

BUK752R3-40C

N-channel TrenchMOS standard level FET

Rev. 03 — 26 January 2009

Product data sheet

1. Product profile

1.1 General description

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

1.2 Features and benefits

- AEC Q101 compliant
- Avalanche robust
- Suitable for standard level gate drive
- Suitable for thermally demanding environment up to 175°C rating

1.3 Applications

- 12V Motor, lamp and solenoid loads
- High performance automotive power systems
- High performance Pulse Width Modulation applications

1.4 Quick reference data

Table 1. Quick reference

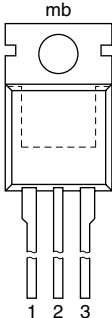
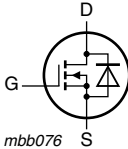
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--|--|-------|------|-----|------|
| V_{DS} | drain-source voltage | $T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$ | - | - | 40 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; see Figure 1 ; see Figure 3 ; | [1] - | - | 100 | A |
| | | | [2] | | | |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; see Figure 2 | - | - | 333 | W |
| Dynamic characteristics | | | | | | |
| Q_{GD} | gate-drain charge | $V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; see Figure 15 | - | 67 | - | nC |
| Static characteristics | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; see Figure 12 ; see Figure 13 | - | 1.96 | 2.3 | mΩ |
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 100\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ Ω}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped | - | - | 1.2 | J |

[1] Refer to document 9397 750 12572 for further information.

[2] Continuous current is limited by package.

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 | | |
| | | | SOT78A (3-lead TO-220AB; SC-46; SFM3) | |

3. Ordering information

Table 3. Ordering information

| Type number | Package | | Version |
|--------------|---------------------------------------|---|---------|
| | Name | Description | |
| BUK752R3-40C | 3-lead TO-220AB; SC-46; SFM3 | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78A |

4. Limiting values

Table 4. 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 ≥ 25 °C; T _j ≤ 175 °C | | - | 40 | V |
| V _{DGR} | drain-gate voltage | R _{GS} = 20 kΩ | | - | 40 | V |
| V _{GS} | gate-source voltage | | | -20 | 20 | V |
| I _D | drain current | T _{mb} = 25 °C; V _{GS} = 10 V; see Figure 1 ; see Figure 3 ; | [1][2] | - | 100 | A |
| | | T _{mb} = 100 °C; V _{GS} = 10 V; see Figure 1 ; | [1][2] | - | 100 | A |
| | | T _{mb} = 25 °C; V _{GS} = 10 V; see Figure 1 ; see Figure 3 ; | [1][3] | - | 276 | A |
| I _{DM} | peak drain current | T _{mb} = 25 °C; t _p ≤ 10 μs; pulsed; see Figure 3 | | - | 1104 | A |
| P _{tot} | total power dissipation | T _{mb} = 25 °C; see Figure 2 | | - | 333 | 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 °C; | [1][3] | - | 276 | A |
| | | T _{mb} = 25 °C; | [1][2] | - | 100 | A |
| I _{SM} | peak source current | t _p ≤ 10 μs; pulsed; T _{mb} = 25 °C | | - | 1104 | A |
| Avalanche ruggedness | | | | | | |
| E _{DS(AL)S} | non-repetitive drain-source avalanche energy | I _D = 100 A; V _{sup} ≤ 40 V; R _{GS} = 50 Ω; V _{GS} = 10 V; T _{j(init)} = 25 °C; unclamped | | - | 1.2 | J |
| E _{DS(AL)R} | repetitive drain-source avalanche energy | see Figure 4 ; | [4][5] [6][7] | - | - | J |

[1] Refer to document 9397 750 12572 for further information.

[2] Continuous current is limited by package.

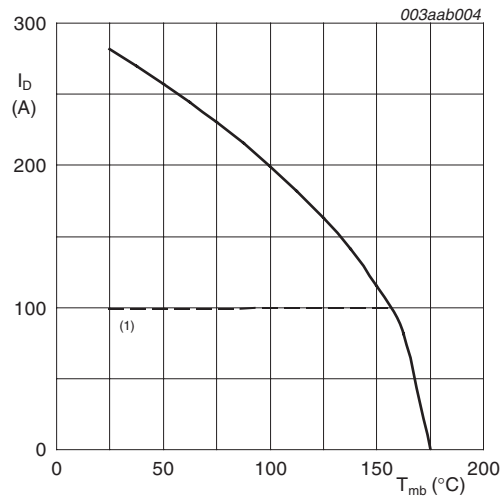
[3] Current is limited by chip power dissipation rating.

[4] Maximum value not quoted. Repetitive rating defined in avalanche rating figure.

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

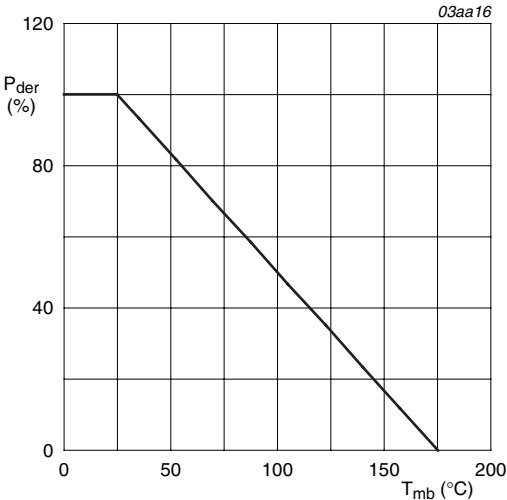
[6] Repetitive avalanche rating limited by an average junction temperature of 170 °C.

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



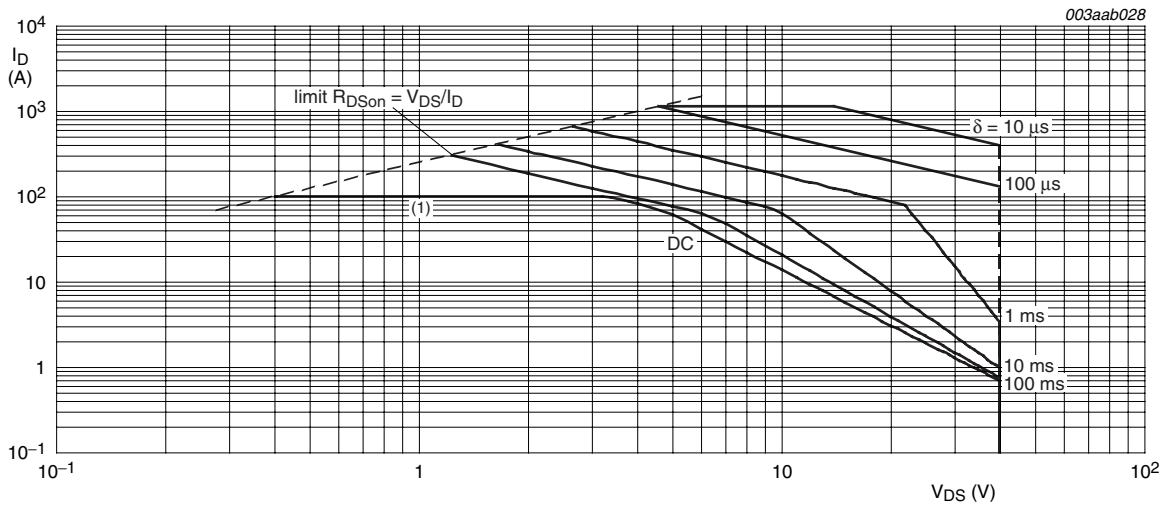
$V_{GS} \geq 10\text{ V}$
(1) Capped at 100 A due to package.

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



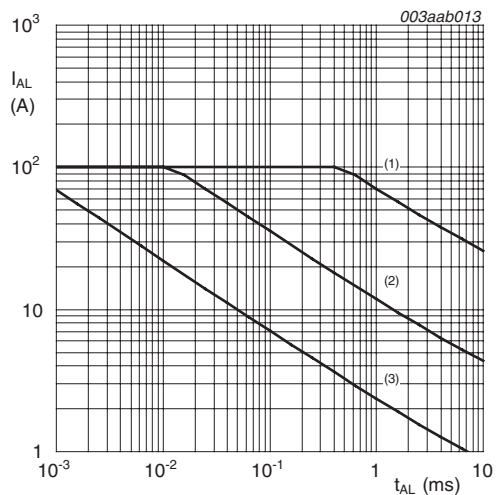
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100\%$$

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



$T_{mb} = 25^\circ\text{C}; I_{DM}$ is single pulse. (1) Capped at 100 A due to package.

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



(1) Single-pulse; $T_{mb} = 25^\circ C$.

(2) Single-pulse; $T_{mb} = 150^\circ C$.

(3) Repetitive.

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

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 | - | - | 0.45 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | Vertical in free air | - | 60 | - | K/W |

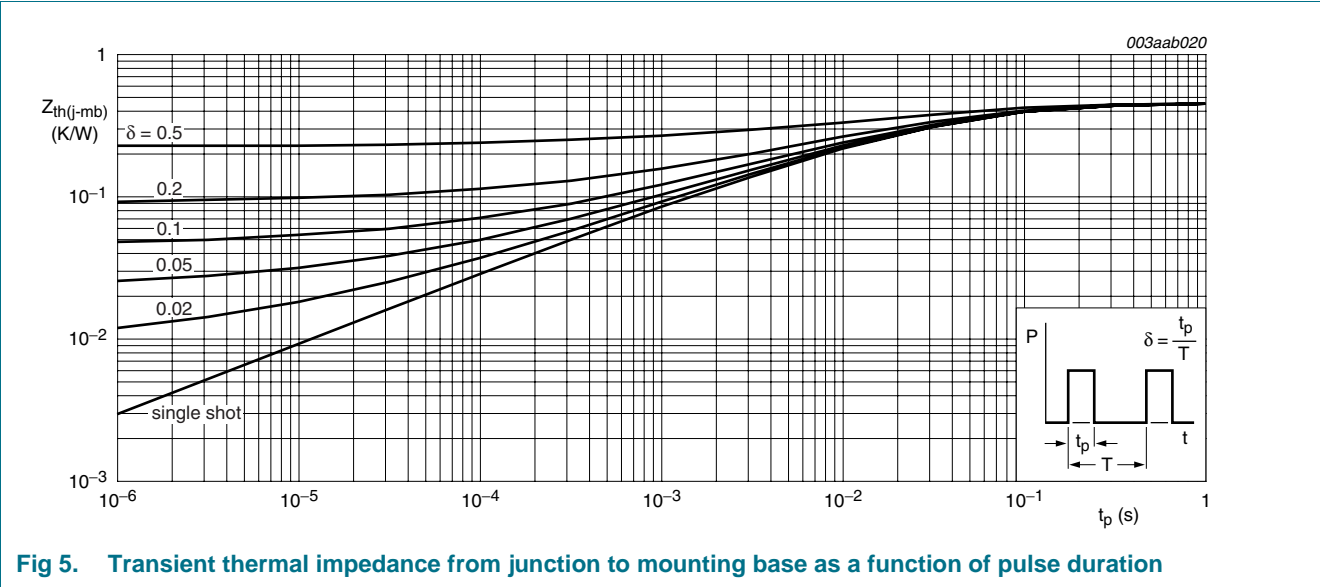


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|-------|------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$ | 40 | - | - | V |
| | | $I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_j = -55 ^\circ C$ | 36 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_j = 25 ^\circ C$; see Figure 10 ; see Figure 11 | 2 | 3 | 4 | V |
| V_{GSth} | gate-source threshold voltage | $I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_j = -55 ^\circ C$; see Figure 10 ; see Figure 11 | - | - | 4.4 | V |
| | | $I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_j = 175 ^\circ C$; see Figure 10 ; see Figure 11 | 1 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 40 V$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$ | - | 0.02 | 1 | μA |
| I_{GSS} | gate leakage current | $V_{DS} = 0 V$; $V_{GS} = 20 V$; $T_j = 25 ^\circ C$ | - | 2 | 100 | nA |
| | | $V_{DS} = 0 V$; $V_{GS} = -20 V$; $T_j = 25 ^\circ C$ | - | 2 | 100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 V$; $I_D = 25 A$; $T_j = 175 ^\circ C$; see Figure 12 ; see Figure 13 | - | - | 4.26 | m Ω |
| | | $V_{GS} = 10 V$; $I_D = 25 A$; $T_j = 25 ^\circ C$; see Figure 12 ; see Figure 13 | - | 1.96 | 2.3 | m Ω |
| I_{DSS} | drain leakage current | $V_{DS} = 40 V$; $V_{GS} = 0 V$; $T_j = 175 ^\circ C$ | - | - | 500 | μA |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 25 A$; $V_{DS} = 32 V$; $V_{GS} = 10 V$; see Figure 15 | - | 175 | - | nC |
| Q_{GS} | gate-source charge | | - | 49 | - | nC |
| Q_{GD} | gate-drain charge | | - | 67 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D = 25 A$; $V_{DS} = 32 V$; see Figure 15 | - | 5 | - | V |
| C_{iss} | input capacitance | $V_{GS} = 0 V$; $V_{DS} = 25 V$; $f = 1 MHz$; $T_j = 25 ^\circ C$; see Figure 16 | - | 8492 | 11323 | pF |
| C_{oss} | output capacitance | | - | 1606 | 1927 | pF |
| C_{rss} | reverse transfer capacitance | | - | 1101 | 1508 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30 V$; $R_L = 1.2 \Omega$; $V_{GS} = 10 V$; $R_{G(ext)} = 10 \Omega$ | - | 65 | - | ns |
| t_r | rise time | | - | 133 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 146 | - | ns |
| t_f | fall time | | - | 119 | - | ns |
| L_D | internal drain inductance | from drain lead 6 mm from package to centre of die | - | 4.5 | - | nH |
| | | from contact screw on mounting base to centre of die | - | 3.5 | - | nH |
| L_S | internal source inductance | from source lead to source bonding pad | - | 7.5 | - | nH |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 25 A$; $V_{GS} = 0 V$; $T_j = 25 ^\circ C$; see Figure 14 | - | 0.85 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20 A$; $di_S/dt = -100 A/\mu s$; $V_{GS} = 0 V$; $V_{DS} = 30 V$ | - | 75 | - | ns |
| Q_r | recovered charge | | - | 57 | - | nC |

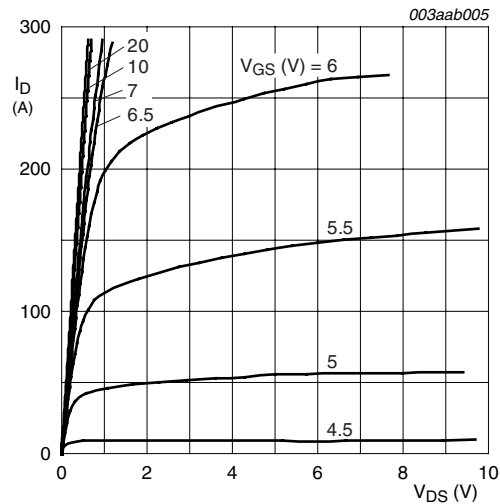


Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values

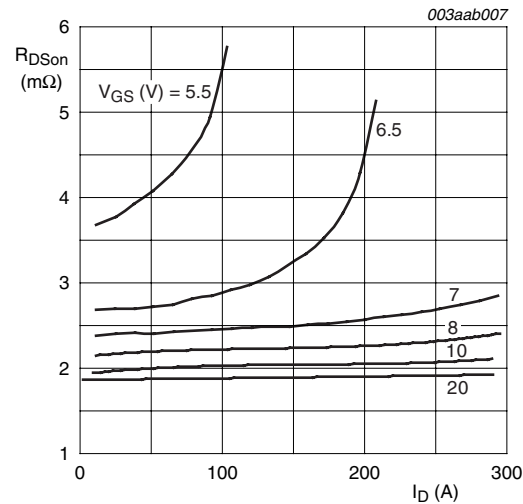


Fig 7. Drain-source on-state resistance as a function of drain current; typical values

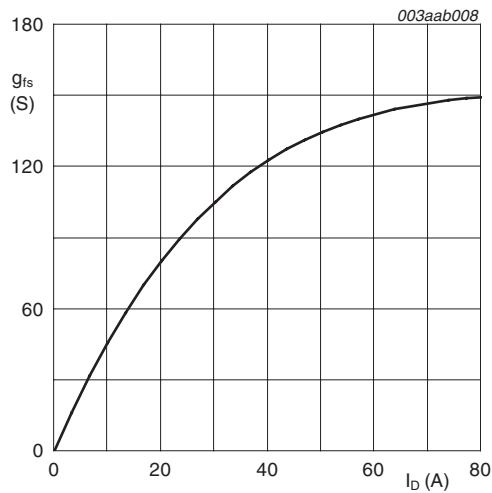


Fig 8. Forward transconductance as a function of drain current; typical values

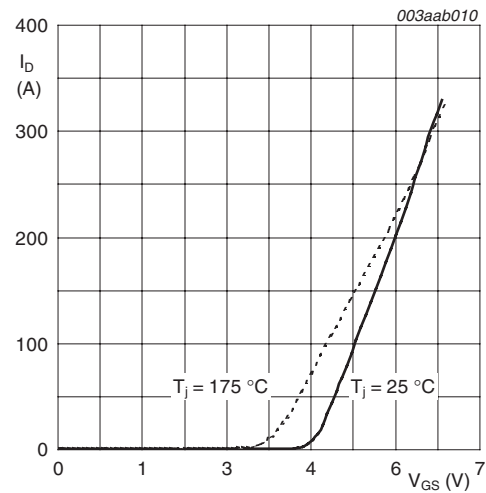
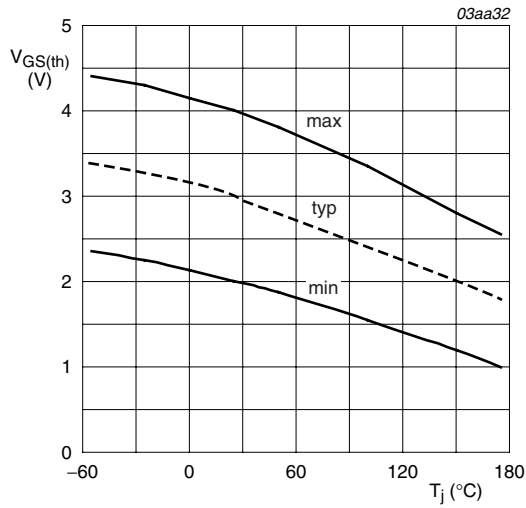
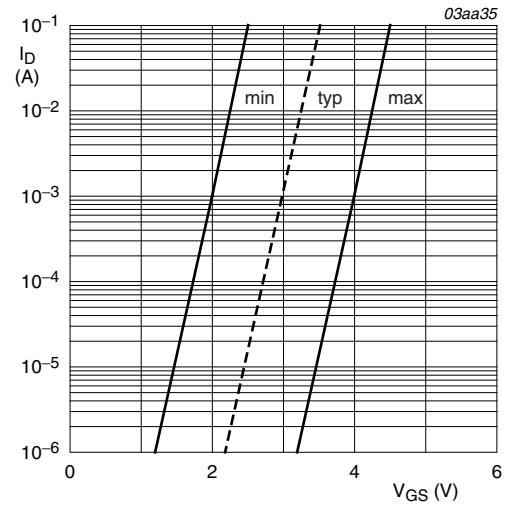


Fig 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values



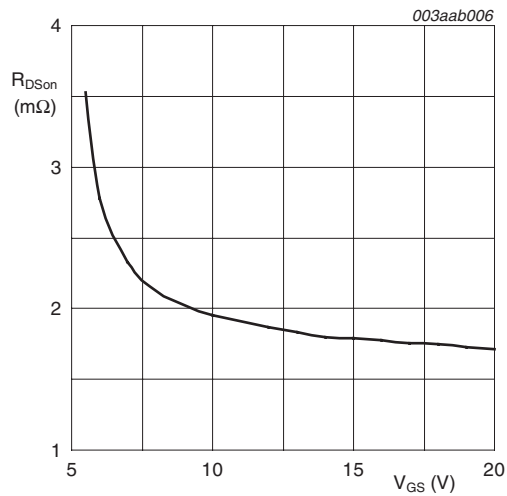
$$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$$

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



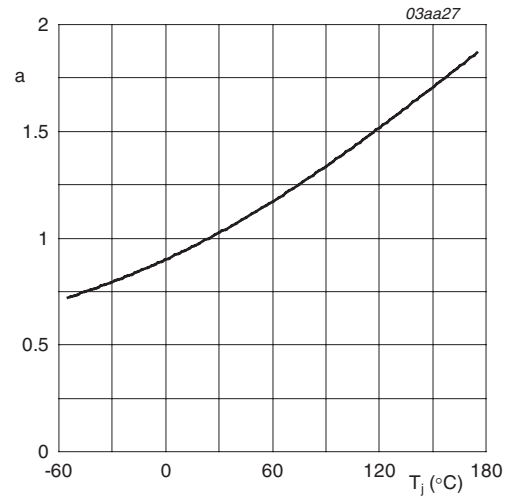
$$T_j = 25^\circ\text{C}; V_{DS} = 5 \text{ V}$$

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



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

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



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

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

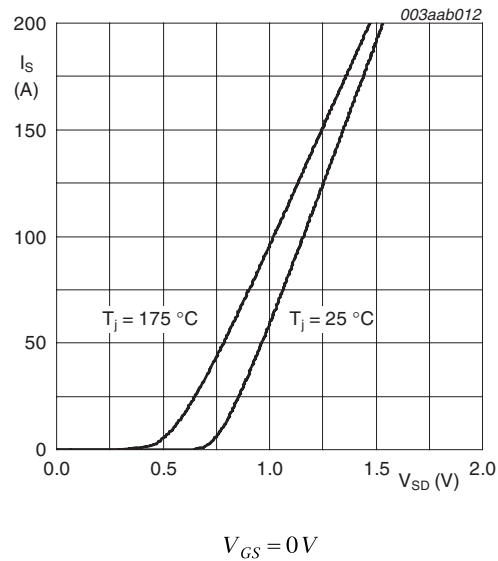


Fig 14. Source current as a function of source-drain voltage; typical values

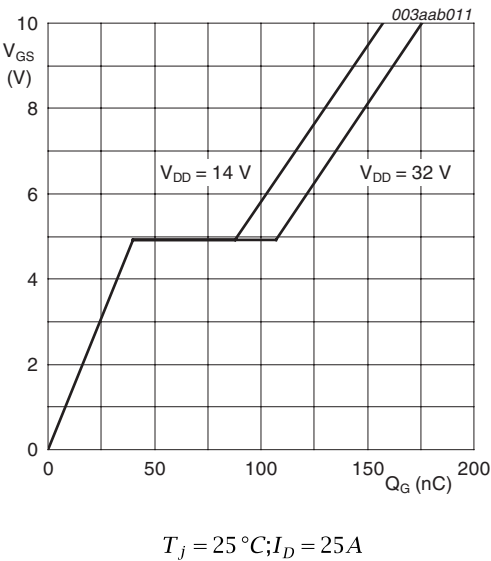


Fig 15. Gate-source voltage as a function of gate charge; typical values

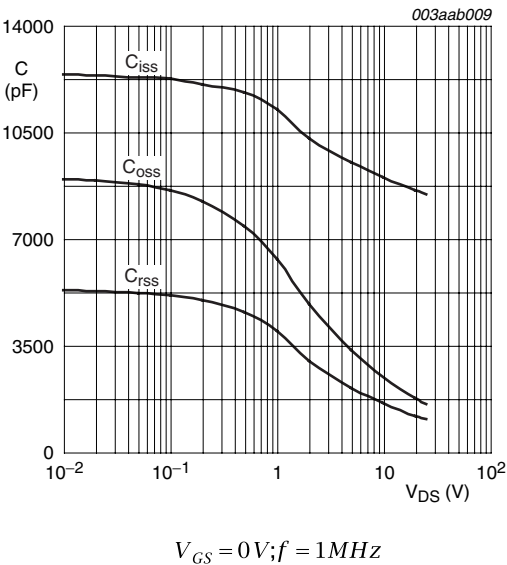


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

7. Package outline

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

SOT78A

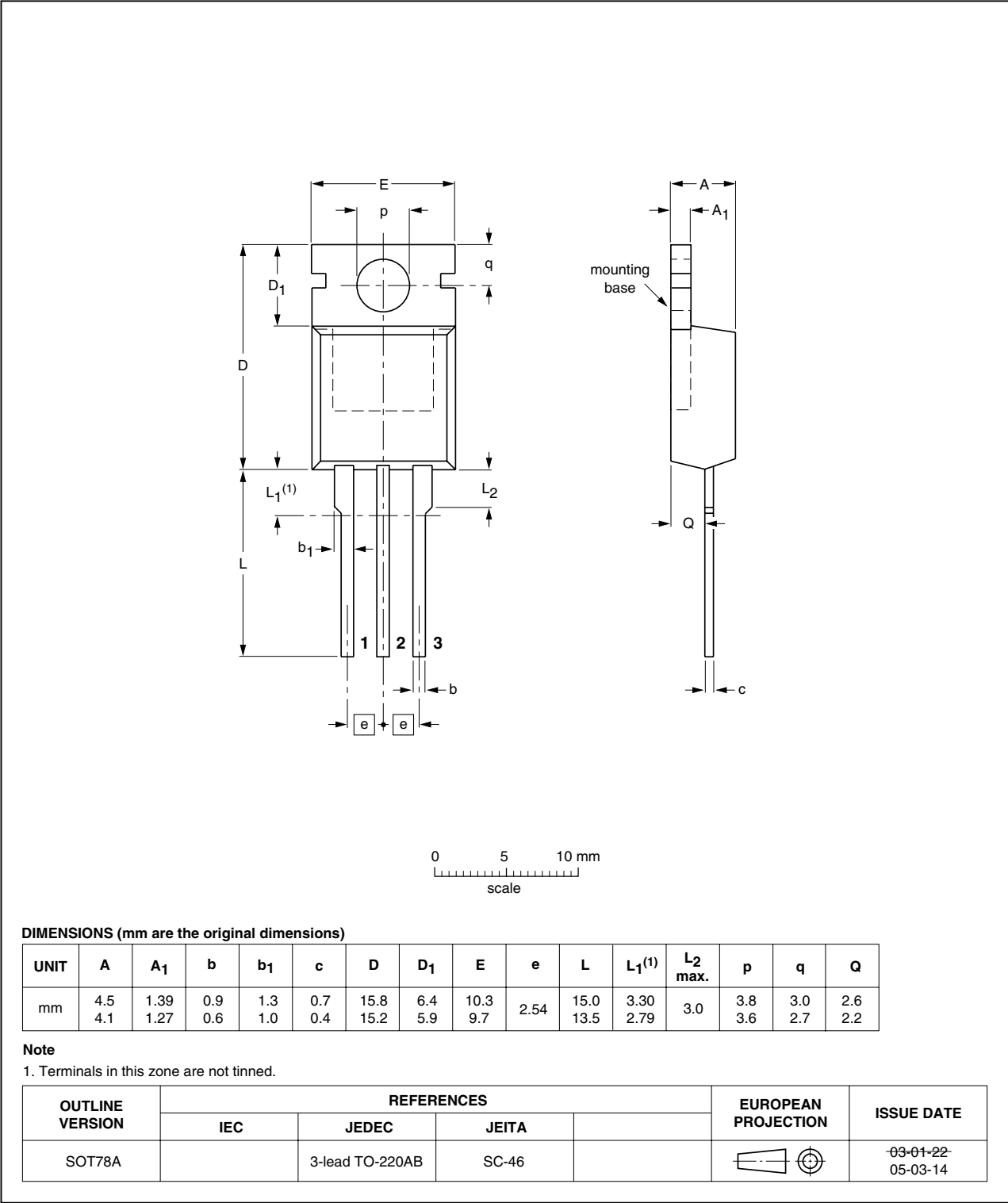


Fig 17. Package outline SOT78A (3-lead TO-220AB; SC-46; SFM3)

8. Revision history

Table 7. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------------|---|--------------------|---------------|-------------------|
| BUK752R3-40C_3 | 20090126 | Product data sheet | - | BUK75_7E2R3-40C_2 |
| 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 BUK752R3-40C separated from data sheet BUK75_7E2R3-40C_2.• Package outline updated. | | | |
| BUK75_7E2R3-40C_2 | 20060810 | Product data sheet | - | BUK75_7E2R3-40C_1 |
| BUK75_7E2R3-40C_1 | 20060503 | Product data sheet | - | - |

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".

[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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