

# BUK9219-55A

TrenchMOS™ logic level FET

Rev. 01 — 24 October 2000

Product specification

## 1. Description

N-channel enhancement mode field-effect power transistor in a plastic package using TrenchMOS™<sup>1</sup> technology, featuring very low on-state resistance.

Product availability:

BUK9219-55A in SOT428 (D-PAK).

## 2. Features

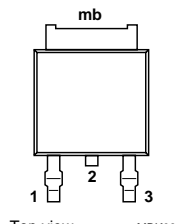
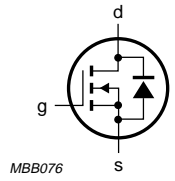
- TrenchMOS™ technology
- Q101 compliant
- 175 °C rated
- Logic level compatible.

## 3. Applications

- Automotive and general purpose power switching:
  - ◆ 12 V and 24 V loads.
  - ◆ Motors, lamps and solenoids.

## 4. Pinning information

Table 1: Pinning - SOT428 (D-PAK), simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d)		
3	source (s)		
mb	drain (d)		

**SOT428 (D-PAK)**

1. TrenchMOS is a trademark of Royal Philips Electronics.



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## 5. Quick reference data

**Table 2: Quick reference data**

Symbol	Parameter	Conditions	Typ	Max	Unit
$V_{DS}$	drain-source voltage (DC)		–	55	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V}$	–	55	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$	–	114	W
$T_j$	junction temperature		–	175	°C
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5\text{ V}; I_D = 25\text{ A}$	15	19	mΩ
		$V_{GS} = 4.5\text{ V}; I_D = 25\text{ A}$	–	20	mΩ

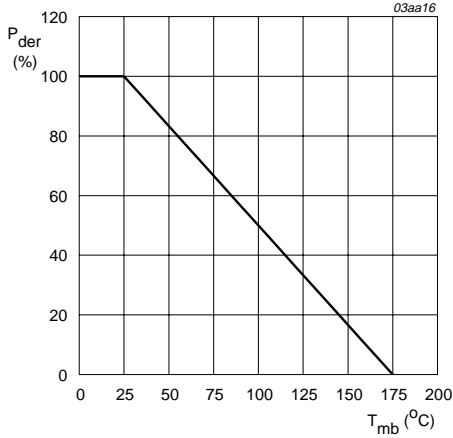
## 6. Limiting values

**Table 3: Limiting values**

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

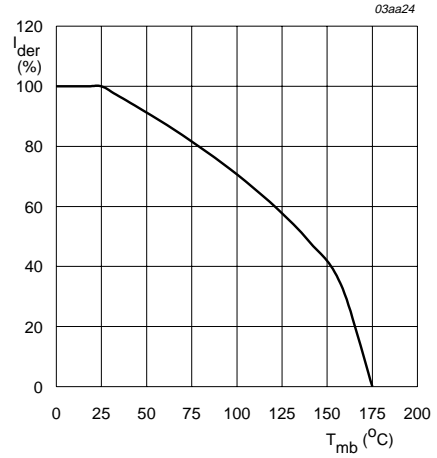
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage (DC)		–	55	V
$V_{DGR}$	drain-gate voltage (DC)	$R_{GS} = 20\text{ k}\Omega$	–	55	V
$V_{GS}$	gate-source voltage (DC)		–	±10	V
$V_{GSM}$	non-repetitive gate-source voltage	$t_p \leq 50\text{ }\mu\text{s}$	–	±15	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V};$ <b>Figure 2 and 3</b>	–	55	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 5\text{ V};$ <b>Figure 2</b>	–	38	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s};$ <b>Figure 3</b>	[1]	219	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C};$ <b>Figure 1</b>	–	114	W
$T_{stg}$	storage temperature		–55	+175	°C
$T_j$	operating junction temperature		–55	+175	°C
<b>Source-drain diode</b>					
$I_{DR}$	reverse drain current (DC)	$T_{mb} = 25\text{ °C}$	–	55	A
$I_{DRM}$	pulsed reverse drain current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s}$	–	219	A
<b>Avalanche ruggedness</b>					
$W_{DSS}$	non-repetitive avalanche energy	unclamped inductive load; $I_D = 49\text{ A};$ $V_{DS} \leq 55\text{ V}; V_{GS} = 5\text{ V}; R_{GS} = 50\text{ }\Omega;$ starting $T_j = 25\text{ °C}$	–	120	mJ

[1]  $I_{DM}$  is limited by chip, not package.



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

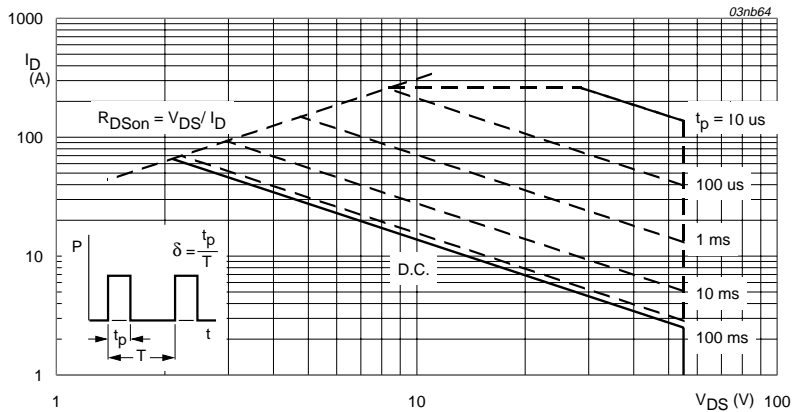
**Fig 1. Normalized total power dissipation as a function of mounting base temperature.**



$$V_{GS} \geq 4.5 \text{ V}$$

$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\%$$

**Fig 2. Normalized continuous drain current as a function of mounting base temperature.**



T<sub>mb</sub> = 25 °C; I<sub>DM</sub> is single pulse.

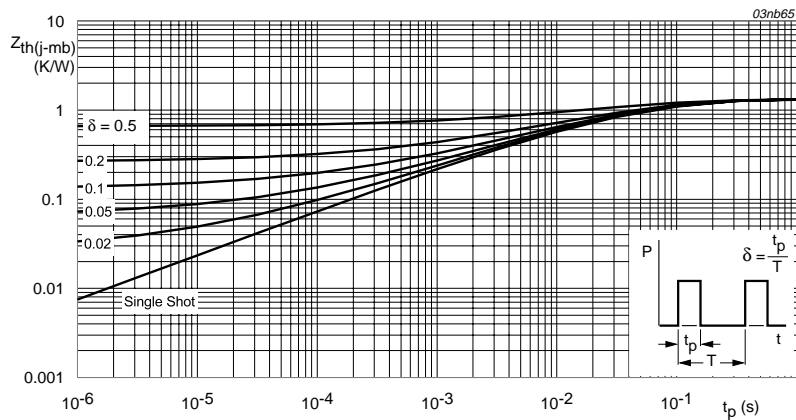
**Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.**

## 7. Thermal characteristics

**Table 4: Thermal characteristics**

Symbol	Parameter	Conditions	Value	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint, FR4 board	71.4	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	1.3	K/W

### 7.1 Transient thermal impedance



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

## 8. Characteristics

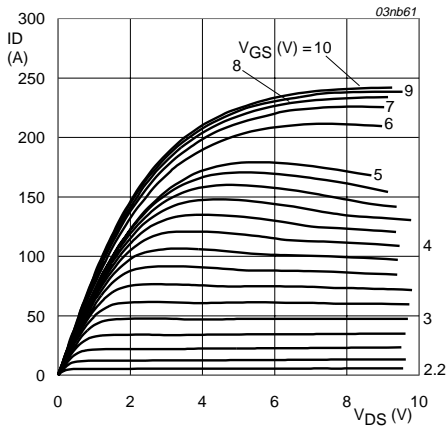
**Table 5: Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V T <sub>j</sub> = 25 °C	55	–	–	V
		T <sub>j</sub> = –55 °C	50	–	–	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; <b>Figure 9</b> T <sub>j</sub> = 25 °C	1	1.5	2	V
		T <sub>j</sub> = 175 °C	0.5	–	–	V
		T <sub>j</sub> = –55 °C	–	–	2.3	V
I <sub>DSS</sub>	drain-source leakage current	V <sub>DS</sub> = 55 V; V <sub>GS</sub> = 0 V T <sub>j</sub> = 25 °C	–	0.05	10	μA
		T <sub>j</sub> = 175 °C	–	–	500	μA
I <sub>GSS</sub>	gate-source leakage current	V <sub>GS</sub> = ±10 V; V <sub>DS</sub> = 0 V	–	2	100	nA
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 5 V; I <sub>D</sub> = 25 A; <b>Figure 7 and 8</b> T <sub>j</sub> = 25 °C	–	15	19	mΩ
		T <sub>j</sub> = 175 °C	–	–	38	mΩ
		V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 25 A	–	–	20	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A	–	14	17.6	mΩ
<b>Dynamic characteristics</b>						
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz; <b>Figure 12</b>	–	2190	2920	pF
C <sub>oss</sub>	output capacitance		–	380	450	pF
C <sub>rss</sub>	reverse transfer capacitance		–	250	345	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DD</sub> = 30 V; R <sub>L</sub> = 1.2 Ω; V <sub>GS</sub> = 5 V; R <sub>G</sub> = 10 Ω	–	45	–	ns
t <sub>r</sub>	rise time		–	130	–	ns
t <sub>d(off)</sub>	turn-off delay time		–	400	–	ns
t <sub>f</sub>	fall time		–	130	–	ns
L <sub>d</sub>	internal drain inductance	measured from drain lead from package to centre of die	–	2.5	–	nH
L <sub>s</sub>	internal source inductance	measured from source lead from package to source bond pad	–	7.5	–	nH

**Table 5: Characteristics...continued**

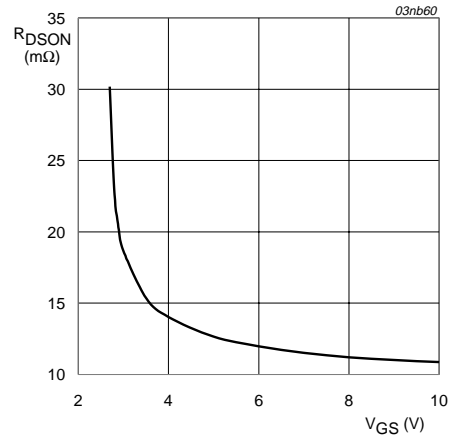
$T_j = 25\text{ }^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Source-drain diode</b>						
$V_{SD}$	source-drain (diode forward) voltage	$I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; <b>Figure 15</b>	–	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$	–	51	–	ns
$Q_r$	recovered charge	$V_{GS} = -10\text{ V}$ ; $V_{DS} = 30\text{ V}$	–	102	–	nC



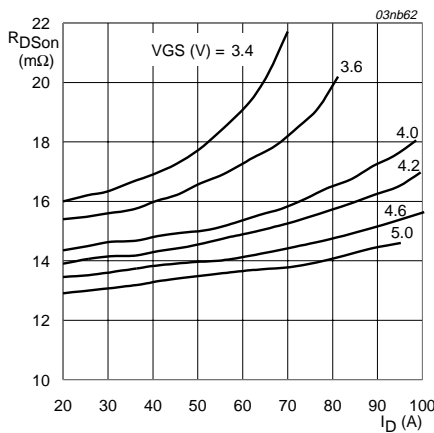
$T_j = 25\text{ }^\circ\text{C}$

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



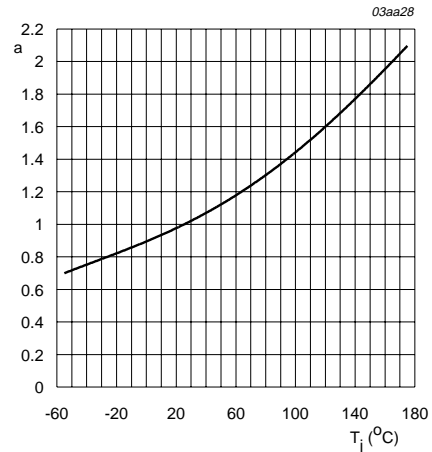
$T_j = 25\text{ }^\circ\text{C}$ ;  $I_D = 25\text{ A}$

**Fig 6. On-state resistance: typical values.**



$T_j = 25\text{ }^\circ\text{C}$

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



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

**Fig 8. Normalized drain source on-state resistance factor as a function of junction temperature.**



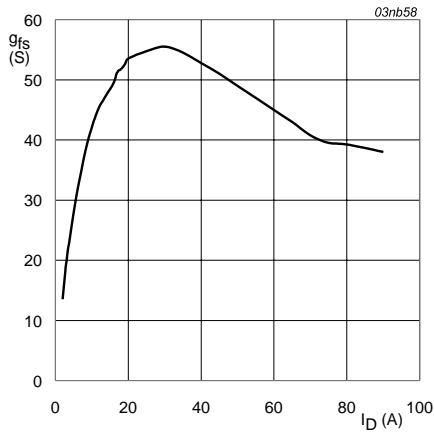
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

**Fig 9. Gate-source threshold voltage as a function of junction temperature.**



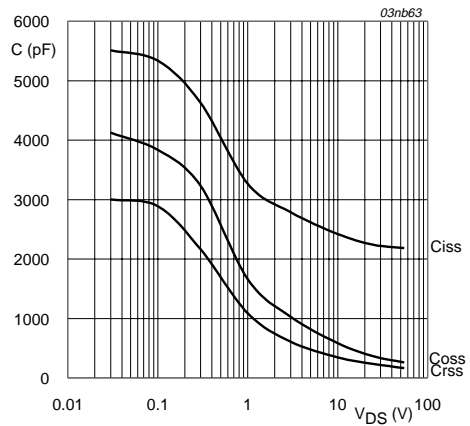
$T_j = 25 \text{ }^{\circ}C; V_{DS} = V_{GS}$

**Fig 10. Sub-threshold drain current as a function of gate-source voltage.**



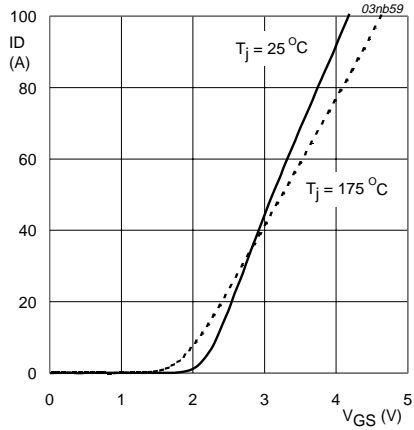
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 25 \text{ V}$

**Fig 11. Forward transconductance as a function of drain current; typical values.**



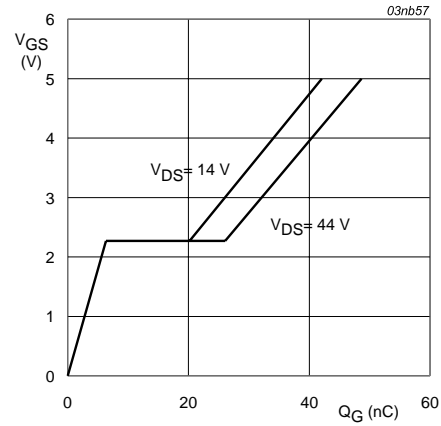
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

**Fig 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.**



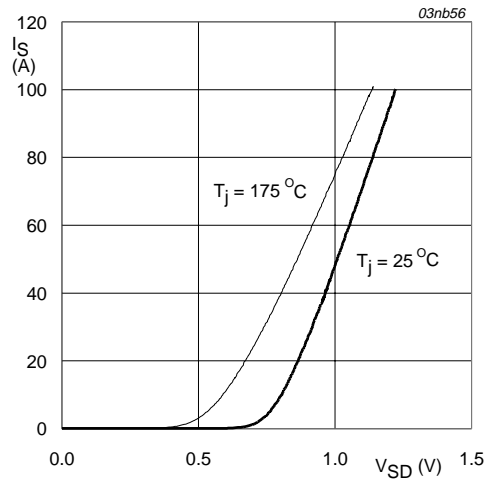
$V_{DS} = 25\text{ V}$

**Fig 13. Transfer characteristics; typical values.**



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

**Fig 14. Turn-on gate charge characteristics; typical values.**



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

**Fig 15. Reverse diode current; typical values.**



**9. Package outline**

Plastic single-ended surface mounted package (Philips version of D-PAK); 3 leads  
(one lead cropped)

SOT428



Fig 16. SOT428 (D-PAK).

## 10. Revision history

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Table 6: Revision history

Rev	Date	CPCN	Description
01	20001024	-	Product specification; initial version.

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## 11. Data sheet status

Datasheet status	Product status	Definition <sup>[1]</sup>
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

[1] Please consult the most recently issued data sheet before initiating or completing a design.

## 12. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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