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Kind regards,

Team Nexperia

BUK954R2-55B

N-channel TrenchMOS logic level FET

Rev. 03 — 8 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 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 3 | [1] | - | 75 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C};$ see Figure 2 | - | - | 300 | W |
| Static characteristics | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 5\text{ V}; I_D = 25\text{ A};$ $T_j = 25\text{ °C};$ see Figure 11 ; see Figure 12 | - | 3.5 | 4.2 | mΩ |
| | | $V_{GS} = 10\text{ V}; I_D = 25\text{ A};$ $T_j = 25\text{ °C}$ | - | 3.1 | 3.7 | mΩ |



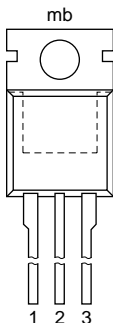
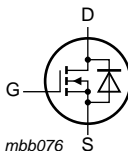
Table 1. Quick reference data ...continued

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--|--|-----|-----|-----|------|
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 75\text{ A}$; $V_{sup} \leq 55\text{ V}$; $R_{GS} = 50\ \Omega$; $V_{GS} = 5\text{ V}$; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; unclamped | - | - | 1.2 | J |
| Dynamic characteristics | | | | | | |
| Q_{GD} | gate-drain charge | $V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $V_{DS} = 44\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$; see Figure 13 | - | 37 | - | nC |

[1] Continuous current is limited by package.

2. Pinning information

Table 2. Pinning information

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

SOT78 (TO-220AB)

3. Ordering information

Table 3. Ordering information

| Type number | Package | | Version |
|--------------|----------|--|---------|
| | Name | Description | |
| BUK954R2-55B | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78 |

4. Limiting values

Table 4. Limiting values

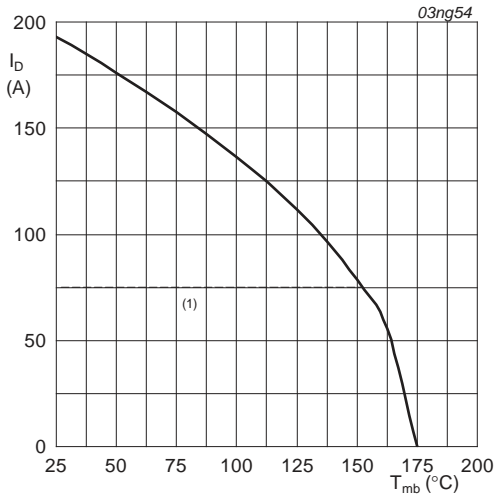
In accordance with the Absolute Maximum Rating System (IEC 60134).

| 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 3 ; see Figure 1 | [1] | - | - | 191 | A |
| | | $T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V};$ see Figure 1 ; see Figure 3 | [2] | - | - | 75 | A |
| | | $T_{mb} = 100\text{ °C}; V_{GS} = 5\text{ V};$ see Figure 1 | [2] | - | - | 75 | A |
| I_{DM} | peak drain current | $T_{mb} = 25\text{ °C}; t_p \leq 10\text{ }\mu\text{s};$ pulsed; see Figure 3 | - | - | 765 | A | |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C};$ see Figure 2 | - | - | 300 | W | |
| T_{stg} | storage temperature | | -55 | - | 175 | °C | |
| T_j | junction temperature | | -55 | - | 175 | °C | |
| Source-drain diode | | | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | [2] | - | - | 75 | A |
| | | | [3] | - | - | 191 | A |
| I_{SM} | peak source current | $t_p \leq 10\text{ }\mu\text{s};$ pulsed; $T_{mb} = 25\text{ °C}$ | - | - | 765 | A | |
| Avalanche ruggedness | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 75\text{ A}; V_{sup} \leq 55\text{ V}; R_{GS} = 50\text{ }\Omega;$ $V_{GS} = 5\text{ V}; T_{j(init)} = 25\text{ °C};$ unclamped | - | - | 1.2 | J | |

[1] Current is limited by power dissipation chip rating.

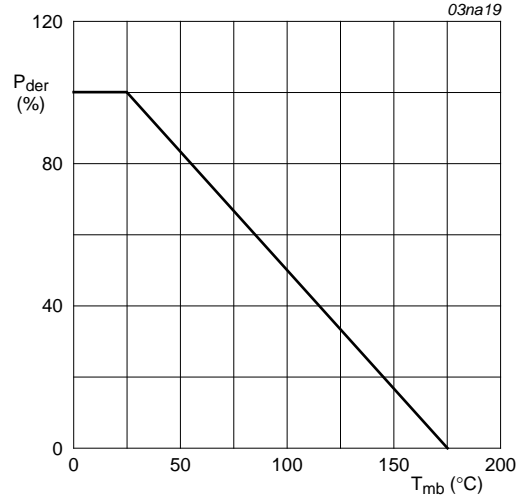
[2] Continuous current is limited by package.

[3] Current is limited by power dissipation chip rating.



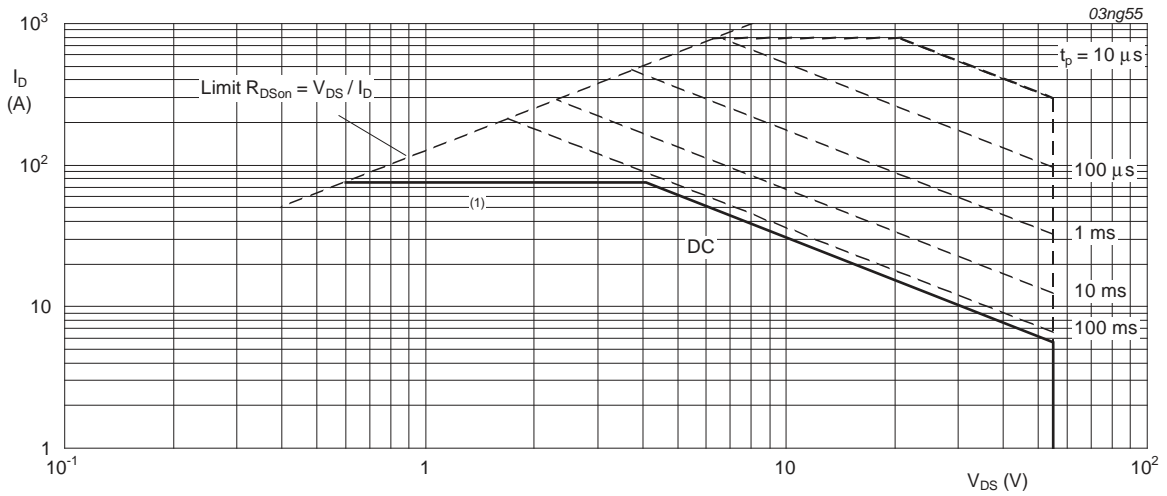
$$V_{GS} \geq 5V$$

Fig. 1. 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



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

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 | see Figure 4 | - | - | 0.5 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | vertical in still air | - | 60 | - | K/W |

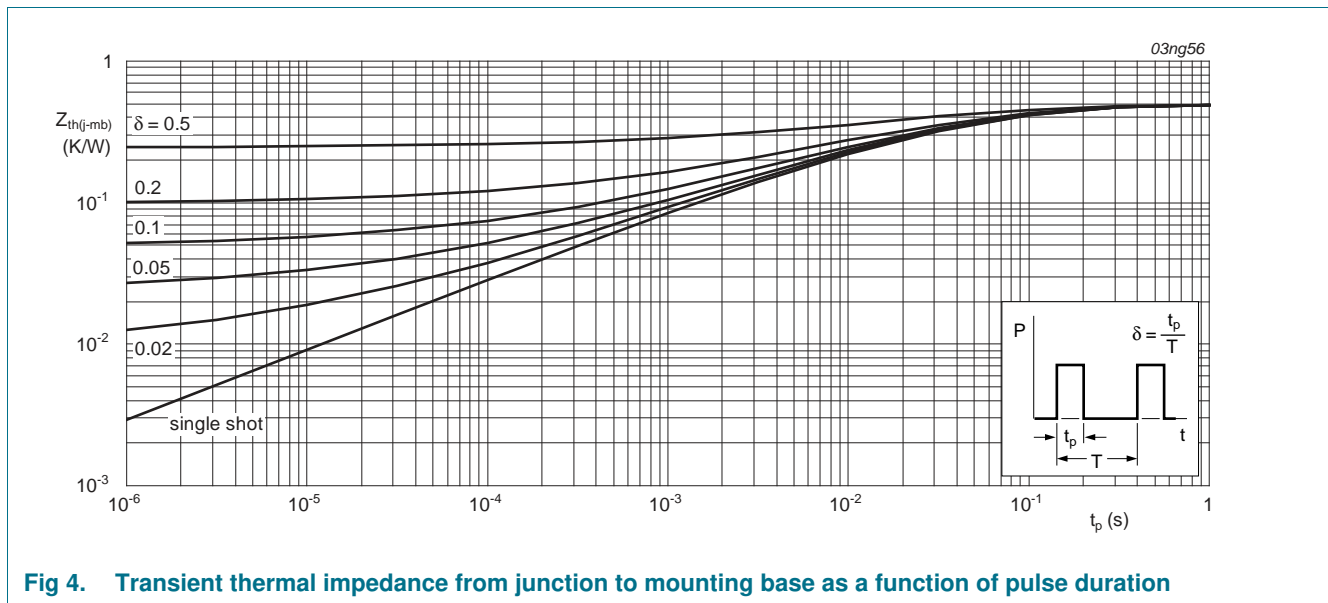


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|-------|---------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | 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 | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 10 | 1.1 | 1.5 | 2 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see Figure 10 | - | - | 2.3 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 10 | 0.5 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 0.02 | 1 | μA |
| | | $V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$ | - | - | 500 | 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 | $V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 11 ; see Figure 12 | - | 3.5 | 4.2 | m Ω |
| | | $V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$ | - | - | 4.4 | m Ω |
| | | $V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 11 ; see Figure 12 | - | - | 8.4 | m Ω |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$ | - | 3.1 | 3.7 | m Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 25 \text{ A}; V_{DS} = 44 \text{ V}; V_{GS} = 5 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 13 | - | 95 | - | nC |
| Q_{GS} | gate-source charge | | - | 17 | - | nC |
| Q_{GD} | gate-drain charge | | - | 37 | - | 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 14 | - | 7665 | 10220 | pF |
| C_{oss} | output capacitance | | - | 1044 | 1253 | pF |
| C_{rss} | reverse transfer capacitance | | - | 466 | 638 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30 \text{ V}; R_L = 1.2 \text{ } \Omega; V_{GS} = 5 \text{ V};$ $R_{G(ext)} = 10 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$ | - | 63 | - | ns |
| t_r | rise time | | - | 232 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 273 | - | ns |
| t_f | fall time | | - | 178 | - | ns |
| L_D | internal drain inductance | from contact screw on mounting base to centre of die ; $T_j = 25 \text{ }^\circ\text{C}$ | - | 3.5 | - | nH |
| | | from drain lead 6 mm from package to centre of die ; $T_j = 25 \text{ }^\circ\text{C}$ | - | 4.5 | - | nH |
| L_S | internal source inductance | from source lead to source bond pad ; $T_j = 25 \text{ }^\circ\text{C}$ | - | 7.5 | - | nH |

Source-drain diode

Table 6. Characteristics ...continued

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------|-----------------------|---|-----|------|-----|------|
| V_{SD} | source-drain voltage | $I_S = 40\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$; see Figure 15 | - | 0.85 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; | - | 78 | - | ns |
| Q_r | recovered charge | $V_{GS} = -10\text{ V}$; $V_{DS} = 30\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$ | - | 171 | - | nC |

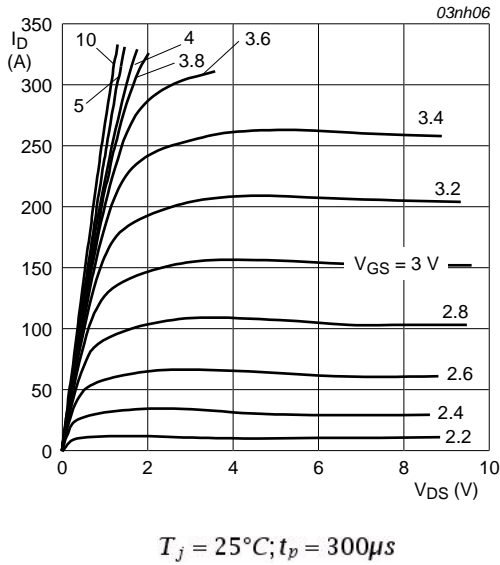


Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

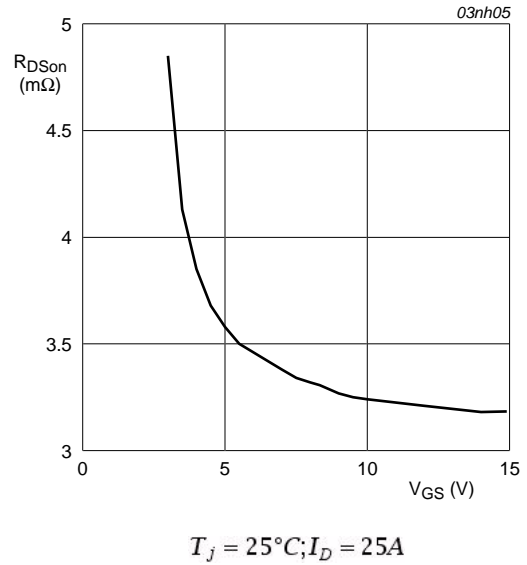


Fig 6. Drain-source on-state resistance as a function of gate-source voltage; typical values

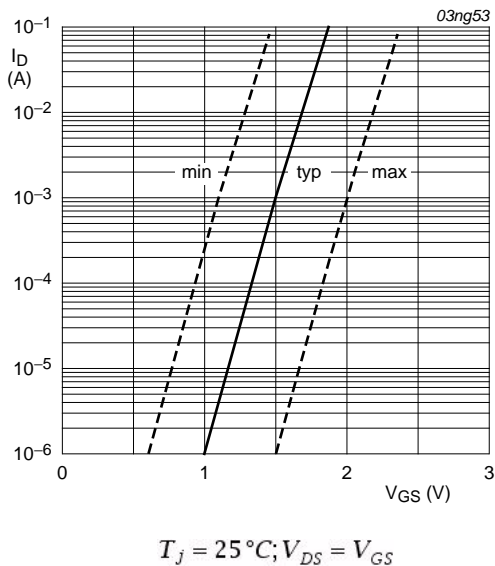


Fig 7. Sub-threshold drain current as a function of gate-source voltage

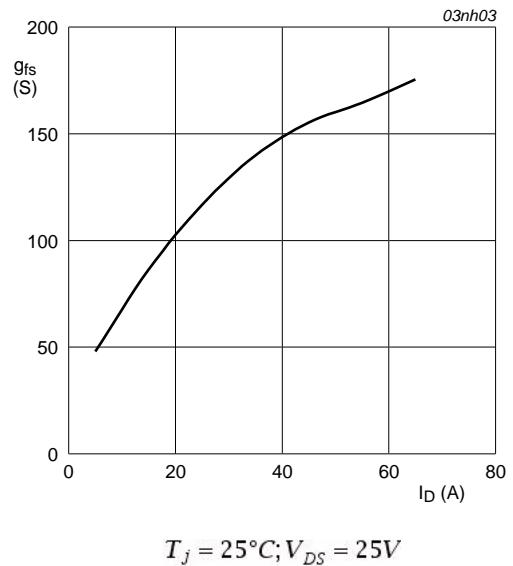


Fig 8. Forward transconductance as a function of drain current; typical values

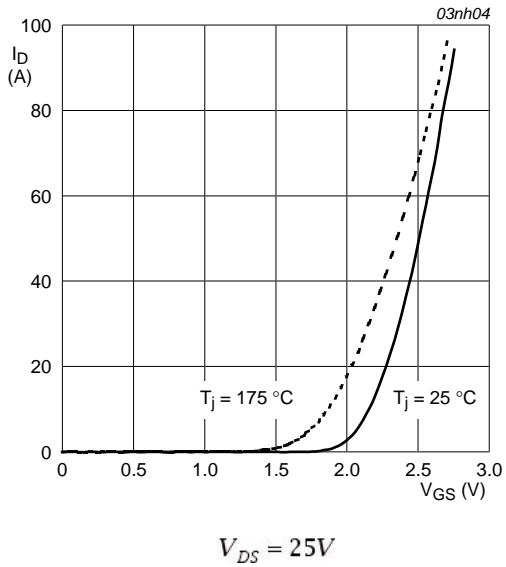


Fig 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

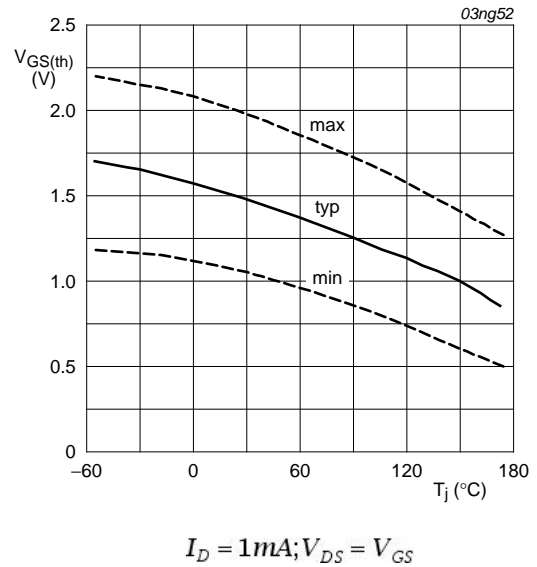


Fig 10. Gate-source threshold voltage as a function of junction temperature

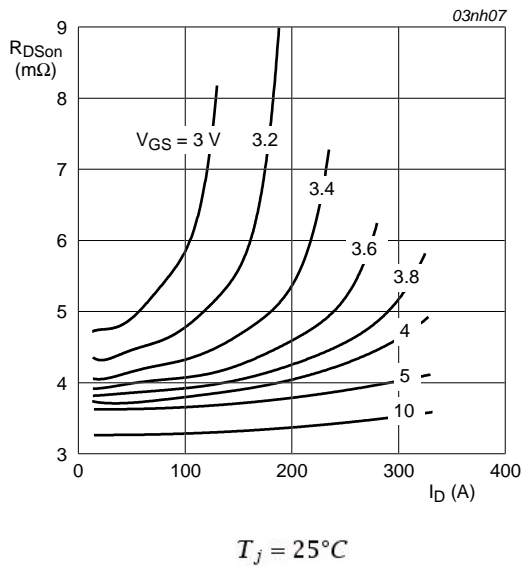


Fig 11. Drain-source on-state resistance as a function of drain current; typical values

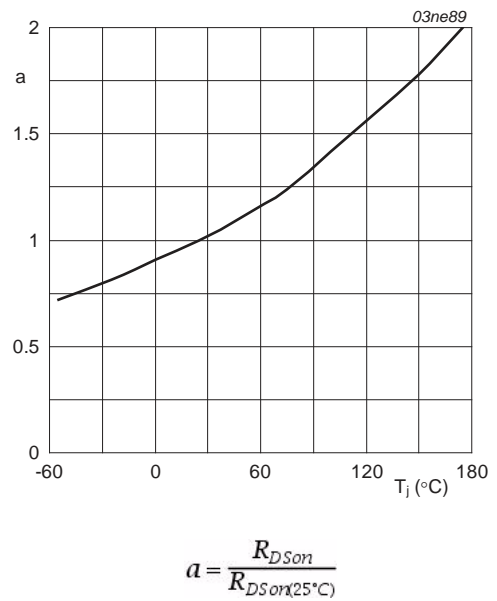
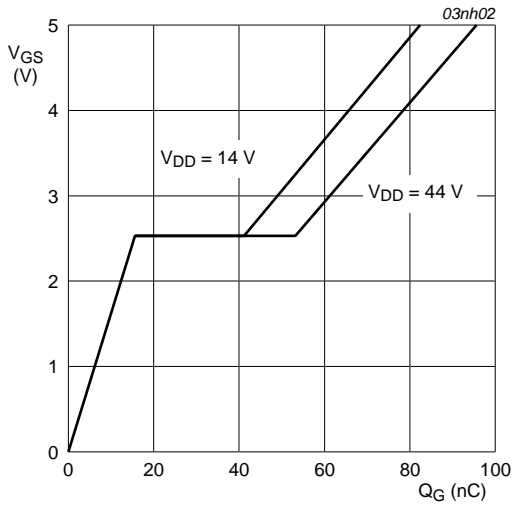
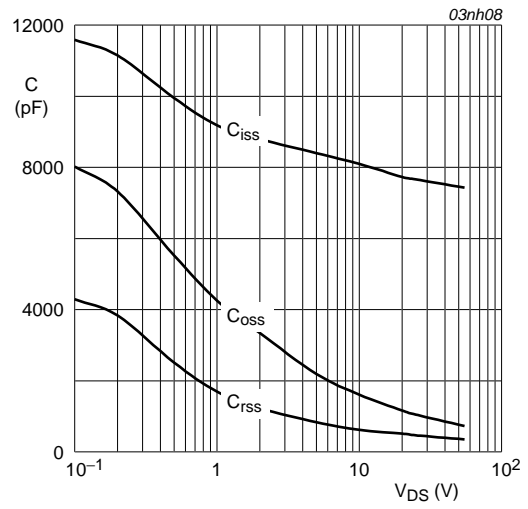


Fig 12. Normalized drain-source on-state resistance factor as a function of junction temperature



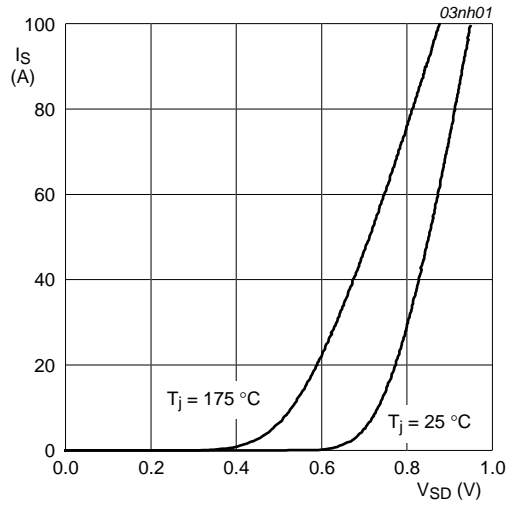
$T_j = 25^\circ\text{C}; I_D = 25\text{A}$

Fig 13. Gate-source threshold voltage as a function of junction temperature



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

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



$V_{GS} = 0\text{V}$

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

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78

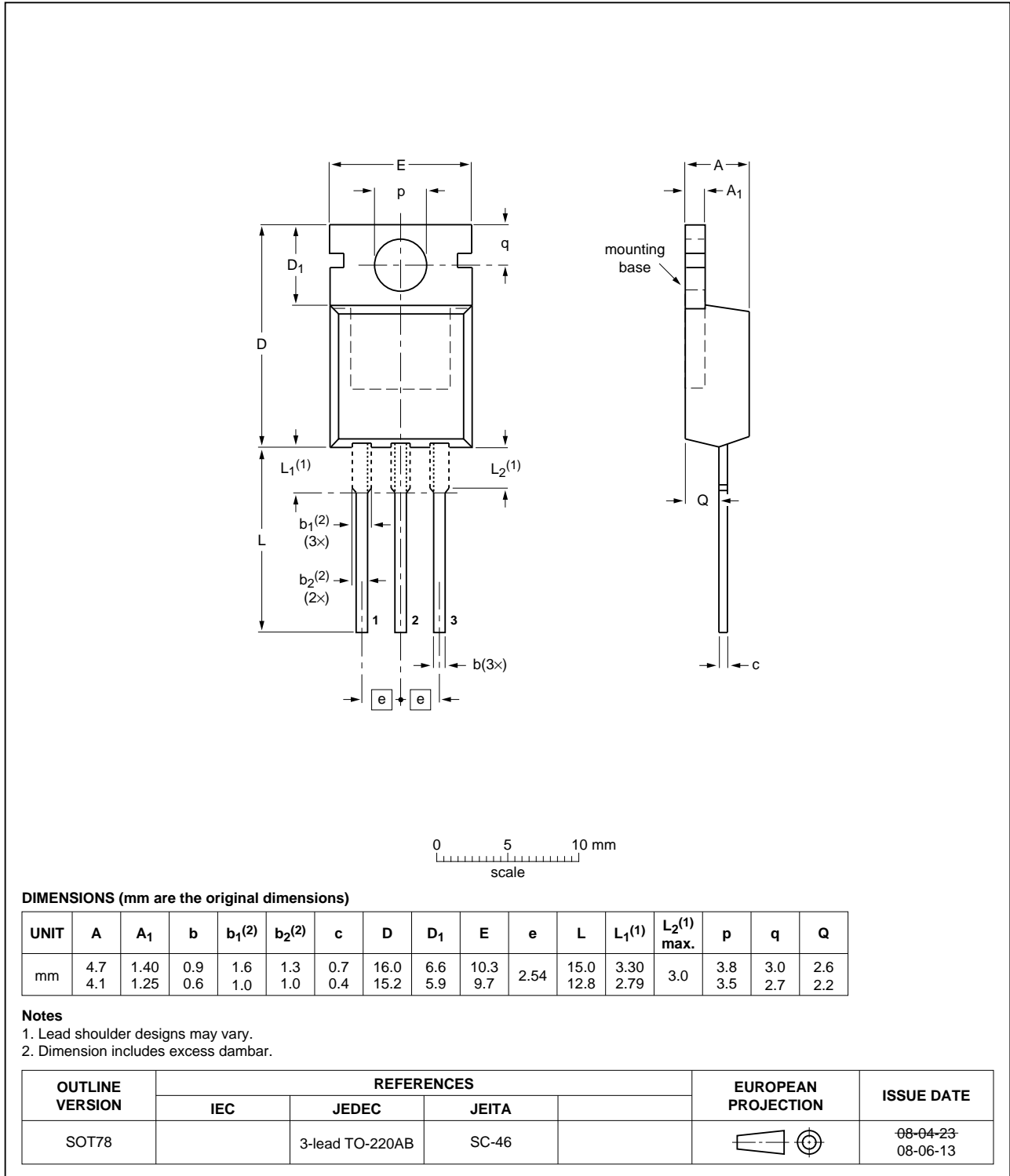


Fig 16. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--|--------------|--------------------|---------------|---|
| BUK954R2-55B v.3 | 20100608 | Product data sheet | - | BUK95_964R2_55B-02 |
| Modifications: | | | | |
| | | | | <ul style="list-style-type: none">• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.• Legal texts have been adapted to the new company name where appropriate.• Type number BUK954R2-55B separated from data sheet BUK95_964R2_55B-02. |
| BUK95_964R2_55B-02 (9397 750 10277) | 20021008 | Product data | - | - |

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. |
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[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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