# BUK9Y19-55B

## N-channel TrenchMOS logic level FET

**Rev. 03 — 29 February 2008** **Product data sheet**

# 1. Product profile

## 1.1 General description

Logic level N-channel enhancement mode power Field-Effect Transistor (FET) in a plastic package using NXP High-Performance Automotive (HPA) TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

## 1.2 Features

- 175 °C rated
- Q101 compliant
- Logic level compatible
- Very low on-state resistance

## 1.3 Applications

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

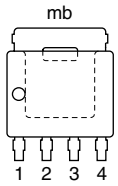
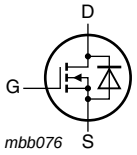
## 1.4 Quick reference data

**Table 1. Quick reference**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_D$ | drain current | $V_{GS}$ = 5 V; $T_{mb}$ = 25 °C; see Figure 1 and 4 | - | - | 46 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | - | - | 85 | W |
| **Static characteristics** | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 5 V; $I_D$ = 20 A; $T_j$ = 25 °C; see Figure 12 and 13 | - | 16.3 | 19 | mΩ |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D$ = 46 A; $V_{sup} \leq$ 55 V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 5 V; $T_{j(init)}$ = 25 °C; unclamped | - | - | 80 | mJ |

## 2. Pinning information

**Table 2. Pinning**

| 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 (LFPAK)

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BUK9Y19-55B | LFPAK | plastic single-ended surface-mounted package (LFPAK); 4 leads | SOT669 |

## 4. Limiting values

**Table 4. Limiting values**

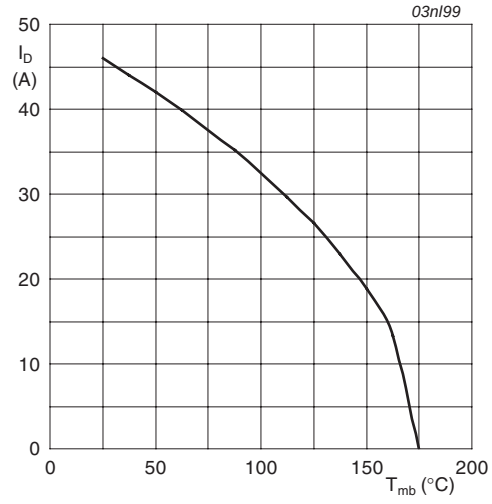
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | 55 | V |
| $V_{DGR}$ | drain-gate voltage | $R_{GS}$ = 20 kΩ | | - | 55 | V |
| $V_{GS}$ | gate-source voltage | | | -15 | 15 | V |
| $I_D$ | drain current | $T_{mb}$ = 25 °C; $V_{GS}$ = 5 V; see Figure 1 and 4 | | - | 46 | A |
| | | $T_{mb}$ = 100 °C; $V_{GS}$ = 5 V; see Figure 1 | | - | 32 | A |
| $I_{DM}$ | peak drain current | $T_{mb}$ = 25 °C; $t_p \leq 10$ μs; pulsed; see Figure 4 | | - | 184 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | | - | 85 | W |
| $T_{stg}$ | storage temperature | | | -55 | 175 | °C |
| $T_j$ | junction temperature | | | -55 | 175 | °C |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D$ = 46 A; $V_{sup} \leq 55$ V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 5 V; $T_{j(init)}$ = 25 °C; unclamped | | - | 80 | mJ |
| $E_{DS(AL)R}$ | repetitive drain-source avalanche energy | see Figure 3 | [1][2] [3] | - | - | J |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{mb}$ = 25 °C | | - | 46 | A |
| $I_{SM}$ | peak source current | $t_p \leq 10$ μs; pulsed; $T_{mb}$ = 25 °C | | - | 184 | A |

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

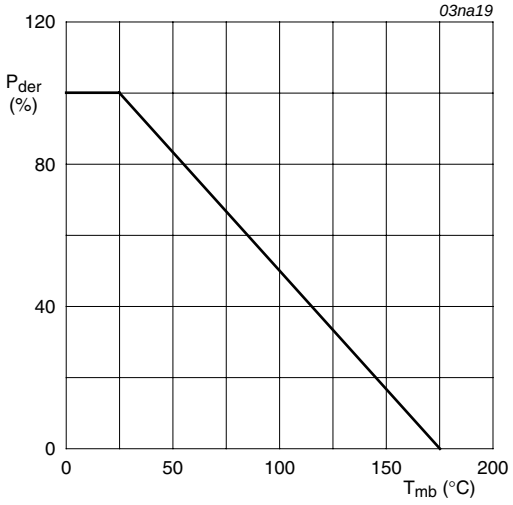
[2] Repetitive avalanche rating limited by average junction temperature of 170 °C.

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



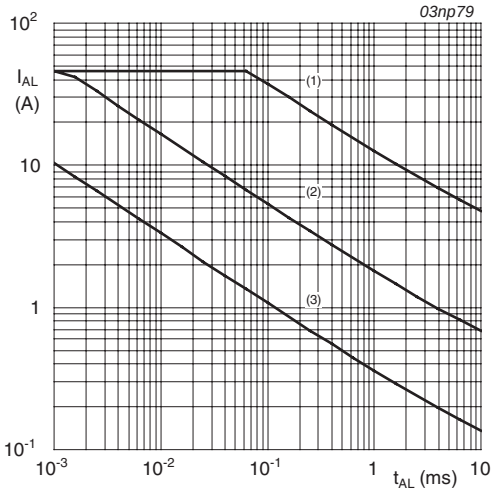

$V_{GS} \geq 5V$

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




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

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

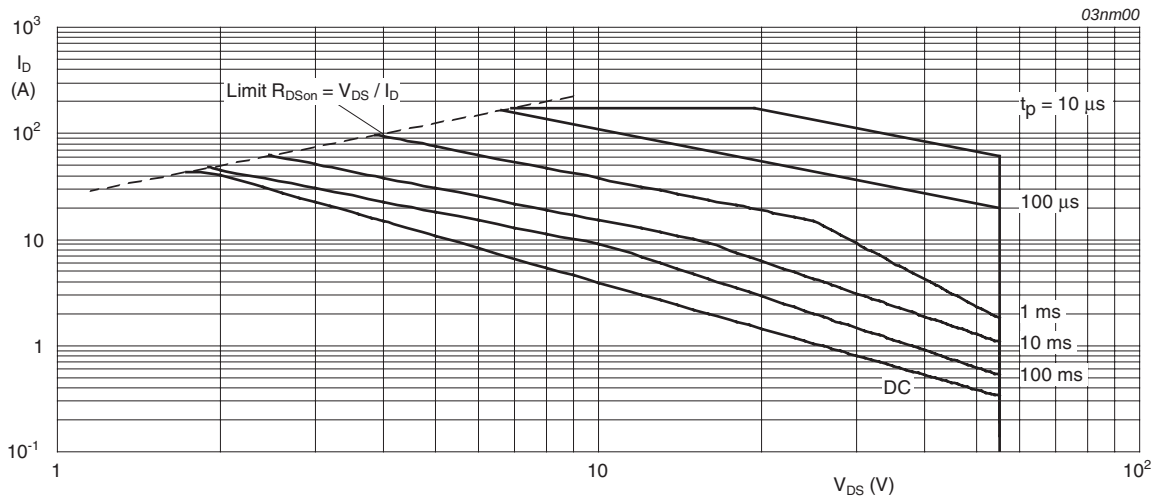



(1) Single−pulse; $T_j$ = 25 °C.

(2) Single−pulse; $T_j$ = 150 °C.

(3) Repetitive.

**Fig 3. Single-shot and repetitive avalanche rating; avalanche current as a function of avalanche period**




$T_{mb}$ = 25 °C; $I_{DM}$ is single pulse

**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 |
|---|---|---|---|---|---|---|
| $R_{th(j\text{-}mb)}$ | thermal resistance from junction to mounting base | see Figure 5 | - | - | 1.8 | K/W |

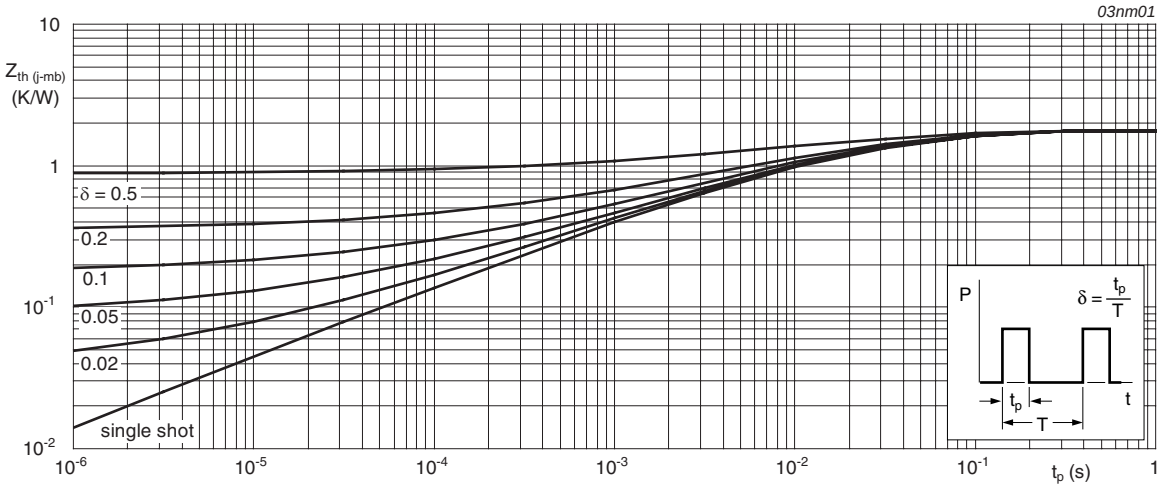
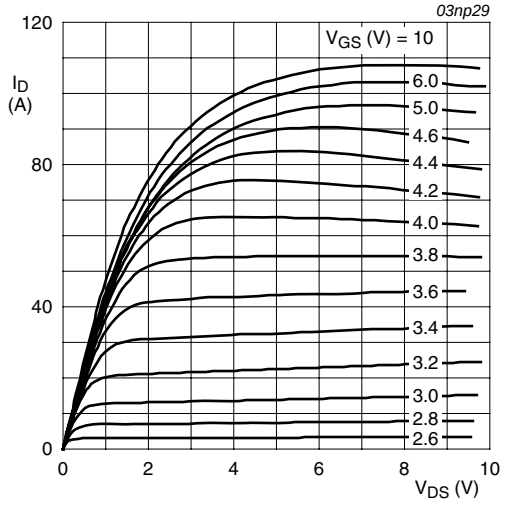



**Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

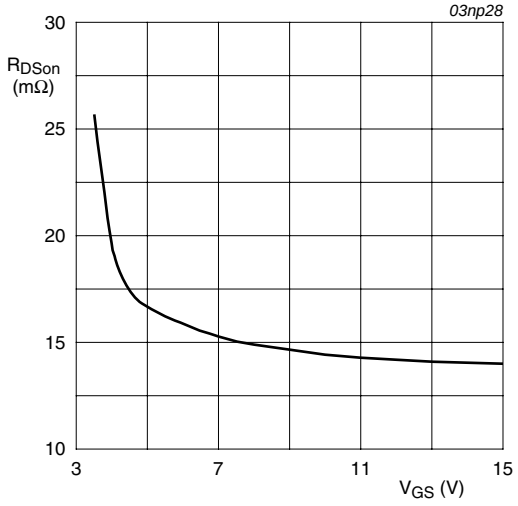
**Table 6. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 0.25 mA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | 55 | - | - | V |
| | | $I_D$ = 0.25 mA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | 50 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; see Figure 11 | - | - | 2.3 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; see Figure 11 | 1.1 | 1.5 | 2 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; see Figure 11 | 0.5 | - | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 55 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | - | - | 500 | µA |
| | | $V_{DS}$ = 55 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | 0.02 | 1 | µA |
| $I_{GSS}$ | gate leakage current | $V_{DS}$ = 0 V; $V_{GS}$ = 15 V; $T_j$ = 25 °C | - | 2 | 100 | nA |
| | | $V_{DS}$ = 0 V; $V_{GS}$ = -15 V; $T_j$ = 25 °C | - | 2 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 4.5 V; $I_D$ = 20 A; $T_j$ = 25 °C | - | - | 21 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 20 A; $T_j$ = 25 °C | - | 14.3 | 17.3 | mΩ |
| | | $V_{GS}$ = 5 V; $I_D$ = 20 A; $T_j$ = 25 °C; see Figure 12 and 13 | - | 16.3 | 19 | mΩ |
| | | $V_{GS}$ = 5 V; $I_D$ = 20 A; $T_j$ = 175 °C; see Figure 12 and 13 | - | - | 40 | mΩ |
| **Source-drain diode** | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 25 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; see Figure 16 | - | 0.85 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 20 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = -10 V; $V_{DS}$ = 30 V; $T_j$ = 25 °C | - | 52 | - | ns |
| $Q_r$ | recovered charge | | - | 38 | - | nC |
| **Dynamic characteristics** | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 25 A; $V_{DS}$ = 44 V; $V_{GS}$ = 5 V; $T_j$ = 25 °C; see Figure 14 | - | 18 | - | nC |
| $Q_{GS}$ | gate-source charge | | - | 5 | - | nC |
| $Q_{GD}$ | gate-drain charge | | - | 8 | - | nC |
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; f = 1 MHz; $T_j$ = 25 °C; see Figure 15 | - | 1494 | 1992 | pF |
| $C_{oss}$ | output capacitance | | - | 217 | 260 | pF |
| $C_{rss}$ | reverse transfer capacitance | | - | 86 | 118 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 30 V; $R_L$ = 1.2 Ω; $V_{GS}$ = 5 V; $R_{G(ext)}$ = 10 Ω; $T_j$ = 25 °C | - | 18 | - | ns |
| $t_r$ | rise time | | - | 180 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 44 | - | ns |
| $t_f$ | fall time | | - | 134 | - | ns |



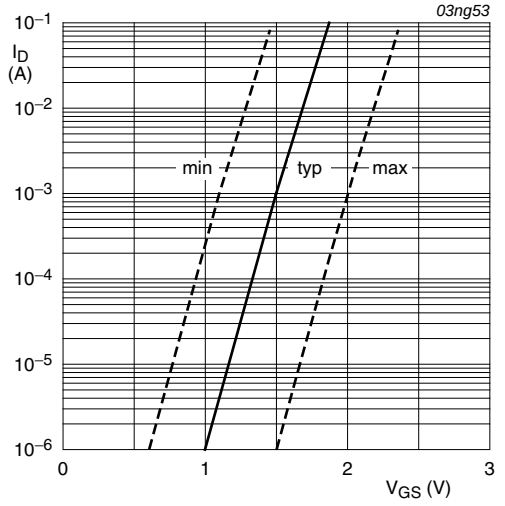

$T_j = 25\ °C; t_p = 300\ \mu s$

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



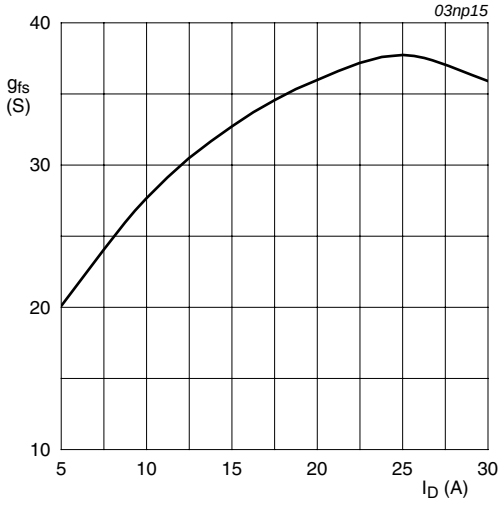

$T_j = 25\ °C; I_D = 20\ A$

**Fig 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**



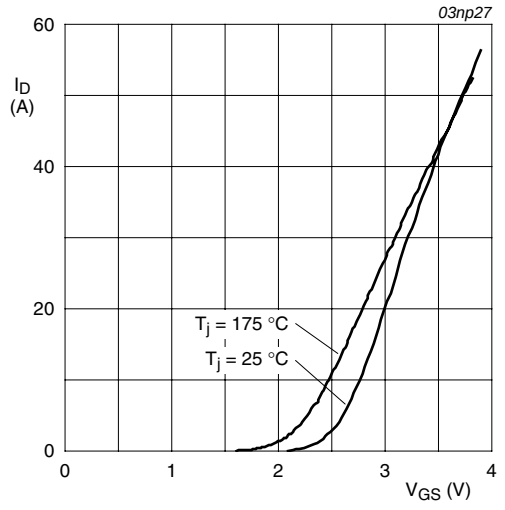

$T_j = 25\ °C; V_{DS} = V_{GS}$

**Fig 8. Sub-threshold drain current as a function of gate-source voltage**



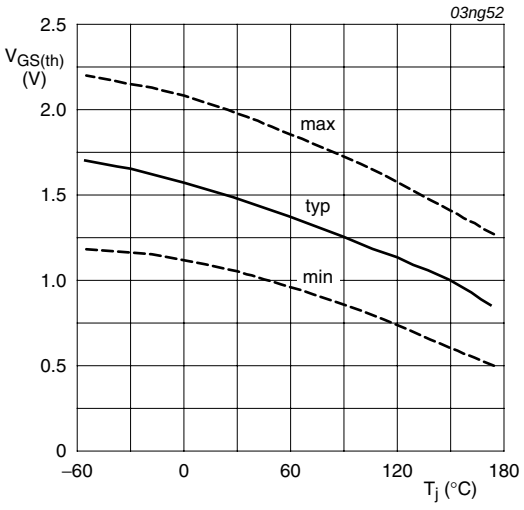

$T_j = 25\ °C; V_{DS} = 25\ V$

**Fig 9. Forward transconductance as a function of drain current; typical values**



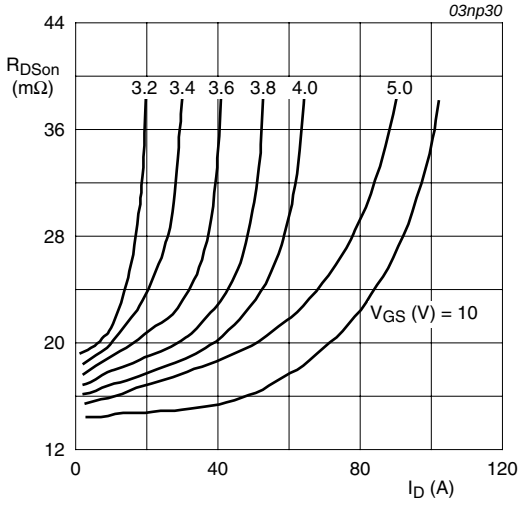

$V_{DS} = 25\,V$

**Fig 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



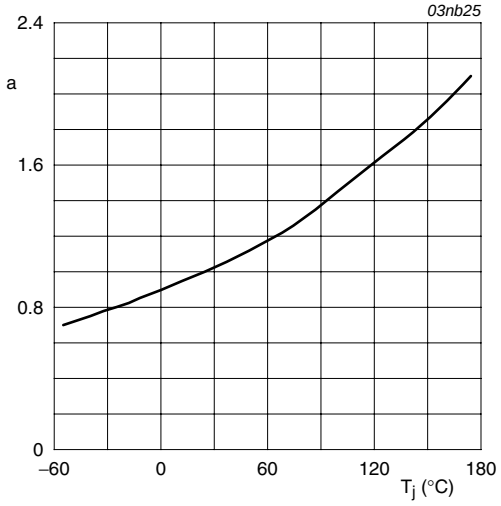

$I_D = 1\,mA; V_{DS} = V_{GS}$

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



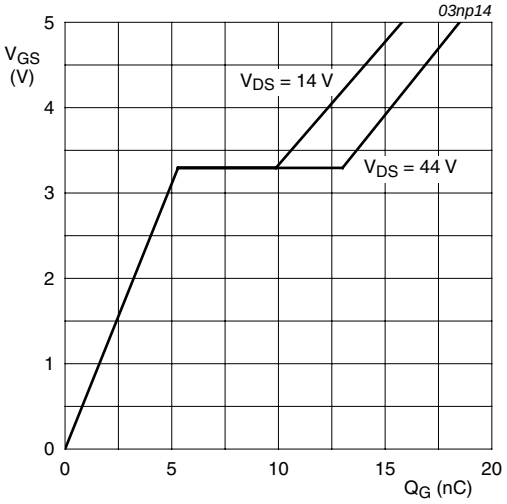

$T_j = 25\,°C$

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



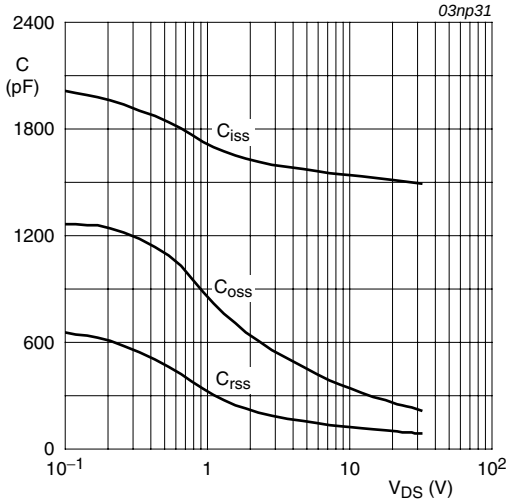

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



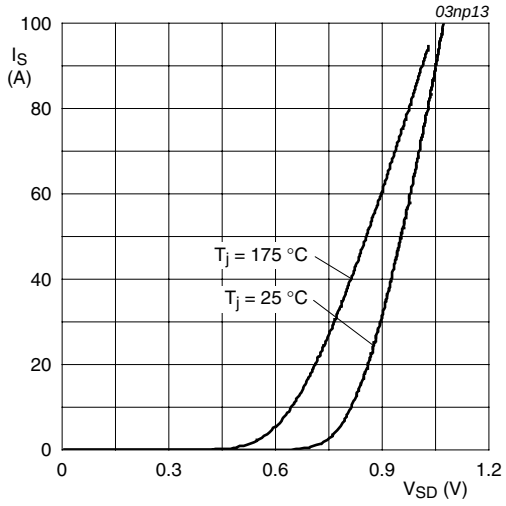

$T_j = 25\,°C; I_D = 25\,A$

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




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

**Fig 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

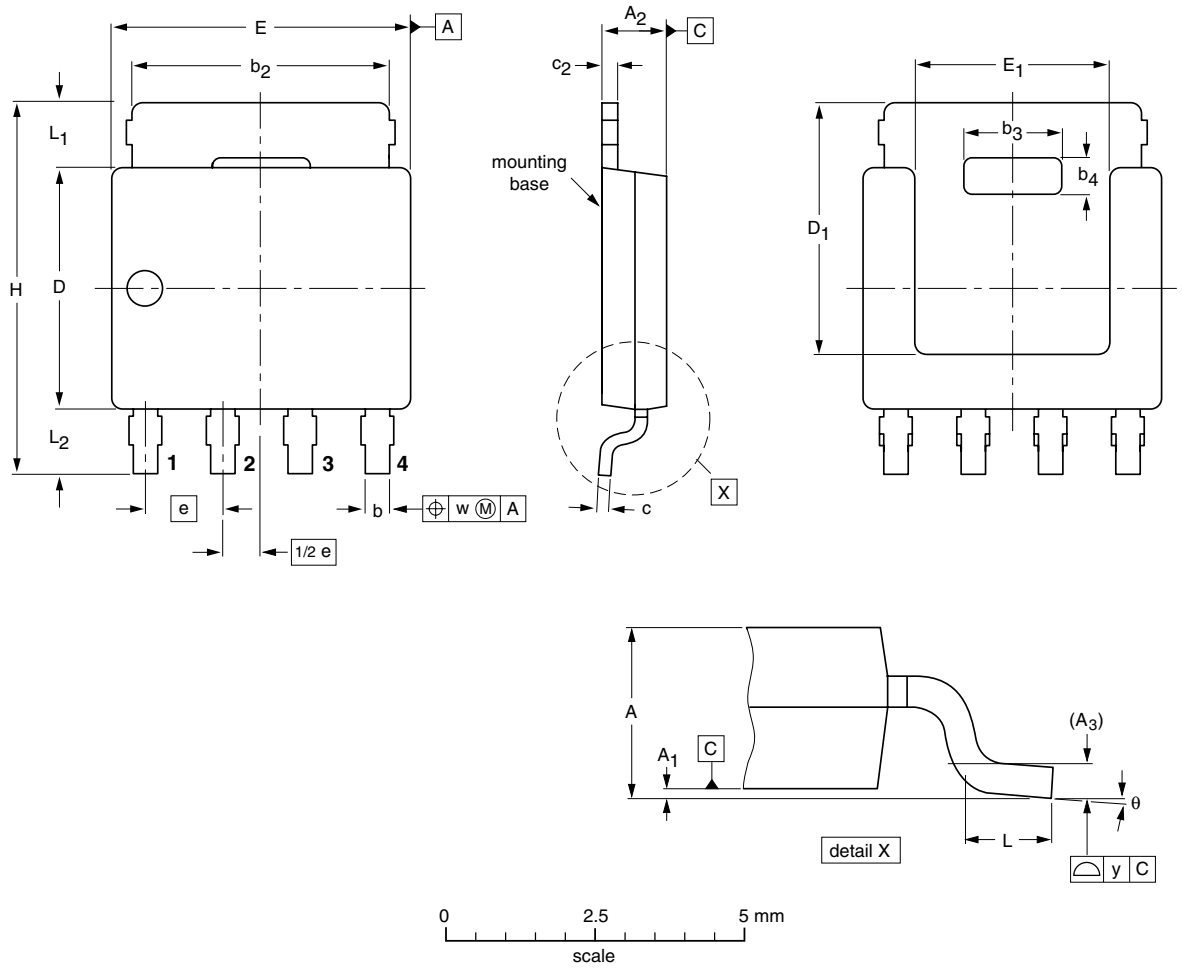



$V_{GS} = 0\,V$

**Fig 16. Source current as a function of source-drain voltage; typical values**

## 7. Package outline

**Plastic single-ended surface-mounted package (LFPAK); 4 leads** **SOT669**




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

| UNIT | A | $A_1$ | $A_2$ | $A_3$ | b | $b_2$ | $b_3$ | $b_4$ | c | $c_2$ | $D^{(1)}$ | $D_1^{(1)}$ max | $E^{(1)}$ | $E_1^{(1)}$ | e | H | L | $L_1$ | $L_2$ | w | y | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.20<br>1.01 | 0.15<br>0.00 | 1.10<br>0.95 | 0.25 | 0.50<br>0.35 | 4.41<br>3.62 | 2.2<br>2.0 | 0.9<br>0.7 | 0.25<br>0.19 | 0.30<br>0.24 | 4.10<br>3.80 | 4.20 | 5.0<br>4.8 | 3.3<br>3.1 | 1.27 | 6.2<br>5.8 | 0.85<br>0.40 | 1.3<br>0.8 | 1.3<br>0.8 | 0.25 | 0.1 | 8°<br>0° |

**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT669 | | MO-235 | | | | ~~04-10-13~~<br>06-03-16 |

**Fig 17. Package outline SOT669 (LFPAK)**

## 8. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BUK9Y19-55B_3 | 20080229 | Product data sheet | - | BUK9Y19-55B_2 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.<br>• Legal texts have been adapted to the new company name where appropriate. | | | |
| BUK9Y19-55B_2 | 20060411 | Product data sheet | - | BUK9Y19-55B-01 |
| BUK9Y19-55B-01 (9397 750 13188) | 20040528 | 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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For sales office addresses, send an email to: **salesaddresses@nxp.com**

## 11. Contents





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**Document identifier: BUK9Y19-55B_3**