

# BUK9728-55A

N-channel TrenchMOS™ logic level FET

Rev. 02 — 10 June 2004

Product data

## 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:

BUK9728-55A in SOT186A (TO-220F).

## 2. Features

- TrenchMOS™ technology
- Q101 compliant
- 150 °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 - SOT186A, simplified outline and symbol

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

**SOT186A (TO-220F)**

1. TrenchMOS is a trademark of Koninklijke Philips Electronics N.V.



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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)	$T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V}$	-	22	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$	-	26	W
$T_j$	junction temperature		-	150	°C
$R_{DS(on)}$	drain-source on-state resistance	$T_j = 25\text{ °C}; V_{GS} = 5\text{ V}; I_D = 15\text{ A}$	23	28	mΩ
		$T_j = 25\text{ °C}; V_{GS} = 4.5\text{ V}; I_D = 15\text{ A}$	-	30	mΩ

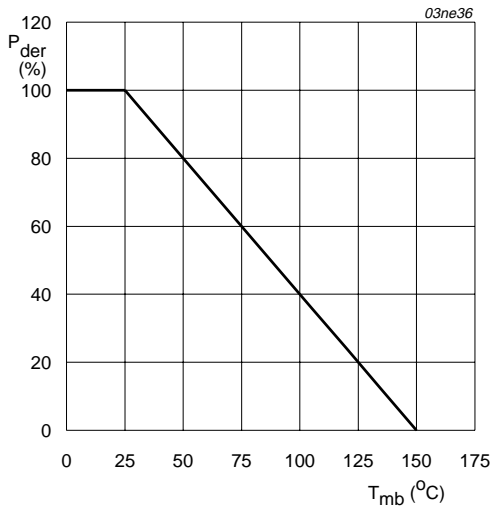
## 6. Limiting values

**Table 3: Limiting values**

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

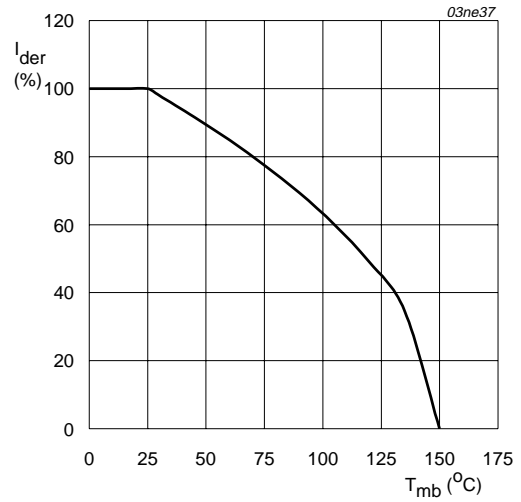
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage (DC)		-	55	V
$V_{DGR}$	drain-gate voltage (DC)	$R_{GS} = 20\text{ k}\Omega$	-	55	V
$V_{GS}$	gate-source voltage (DC)		-	±10	V
$V_{GSM}$	non-repetitive gate-source voltage	$t_p \leq 50\text{ }\mu\text{s}$	-	±15	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V};$ Figure 2 and 3	-	22	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 5\text{ V};$ Figure 2	-	16	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s};$ Figure 3	[1] -	90	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C};$ Figure 1	-	26	W
$T_{stg}$	storage temperature		-55	+150	°C
$T_j$	operating junction temperature		-55	+150	°C
<b>Source-drain diode</b>					
$I_{DR}$	reverse drain current (DC)	$T_{mb} = 25\text{ °C}$	-	22	A
$I_{DRM}$	peak reverse drain current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	90	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 22\text{ A};$ $V_{DS} \leq 55\text{ V}; V_{GS} = 5\text{ V}; R_{GS} = 50\text{ }\Omega;$ starting $T_j = 25\text{ °C}$	-	180	mJ

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



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

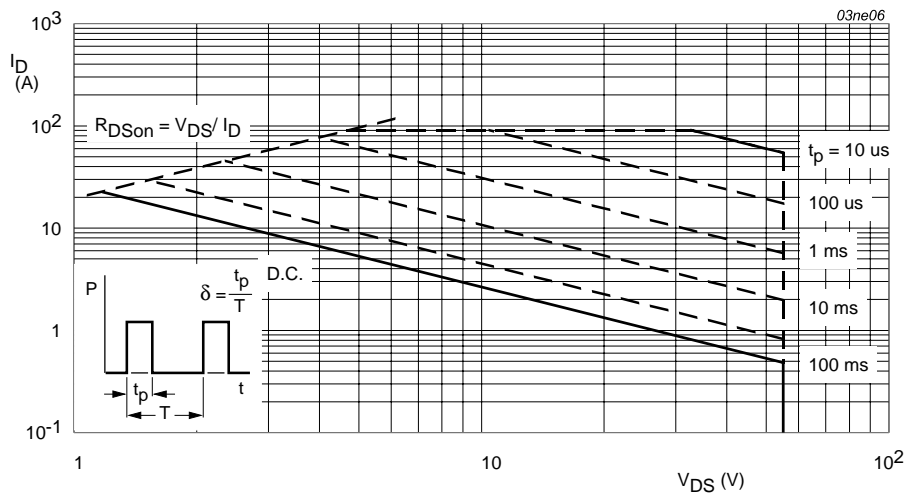
**Fig 1. Normalized total power dissipation as a function of mounting base temperature.**



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

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

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



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

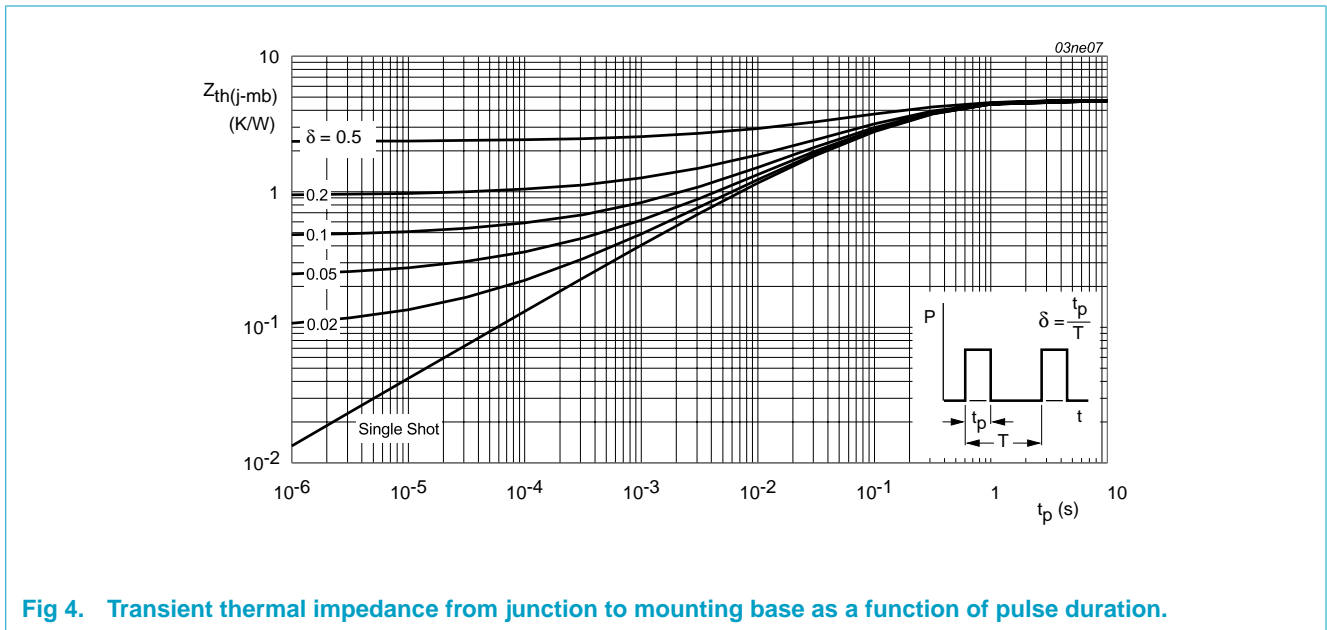
**Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.**

**7. Thermal characteristics**

**Table 4: Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	4.7	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	55	-	K/W

**7.1 Transient thermal impedance**

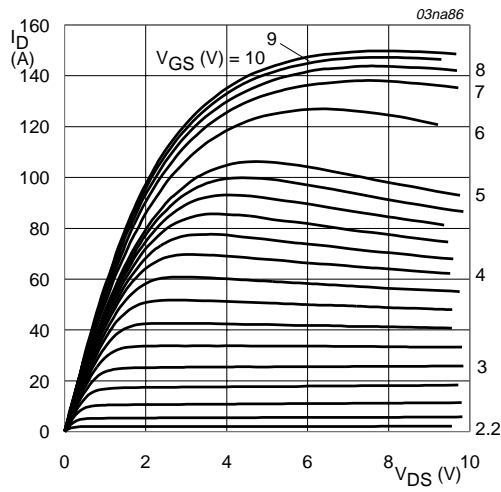


**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.**

## 8. Characteristics

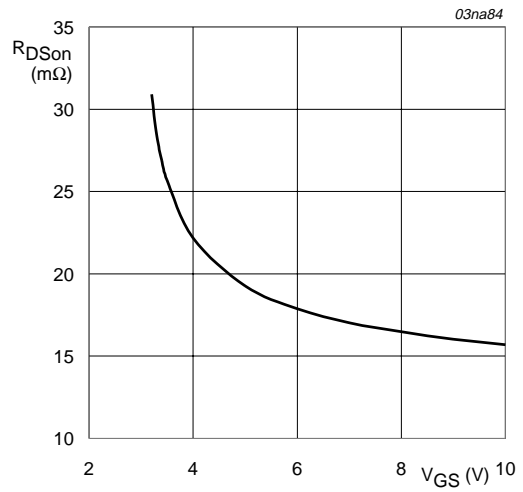
**Table 5: Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified*

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> ; Figure 9				
		T <sub>j</sub> = 25 °C	1	1.5	2	V
		T <sub>j</sub> = 150 °C	0.6	-	-	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> = 150 °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> = 15 A; Figure 7 and 8				
		T <sub>j</sub> = 25 °C	-	23	28	mΩ
		T <sub>j</sub> = 150 °C	-	-	51	mΩ
		V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 15 A	-	-	30	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 15 A	-	21	25	mΩ
<b>Dynamic characteristics</b>						
Q <sub>g(tot)</sub>	total gate charge	V <sub>GS</sub> = 5 V; V <sub>DD</sub> = 44 V;	-	27	-	nC
Q <sub>gs</sub>	gate-to-source charge	I <sub>D</sub> = 15 A; Figure 14	-	4.2	-	nC
Q <sub>gd</sub>	gate-to-drain (Miller) charge		-	11.7	-	nC
C <sub>iSS</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V;	-	1200	1725	pF
C <sub>oss</sub>	output capacitance	f = 1 MHz; Figure 12	-	210	250	pF
C <sub>rSS</sub>	reverse transfer capacitance		-	140	195	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DD</sub> = 30 V; R <sub>L</sub> = 1.2 Ω;	-	14	-	ns
t <sub>r</sub>	rise time	V <sub>GS</sub> = 5 V; R <sub>G</sub> = 10 Ω	-	125	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	64	-	ns
t <sub>f</sub>	fall time		-	68	-	ns
L <sub>d</sub>	internal drain inductance	from drain lead 6 mm from package to centre of die	-	4.5	-	nH
L <sub>s</sub>	internal source inductance	from source lead 6 mm from package to source bond pad	-	7.5	-	nH
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain (diode forward) voltage	I <sub>S</sub> = 15 A; V <sub>GS</sub> = 0 V; Figure 15	-	0.85	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs	-	35	-	ns
Q <sub>r</sub>	recovered charge	V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 30 V	-	70	-	nC



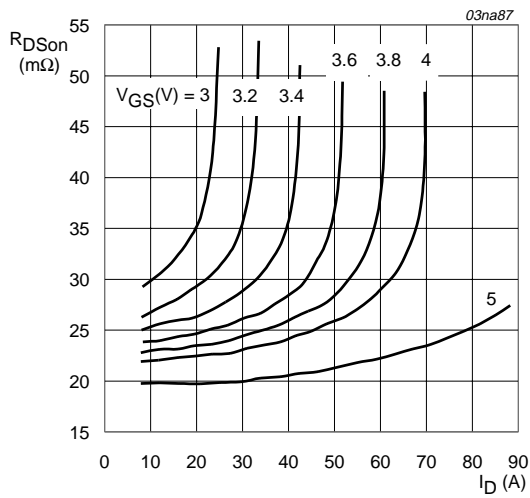
$T_j = 25\text{ }^\circ\text{C}$

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



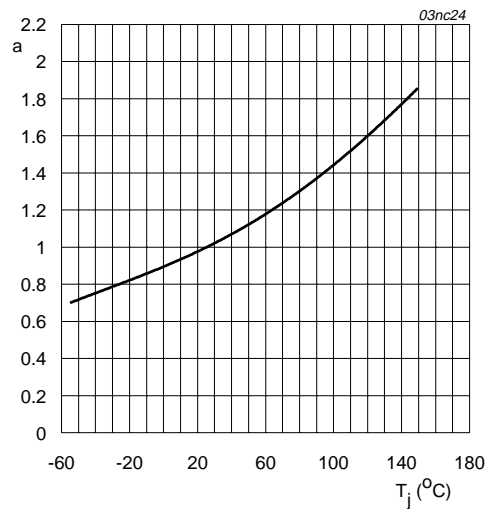
$T_j = 25\text{ }^\circ\text{C}; I_D = 15\text{ A}$

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



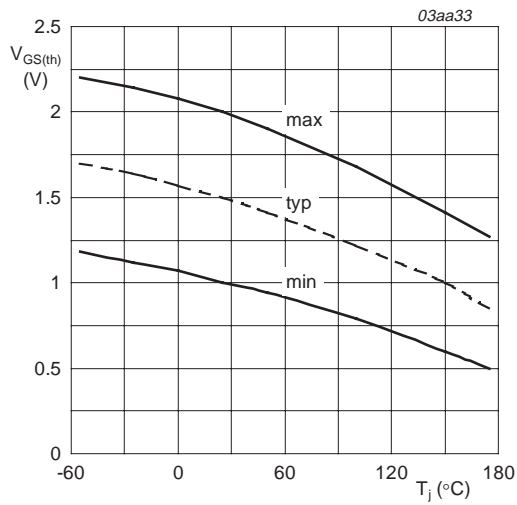
$T_j = 25\text{ }^\circ\text{C}$

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



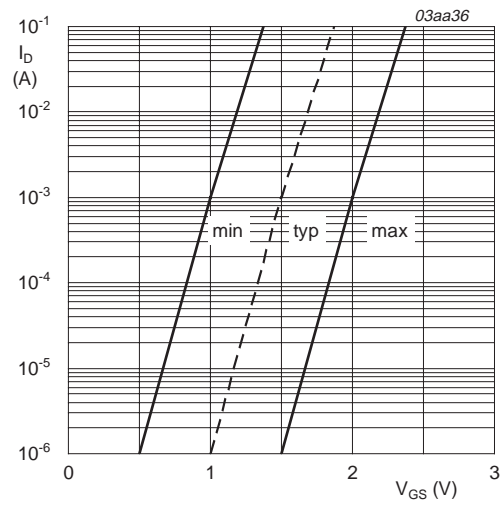
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



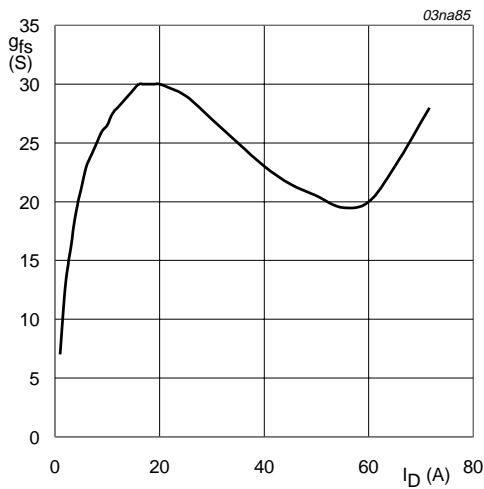
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



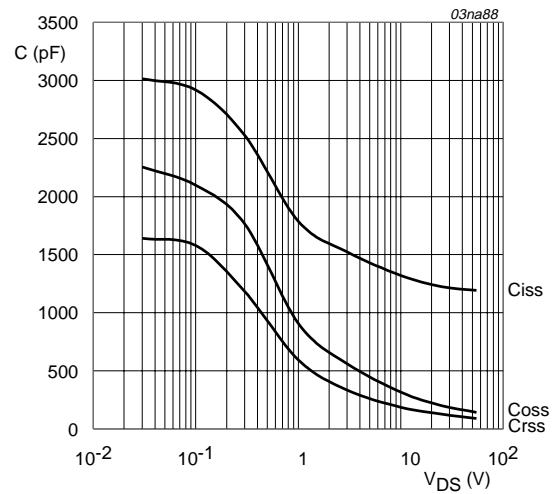
$T_j = 25 \text{ °C}; V_{DS} = V_{GS}$

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



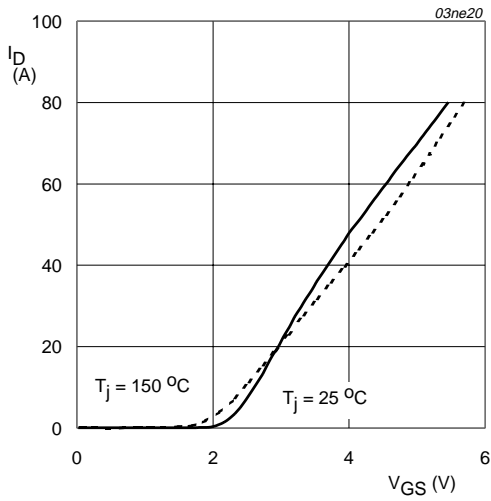
$T_j = 25 \text{ °C}; V_{DS} = 25 \text{ V}$

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



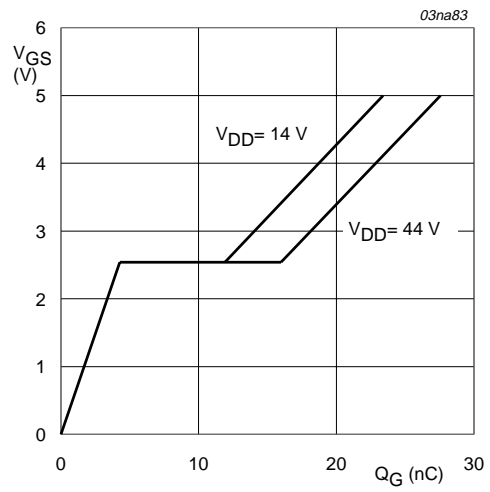
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



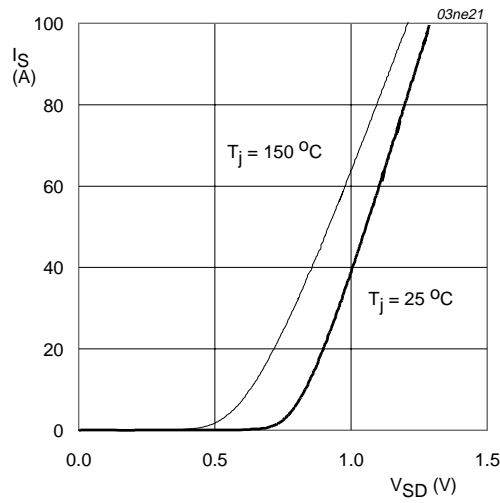
$V_{DS} = 25\text{ V}$

**Fig 13. Transfer characteristics: drain current as a function of gate-source voltage; typical values.**



$T_j = 25\text{ }^\circ\text{C}; I_D = 15\text{ A}$

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



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

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



**9. Package outline**

Plastic single-ended package; isolated heatsink mounted;  
1 mounting hole; 3 lead TO-220 'full pack'

SOT186A

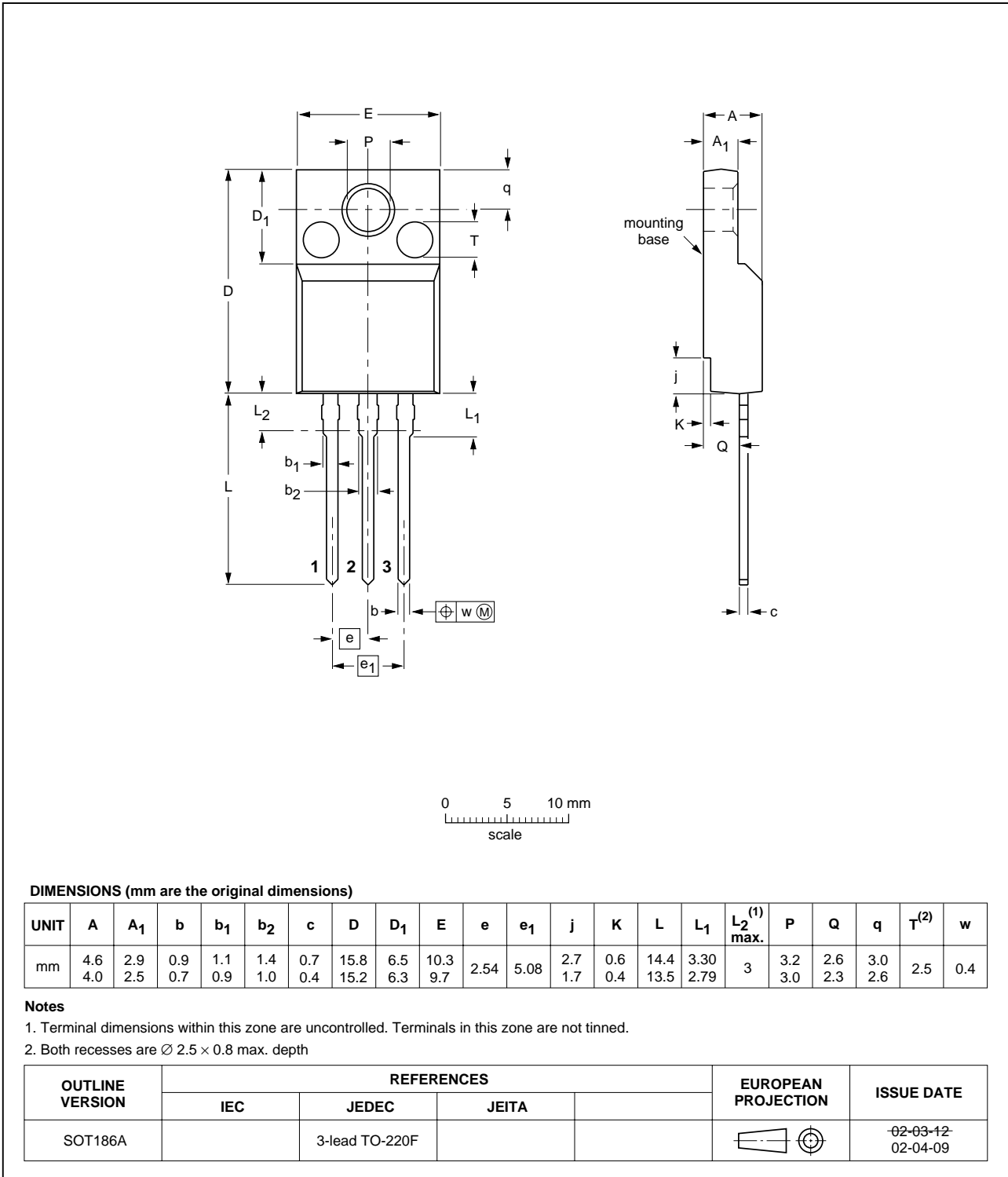


Fig 16. SOT186A.

## 10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
02	20040610	-	<b>Product data (9397 750 13326)</b> <b>Modifications:</b> <ul style="list-style-type: none"><li>• Latest version of package outline imported into data sheet.</li></ul>
01	20010213	-	<b>Product specification (9397 750 08002)</b>

## 11. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2][3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**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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For sales office addresses, send e-mail to: [sales.addresses@www.semiconductors.philips.com](mailto:sales.addresses@www.semiconductors.philips.com).

Fax: +31 40 27 24825

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