
# BUK765R2-40B

## N-channel TrenchMOS standard level FET

Rev. 3 — 22 November 2011 Product data sheet

## 1. Product profile

### 1.1 General description

Standard 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

- Q101 compliant
- Suitable for standard level gate drive sources
- Suitable for thermally demanding environments due to 175 ℃ rating

### 1.3 Applications

- 12 V loads
- Automotive systems
- General purpose power switching
- Motors, lamps and solenoids

### 1.4 Quick reference data

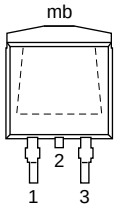
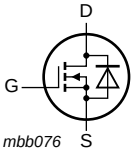
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ ℃; $T_j \leq 175$ ℃ | | - | - | 40 | V |
| $I_D$ | drain current | $V_{GS} = 10$ V; $T_{mb} = 25$ ℃; see Figure 1; see Figure 3 | [1] | - | - | 75 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ ℃; see Figure 2 | | - | - | 203 | W |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ ℃; see Figure 11; see Figure 12 | | - | 4.4 | 5.2 | mΩ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS} = 10$ V; $I_D = 25$ A; $V_{DS} = 32$ V; $T_j = 25$ ℃; see Figure 13 | | - | 16 | - | nC |
| **Avalanche ruggedness** | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 75$ A; $V_{sup} \leq 40$ V; $R_{GS} = 50$ Ω; $V_{GS} = 10$ V; $T_{j(init)} = 25$ ℃; unclamped | | - | - | 494 | mJ |

[1] Continuous current is limited by package.

## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate |   SOT404 (D2PAK) |   |
| 2 | D | drain[1] | | |
| 3 | S | source | | |
| mb | D | mounting base; connected to drain | | |

[1] It is not possible to make a connection to pin 2.

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BUK765R2-40B | D2PAK | plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) | SOT404 |

## 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 | $T_j \geq 25$ °C; $T_j \leq 175$ °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] | - | 143 | A |
| | | | [2] | - | 75 | A |
| | | $T_{mb}$ = 100 °C; $V_{GS}$ = 10 V; see Figure 1 | [2] | - | 75 | A |
| $I_{DM}$ | peak drain current | $T_{mb}$ = 25 °C; pulsed; $t_p \leq 10$ µs; see Figure 3 | | - | 573 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | | - | 203 | 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] | - | 143 | A |
| | | | [2] | - | 75 | A |
| $I_{SM}$ | peak source current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C | | - | 573 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D$ = 75 A; $V_{sup} \leq 40$ V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; unclamped | | - | 494 | mJ |

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

[2] Continuous current is limited by package.

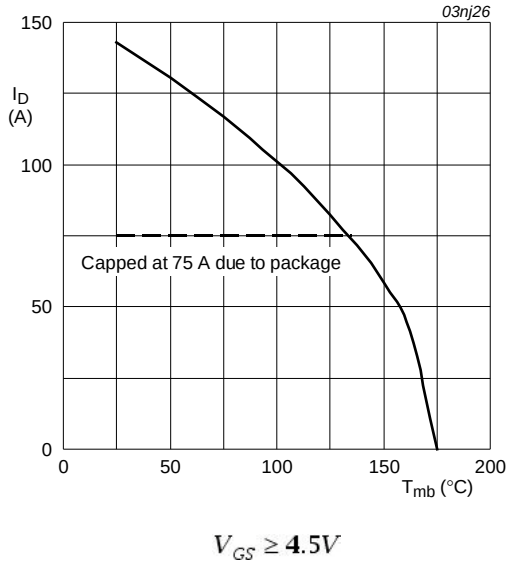



**Fig 1. Continuous drain current as a function of mounting base temperature**

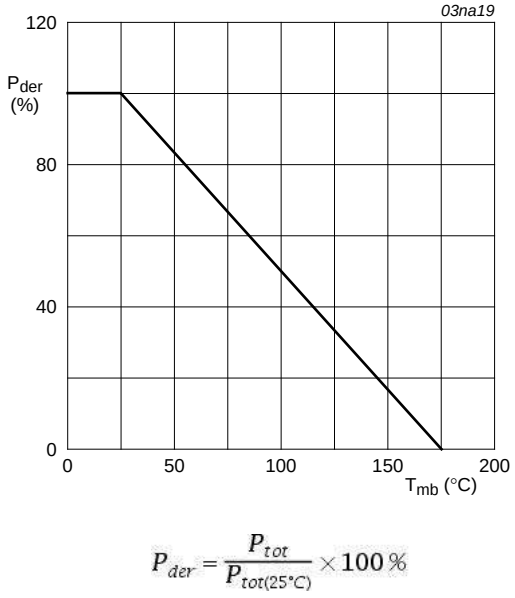
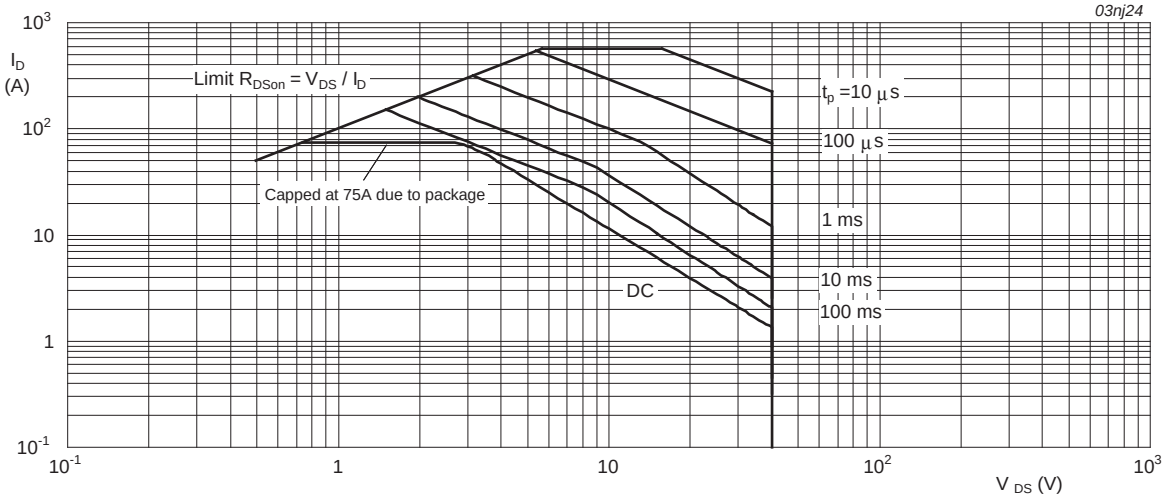



**Fig 2. Normalized total power dissipation as a function of mounting base temperature**




$T_{mb} = 25°C; I_{DM}$ 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 | - | - | 0.74 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | minimum footprint ; mounted on a printed-circuit board | - | 50 | - | K/W |

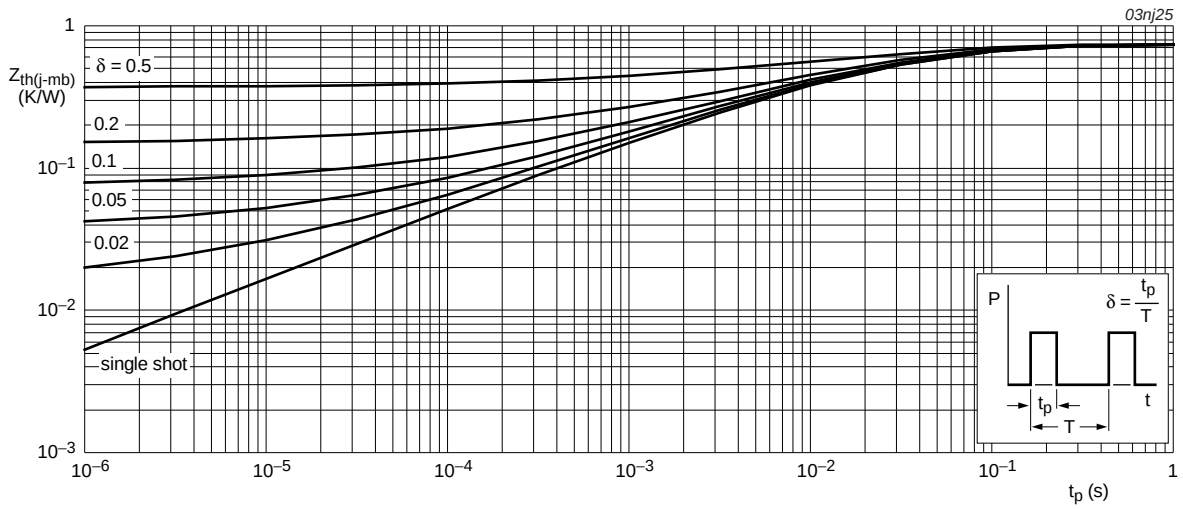
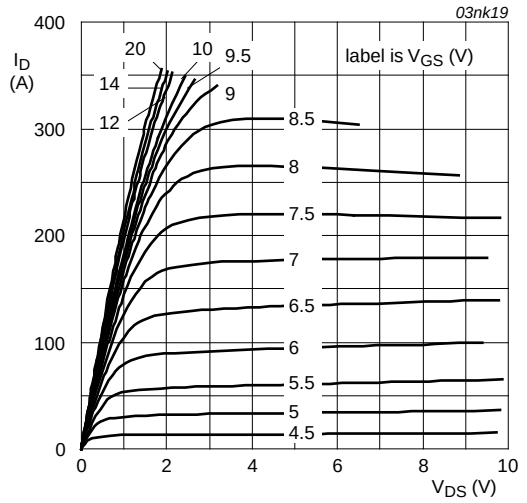



**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

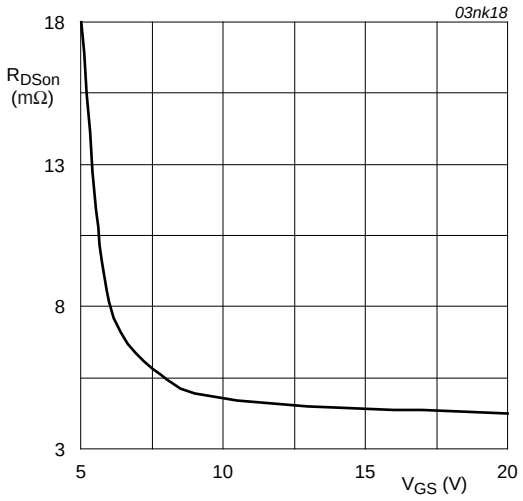
**Table 6. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 0.25 mA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | 40 | - | - | V |
| | | $I_D$ = 0.25 mA; $V_{GS}$ = 0 V; $T_j$ = -55 ℃ | 36 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 ℃; see Figure 10 | 2 | 3 | 4 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 ℃; see Figure 10 | - | - | 4.4 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 ℃; see Figure 10 | 1 | - | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 40 V; $V_{GS}$ = 0 V; $T_j$ = 25 ℃ | - | 0.02 | 1 | µA |
| | | $V_{DS}$ = 40 V; $V_{GS}$ = 0 V; $T_j$ = 175 ℃ | - | - | 500 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 20 V; $V_{DS}$ = 0 V; $T_j$ = 25 ℃ | - | 2 | 100 | nA |
| | | $V_{GS}$ = -20 V; $V_{DS}$ = 0 V; $T_j$ = 25 ℃ | - | 2 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 175 ℃; see Figure 11; see Figure 12 | - | - | 9.9 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 ℃; see Figure 11; see Figure 12 | - | 4.4 | 5.2 | mΩ |
| **Dynamic characteristics** | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 25 A; $V_{DS}$ = 32 V; $V_{GS}$ = 10 V; $T_j$ = 25 ℃; see Figure 13 | - | 52 | - | nC |
| $Q_{GS}$ | gate-source charge | | - | 12 | - | nC |
| $Q_{GD}$ | gate-drain charge | | - | 16 | - | nC |
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; f = 1 MHz; $T_j$ = 25 ℃; see Figure 14 | - | 2842 | 3789 | pF |
| $C_{oss}$ | output capacitance | | - | 711 | 853 | pF |
| $C_{rss}$ | reverse transfer capacitance | | - | 296 | 406 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 30 V; $R_L$ = 1.2 Ω; $V_{GS}$ = 10 V; $R_{G(ext)}$ = 10 Ω; $T_j$ = 25 ℃ | - | 15 | - | ns |
| $t_r$ | rise time | | - | 51 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 81 | - | ns |
| $t_f$ | fall time | | - | 56 | - | ns |
| $L_D$ | internal drain inductance | from drain lead 6 mm from package to centre of die ; $T_j$ = 25 ℃ | - | 4.5 | - | nH |
| | | from upper edge of drain mounting base to centre of die ; $T_j$ = 25 ℃ | - | 2.5 | - | nH |
| $L_S$ | internal source inductance | from source lead to source bond pad ; $T_j$ = 25 ℃ | - | 7.5 | - | nH |
| **Source-drain diode** | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 25 A; $V_{GS}$ = 0 V; $T_j$ = 25 ℃; see Figure 15 | - | 0.85 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 20 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = -10 V; $V_{DS}$ = 20 V; $T_j$ = 25 ℃ | - | 54 | - | ns |
| $Q_r$ | recovered charge | | - | 38 | - | nC |



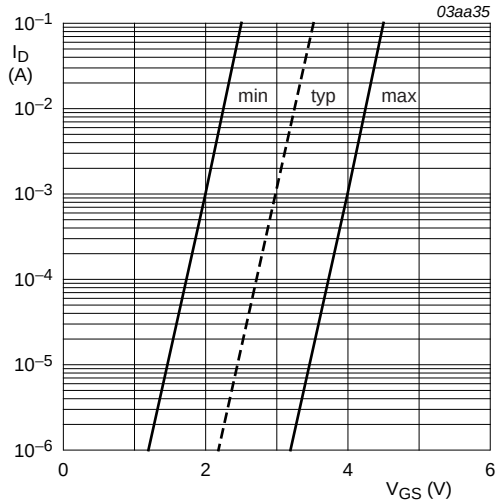

$T_j = 25°C; t_p = 300\mu s$

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



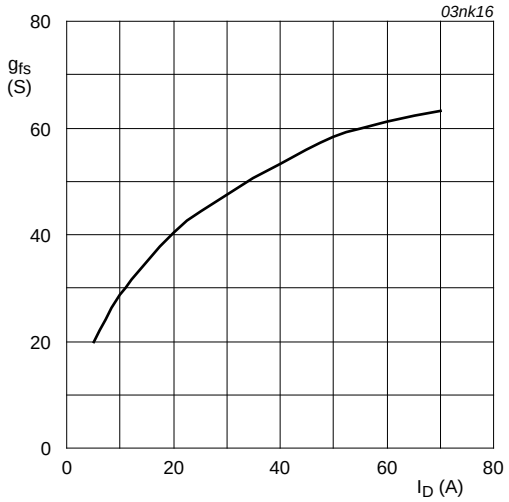

$T_j = 25°C; I_D = 25A$

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



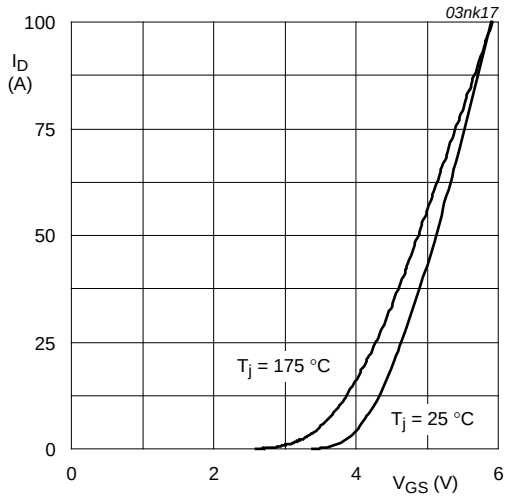

$T_j = 25°C; V_{DS} = 5V$

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



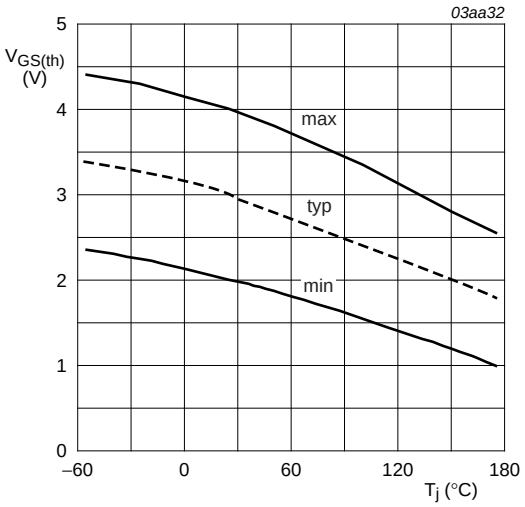

$T_j = 25°C; V_{DS} = 25V$

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



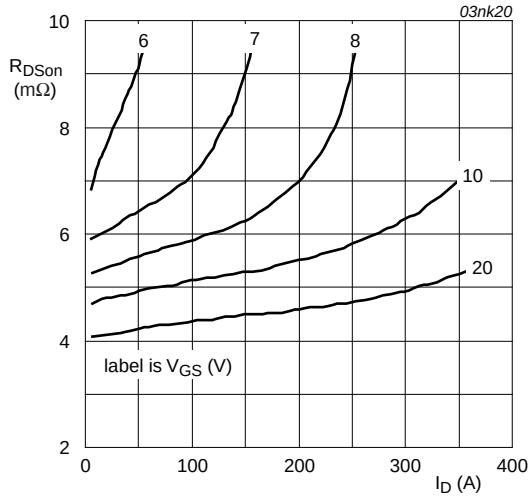

$V_{DS} = 25V$

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



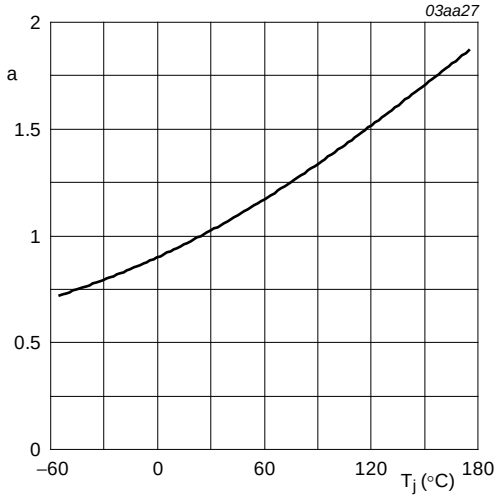

$I_D = 1mA; V_{DS} = V_{GS}$

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



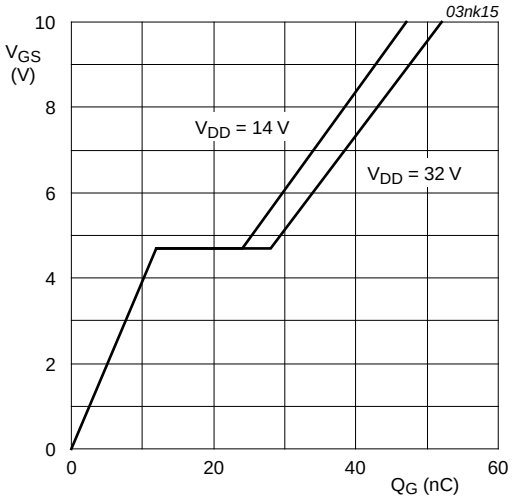

$T_j = 25°C$

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



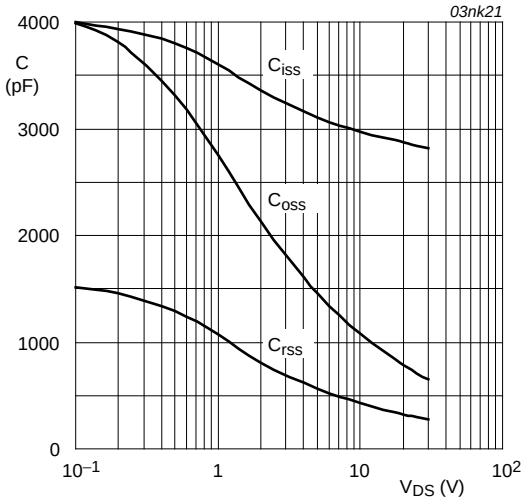

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



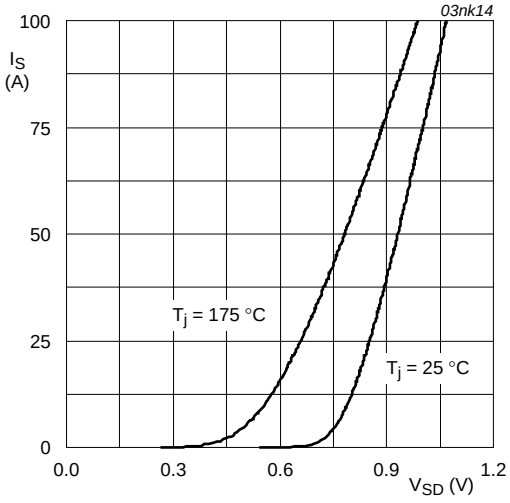

$T_j = 25°C; I_D = 25A$

**Fig 13. Gate-source voltage as a function of gate charge; typical values**




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

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

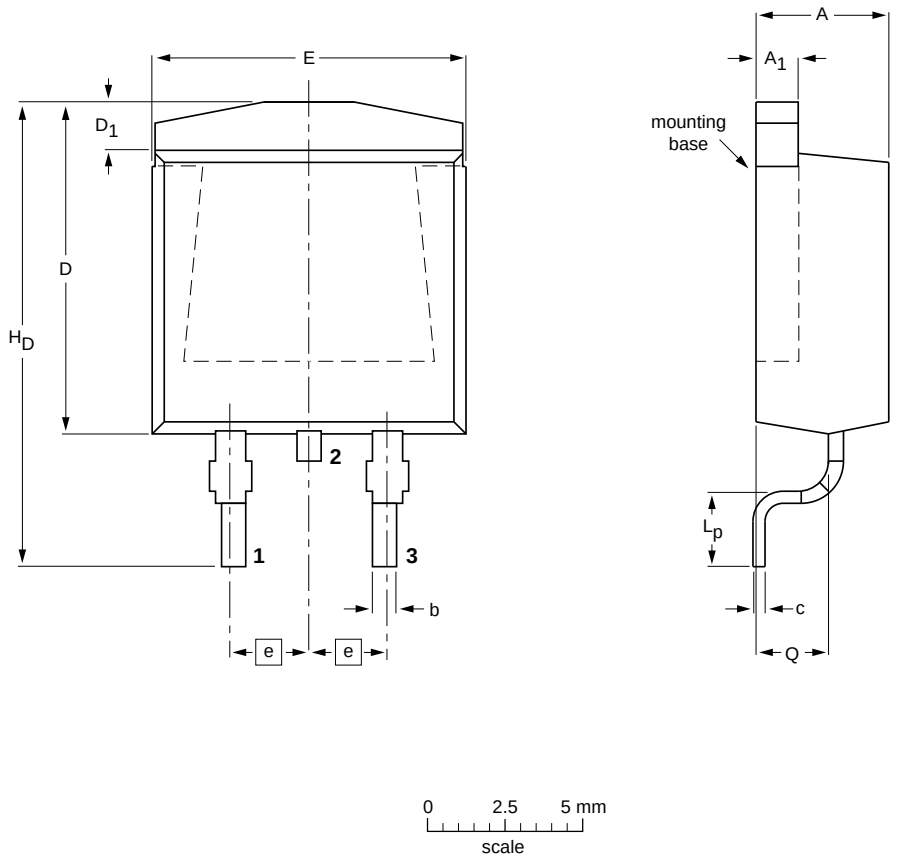



$V_{GS} = 0V$

**Fig 15. Source current as a function of source-drain voltage; typical values**

## 7. Package outline

**Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)** **SOT404**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | b | c | D max. | $D_1$ | E | e | $L_p$ | $H_D$ | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.50<br>4.10 | 1.40<br>1.27 | 0.85<br>0.60 | 0.64<br>0.46 | 11 | 1.60<br>1.20 | 10.30<br>9.70 | 2.54 | 2.90<br>2.10 | 15.80<br>14.80 | 2.60<br>2.20 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT404 | | | | | | ~~05-02-11~~<br>06-03-16 |

**Fig 16. Package outline SOT404 (D2PAK)**

## 8. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BUK765R2-40B v.3 | 20111122 | Product data sheet | - | BUK765R2-40B v.2 |
| Modifications: | • Various changes to content. | | | |
| BUK765R2-40B v.2 | 20090116 | Product data sheet | - | BUK75_765R2_40B v.1 |

# 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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## 11. Contents





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**Document identifier: BUK765R2-40B**