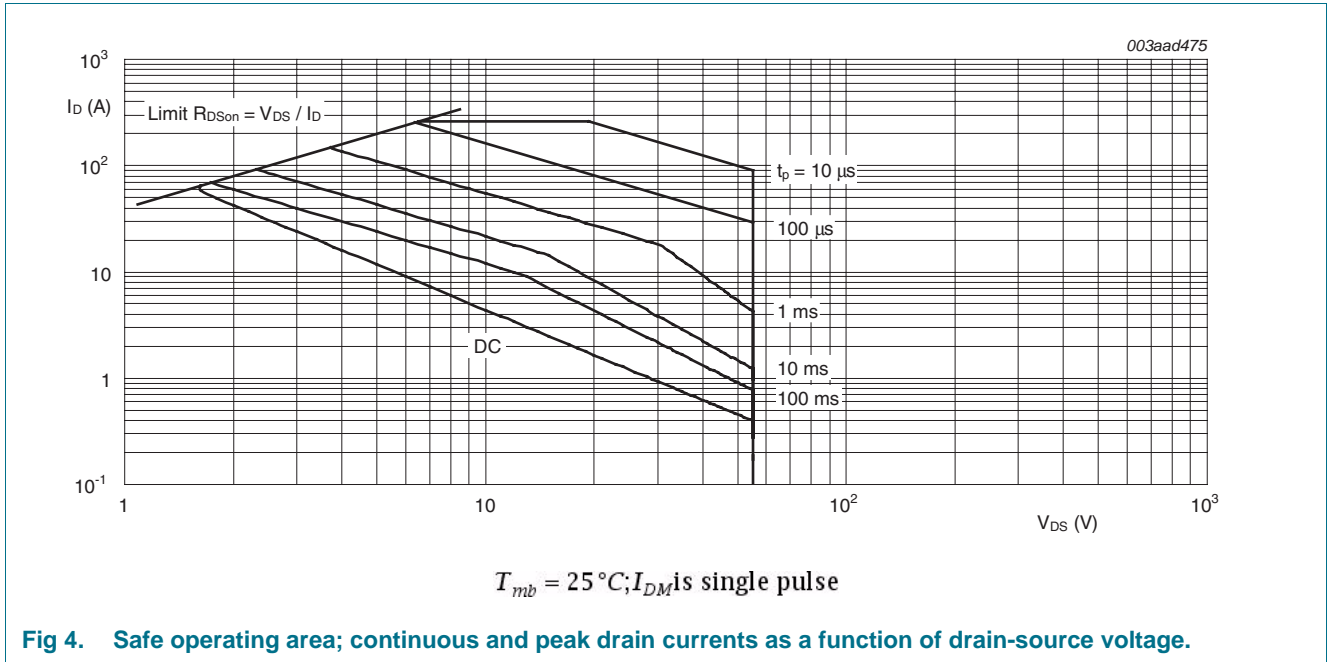


Fig 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

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 | see Figure 5 | - | - | 1.42 | K/W |

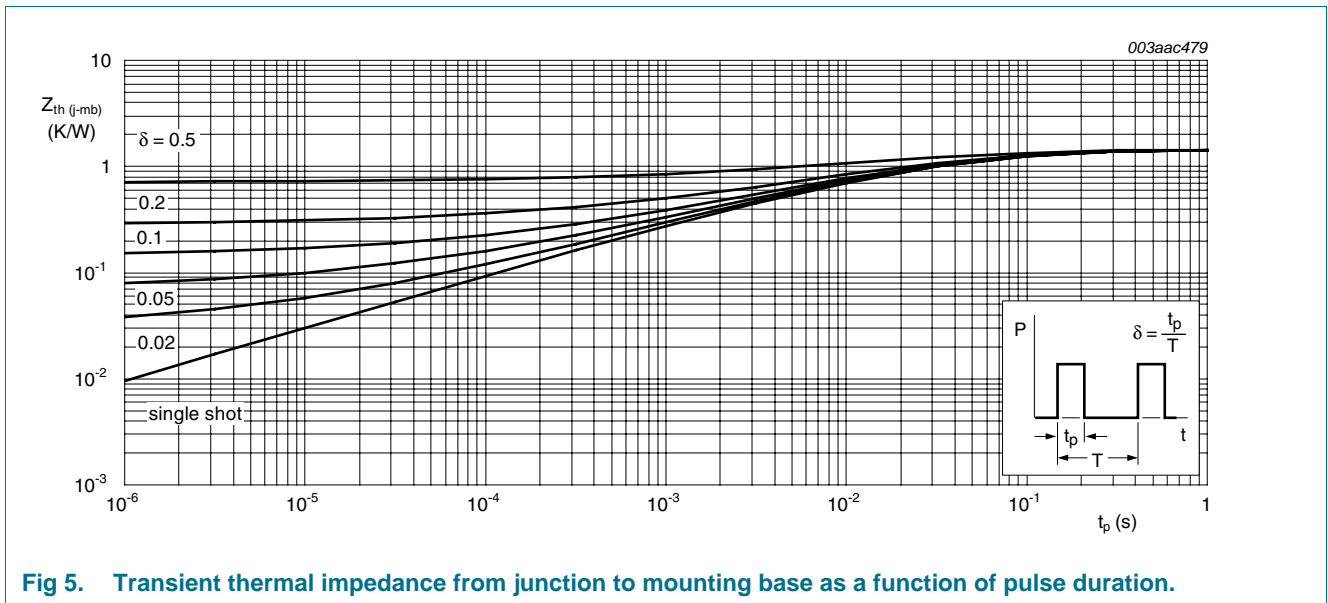


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

6. Characteristics

Table 6. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|------|------|------|---------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | 55 | - | - | V |
| | | $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$ | 50 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11 | - | - | 2.45 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11 | 1.25 | 1.65 | 2.15 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11 | 0.5 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$ | - | - | 500 | μA |
| | | $V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 0.02 | 1 | μA |
| I_{GSS} | gate leakage current | $V_{DS} = 0 \text{ V}; V_{GS} = 15 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 2 | 100 | nA |
| | | $V_{DS} = 0 \text{ V}; V_{GS} = -15 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 2 | 100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 4.5 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$ | - | - | 13 | m Ω |
| | | $V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$ | - | 8.1 | 11 | m Ω |
| | | $V_{GS} = 5 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 12 ; see Figure 13 | - | 9.1 | 12 | m Ω |
| | | $V_{GS} = 5 \text{ V}; I_D = 20 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 13 | - | - | 27.6 | m Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 20 \text{ A}; V_{DS} = 44 \text{ V}; V_{GS} = 5 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 14 | - | 32 | - | nC |
| Q_{GS} | gate-source charge | | - | 6 | - | nC |
| Q_{GD} | gate-drain charge | | - | 13 | - | nC |
| C_{iss} | input capacitance | $V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 15 | - | 2160 | 2880 | pF |
| C_{oss} | output capacitance | | - | 315 | 378 | pF |
| C_{rss} | reverse transfer capacitance | | - | 175 | 240 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30 \text{ V}; R_L = 1.5 \text{ } \Omega; V_{GS} = 5 \text{ V};$ $R_{G(ext)} = 10 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$ | - | 29 | - | ns |
| t_r | rise time | | - | 78 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 100 | - | ns |
| t_f | fall time | | - | 63 | - | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 20 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 16 | - | 0.85 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20 \text{ A}; di_S/dt = -100 \text{ A}/\mu\text{s};$ | - | 44 | - | ns |
| Q_r | recovered charge | $V_{GS} = -10 \text{ V}; V_{DS} = 30 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 83 | - | nC |

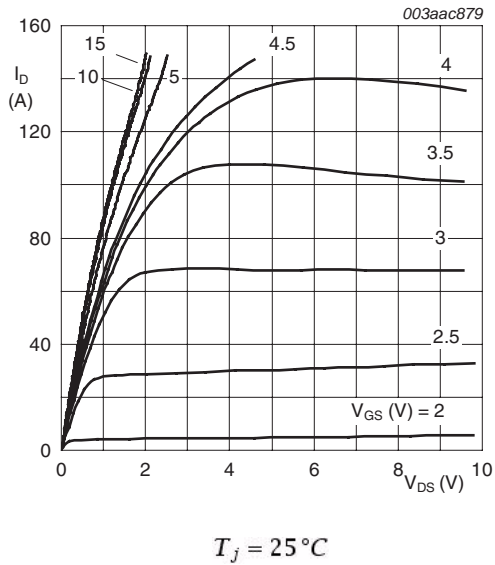


Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values.

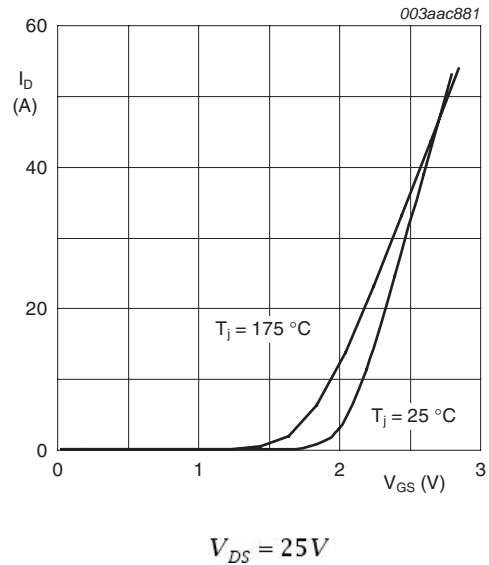


Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values.

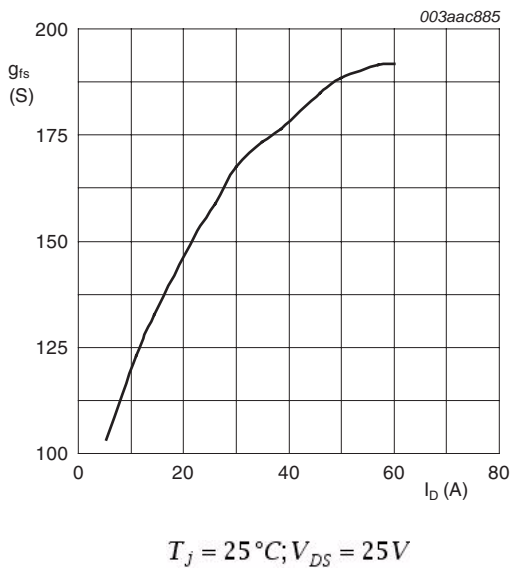


Fig 8. Forward transconductance as a function of drain current; typical values.

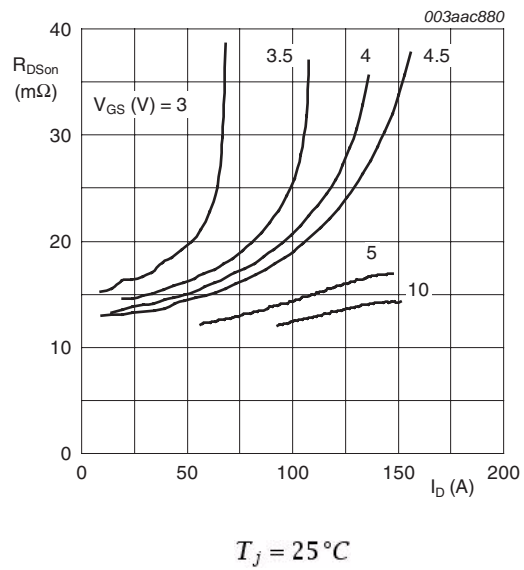
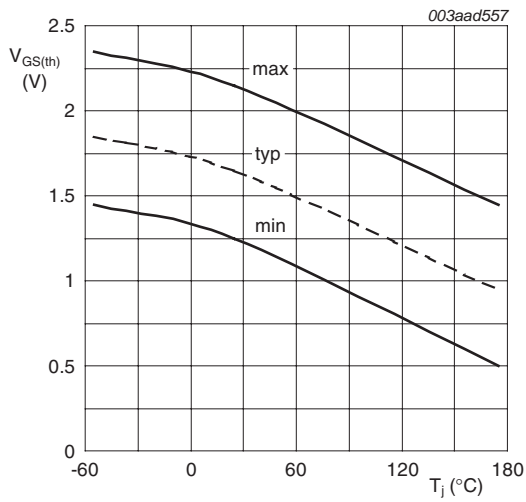
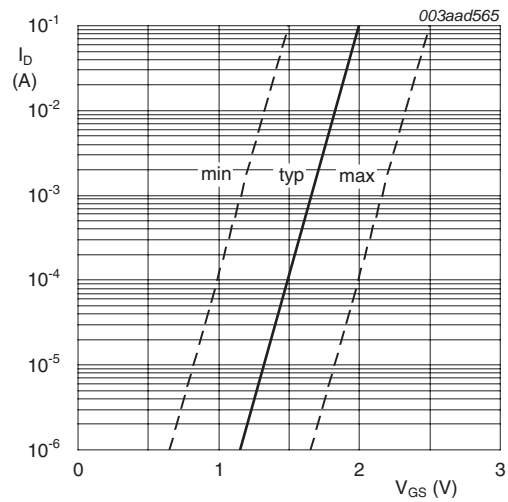


Fig 9. Drain-source on-state resistance as a function of drain current; typical values.



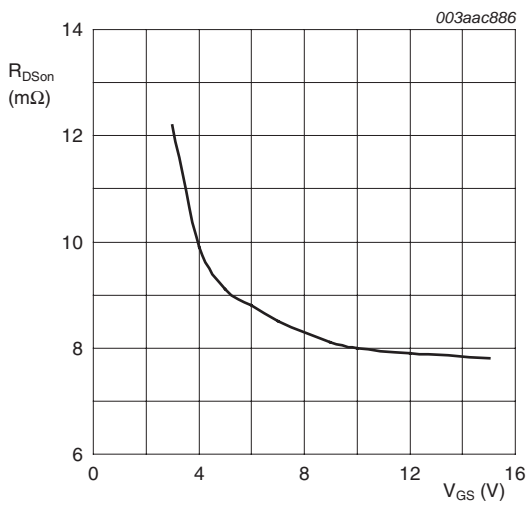
$$I_D = 1\text{mA}; V_{DS} = V_{GS}$$

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



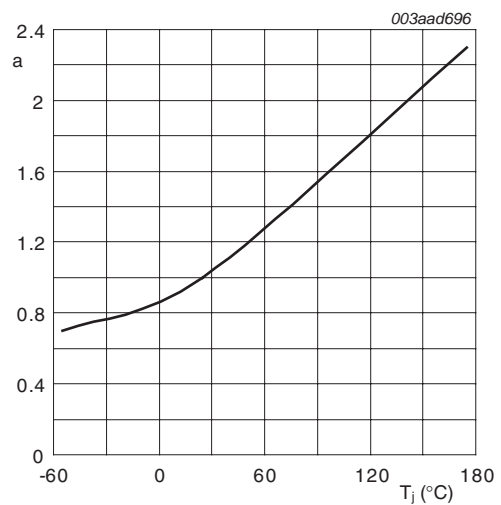
$$T_j = 25\text{ }^\circ\text{C}; V_{DS} = V_{GS}$$

Fig 11. Sub-threshold drain current as a function of gate-source voltage



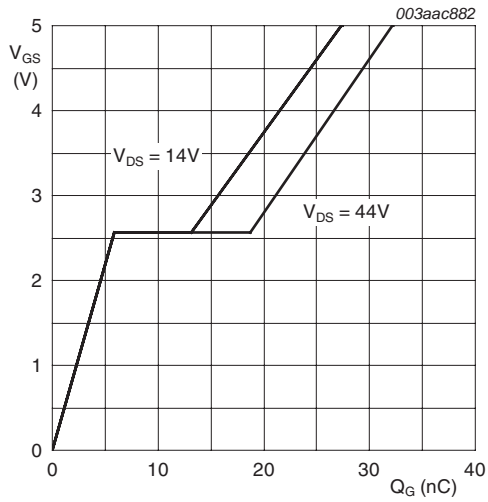
$$T_j = 25\text{ }^\circ\text{C}; I_D = 20\text{A}$$

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



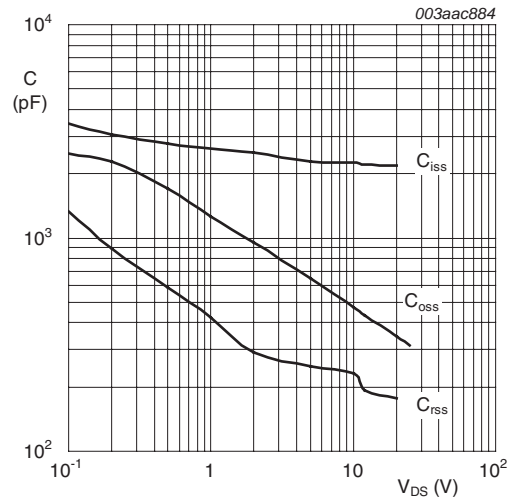
$$a = \frac{R_{DS(on)}}{R_{DS(on)@25^\circ\text{C}}}$$

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



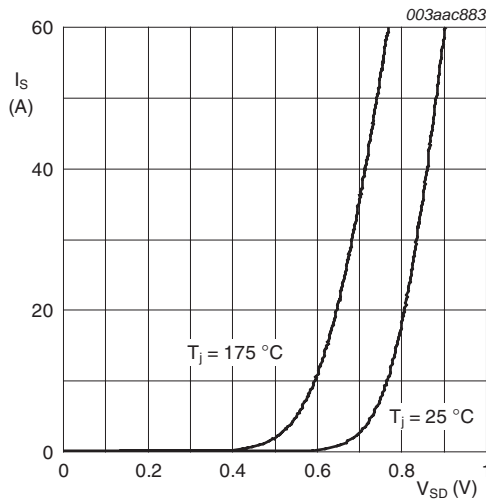
$T_j = 25^\circ\text{C}; I_D = 20\text{A}$

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



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

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.

7. Package outline

Plastic single-ended surface-mounted package (LFPAK); 4 leads

SOT669

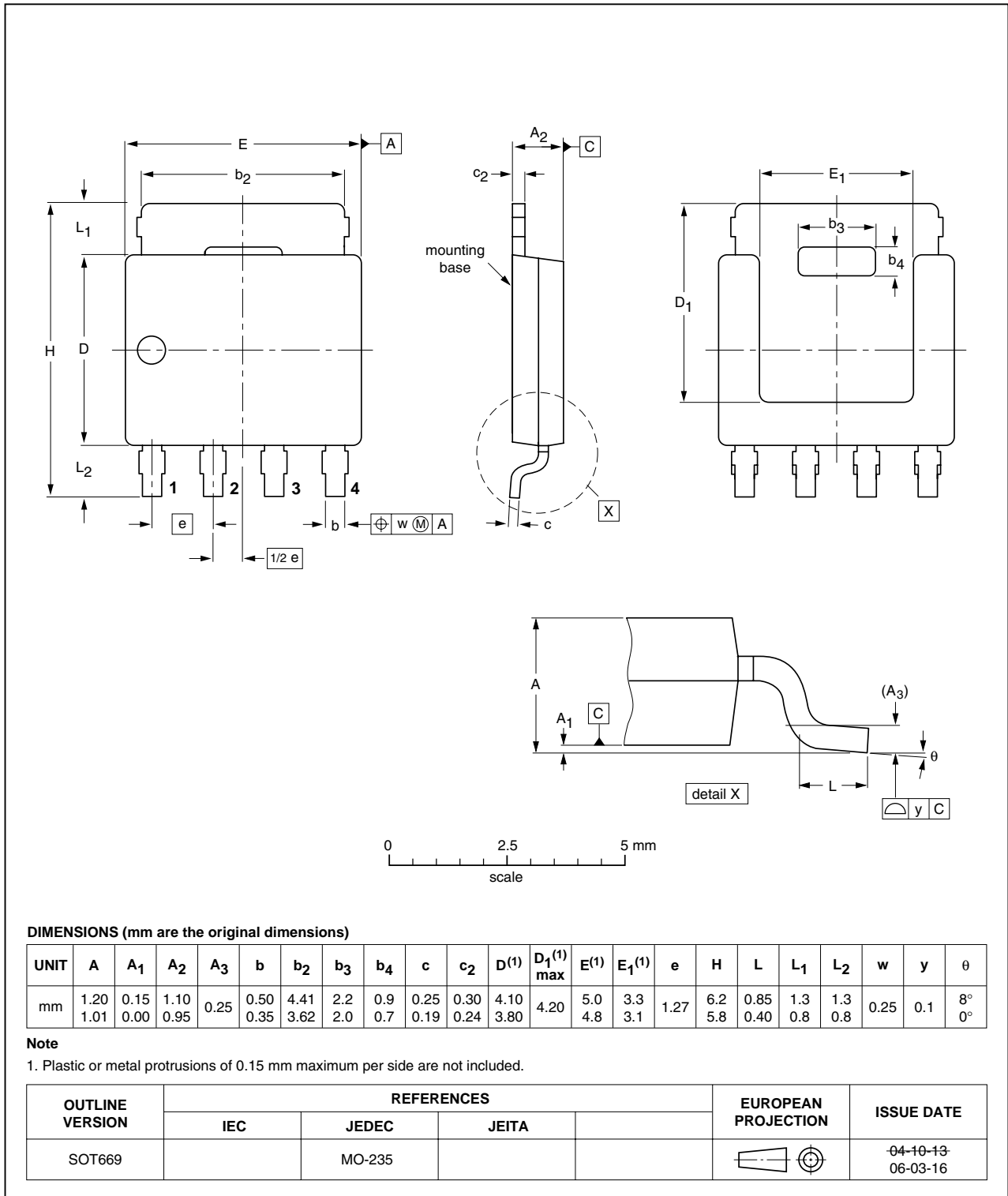


Fig 17. Package outline SOT669 (LFPAK)

8. Revision history

Table 7. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|----------------------|---------------|---------------|
| BUK9Y12-55B_4 | 20100407 | Product data sheet | - | BUK9Y12-55B_3 |
| Modifications: | • Status changed from objective to product. | | | |
| BUK9Y12-55B_3 | 20100216 | Objective data sheet | - | BUK9Y12-55B_2 |

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. |

[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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