

# PSMN009-100P/100B

N-channel enhancement mode field-effect transistor

Rev. 01 — 29 April 2002

Product data

## 1. Description

N-channel logic level field-effect power transistor in a plastic package using TrenchMOS™ technology.

Product availability:

PSMN009-100P in SOT78 (TO-220AB)

PSMN009-100B in SOT404 (D<sup>2</sup>-PAK).

## 2. Features

- Low on-state resistance
- Fast switching.

## 3. Applications

- High frequency computer motherboard DC to DC converters
- OR-ing applications.

## 4. Pinning information

Table 1: Pinning - SOT78 and SOT404, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d) <span style="color: red;">[1]</span>		
3	source (s)		
mb	drain (d)		
		 SOT78 (TO-220AB)	 SOT404 (D <sup>2</sup> -PAK)

[1] It is not possible to make connection to pin 2 of the SOT404 package.

## 5. Quick reference data

**Table 2: Quick reference data**

Symbol	Parameter	Conditions	Typ	Max	Unit
$V_{DS}$	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	100	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V}$	-	75	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$	-	230	W
$T_j$	junction temperature		-	175	°C
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C}$	7.5	8.8	mΩ

## 6. Limiting values

**Table 3: Limiting values**

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

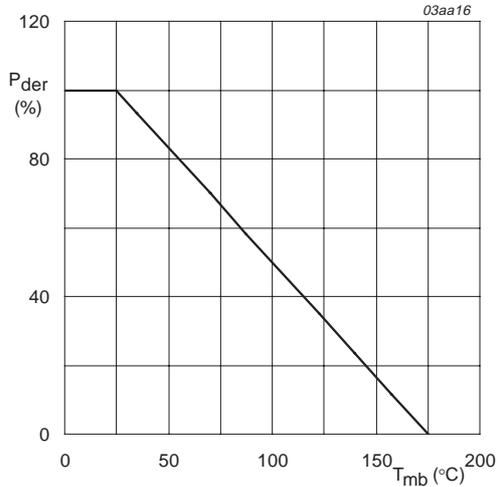
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	100	V
$V_{DGR}$	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}; R_{GS} = 20\text{ k}\Omega$	-	100	V
$V_{GS}$	gate-source voltage (DC)		-	±20	V
$V_{GSM}$	gate-source voltage	$t_p \leq 50\text{ }\mu\text{s}$ ; pulsed; duty cycle 25%; $T_j \leq 150\text{ °C}$	-	±30	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V}$ ; <b>Figure 2 and 3</b>	-	75	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 10\text{ V}$ ; <b>Figure 2</b>	-	65	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <b>Figure 3</b>	-	400	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <b>Figure 1</b>	-	230	W
$T_{stg}$	storage temperature		-55	+175	°C
$T_j$	junction temperature		-55	+175	°C

### Source-drain diode

$I_S$	source (diode forward) current (DC)	$T_{mb} = 25\text{ °C}$	-	75	A
$I_{SM}$	peak source (diode forward) current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	400	A

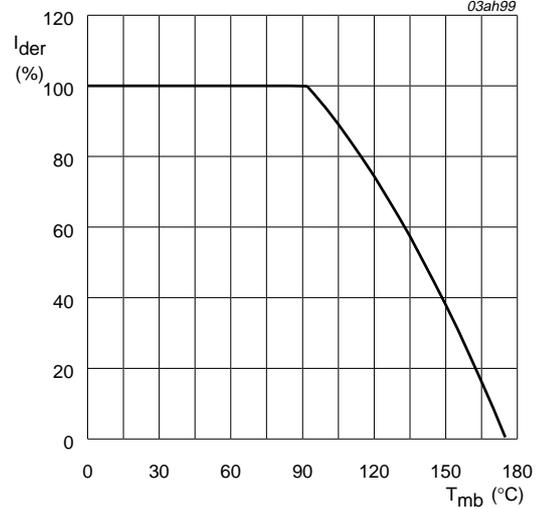
### Avalanche ruggedness

$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 35\text{ A}; t_p = 0.1\text{ ms}; V_{DD} = 15\text{ V};$ $R_{GS} = 50\text{ }\Omega; V_{GS} = 10\text{ V}$ ; starting $T_j = 25\text{ °C}$	-	120	mJ
$I_{DS(AL)S}$	non-repetitive avalanche current	unclamped inductive load; $V_{DD} = 15\text{ V}; R_{GS} = 50\text{ }\Omega; V_{GS} = 10\text{ V};$ starting $T_j = 25\text{ °C}$	-	75	A



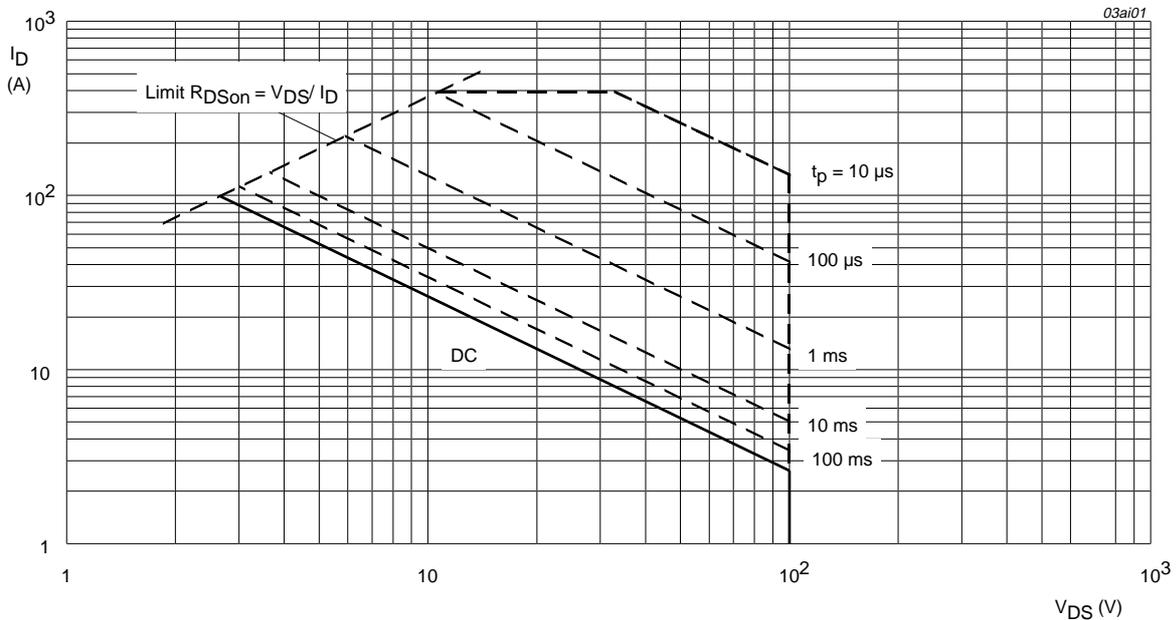
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



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

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.

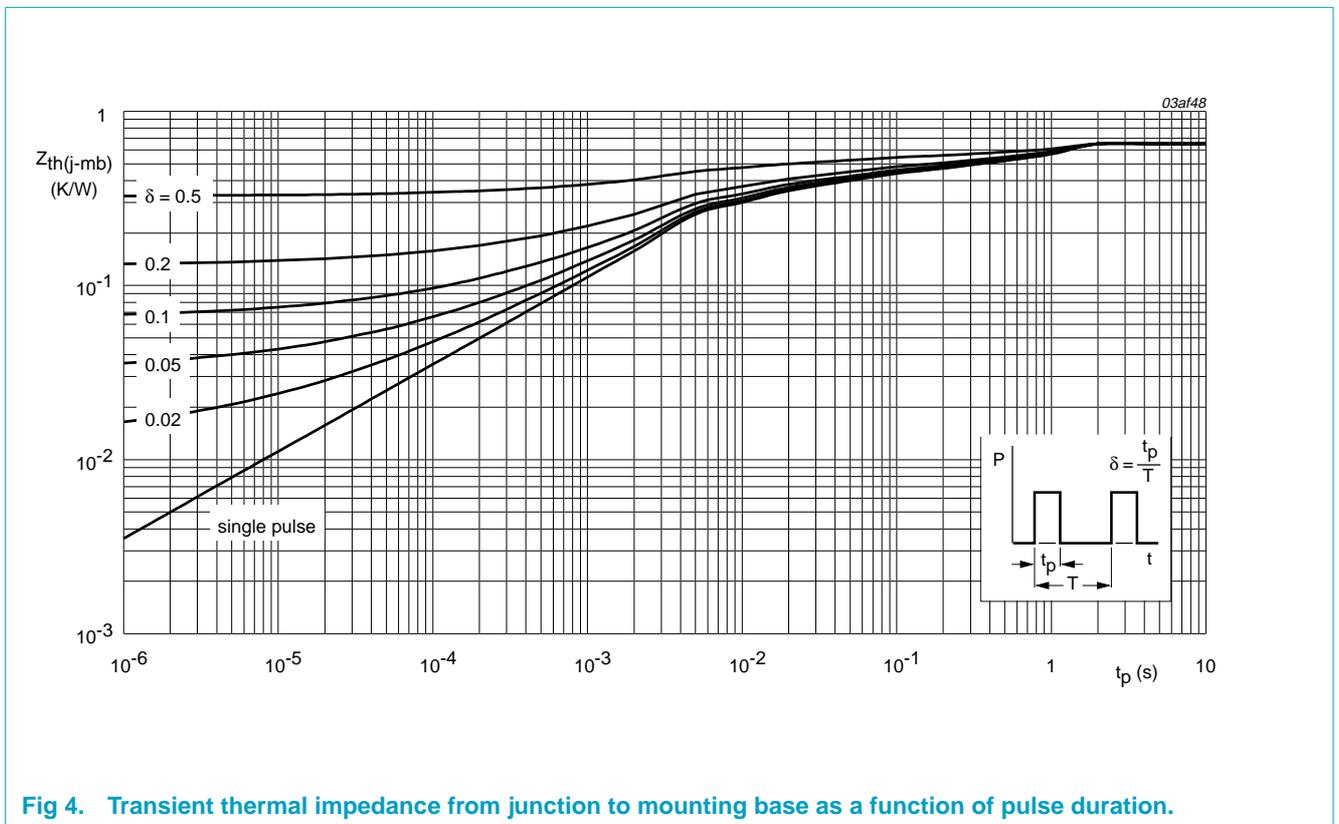
Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

## 7. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	0.65	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient					
	SOT78	vertical in free air	-	60	-	K/W
	SOT404	minimum footprint; mounted on a PCB	-	50	-	K/W

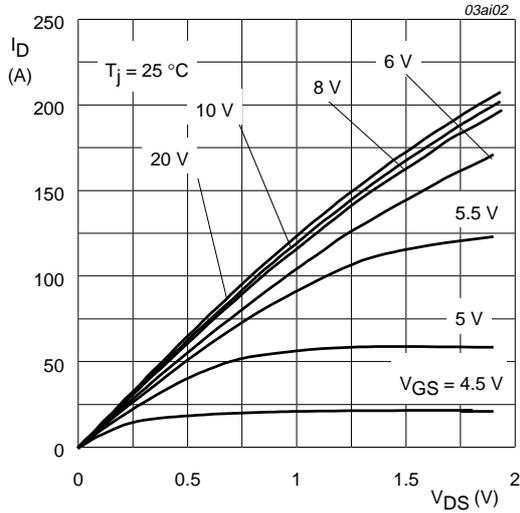
### 7.1 Transient thermal impedance



## 8. Characteristics

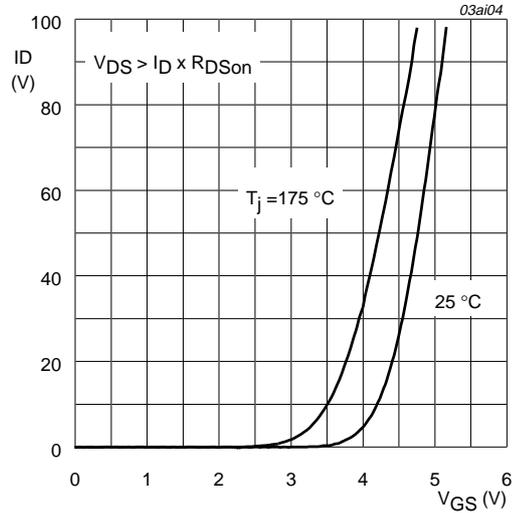
**Table 5: Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified*

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	100	-	-	V
		T <sub>j</sub> = -55 °C	90	-	-	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	2	3	4	V
		T <sub>j</sub> = 175 °C	1	-	-	V
		T <sub>j</sub> = -55 °C	-	-	4.4	V
I <sub>DSS</sub>	drain-source leakage current	V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 0 V				
		T <sub>j</sub> = 25 °C	-	0.02	1	μA
		T <sub>j</sub> = 175 °C	-	-	500	μA
I <sub>GSS</sub>	gate-source leakage current	V <sub>GS</sub> = ±20 V; V <sub>DS</sub> = 0 V	-	10	100	nA
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10V; I <sub>D</sub> = 25 A; <b>Figure 7 and 8</b>				
		T <sub>j</sub> = 25 °C	-	7.5	8.8	mΩ
		T <sub>j</sub> = 175 °C	-	20.25	23.8	mΩ
<b>Dynamic characteristics</b>						
Q <sub>g(tot)</sub>	total gate charge	I <sub>D</sub> = 75 A; V <sub>DD</sub> = 80 V; V <sub>GS</sub> = 10 V;	-	156	-	nC
Q <sub>gs</sub>	gate-source charge	<b>Figure 13</b>	-	31	-	nC
Q <sub>gd</sub>	gate-drain (Miller) charge		-	44	-	nC
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz;	-	8250	-	pF
C <sub>oss</sub>	output capacitance	<b>Figure 11</b>	-	620	-	pF
C <sub>rss</sub>	reverse transfer capacitance		-	300	-	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DD</sub> = 15 V; I <sub>D</sub> = 12 A; V <sub>GS</sub> = 10 V;	-	38	-	ns
t <sub>r</sub>	rise time	R <sub>G</sub> = 6 Ω; resistive load	-	59	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	120	-	ns
t <sub>f</sub>	fall time		-	43	-	ns
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain (diode forward) voltage	I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; <b>Figure 12</b>	-	0.8	1.2	V



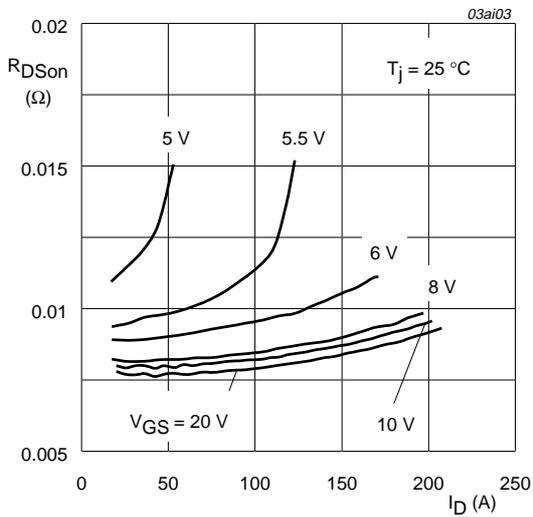
$T_j = 25\text{ }^\circ\text{C}$

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



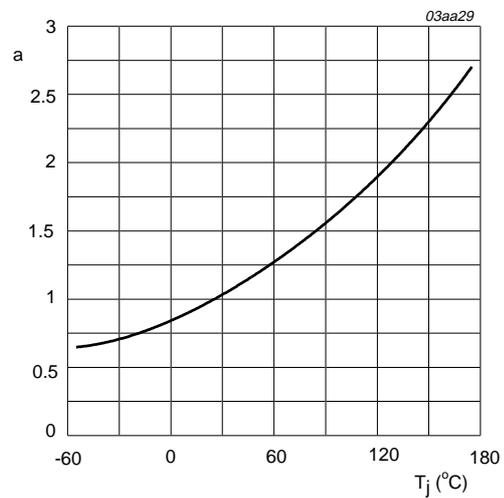
$T_j = 25\text{ }^\circ\text{C}$  and  $175\text{ }^\circ\text{C}$ ;  $V_{DS} > I_D \times R_{DSon}$

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



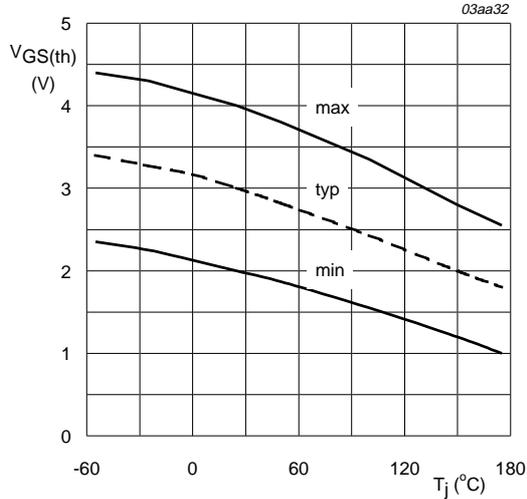
$T_j = 25\text{ }^\circ\text{C}$

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



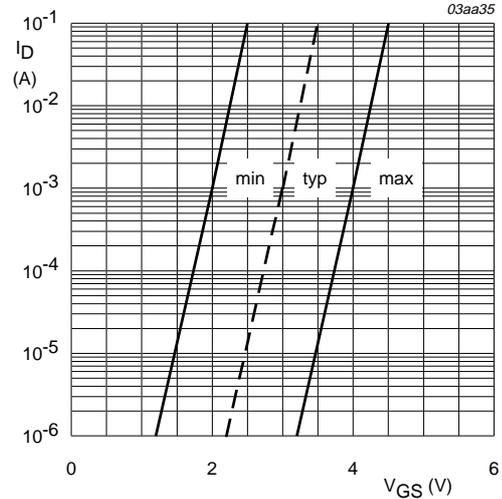
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



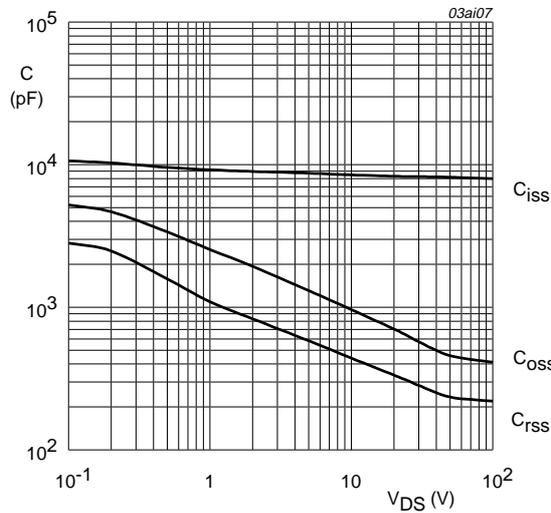
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



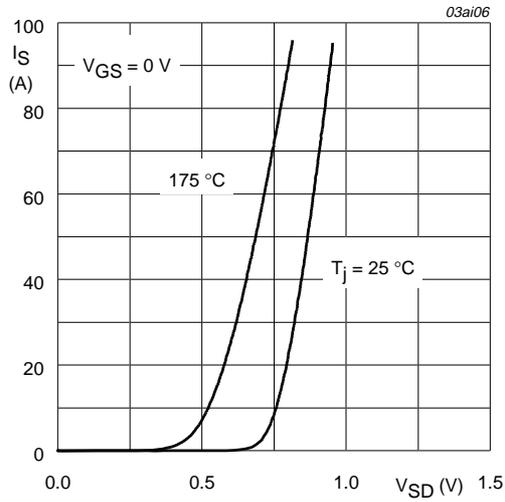
$T_j = 25 \text{ }^\circ\text{C}; V_{DS} = 5 \text{ V}$

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



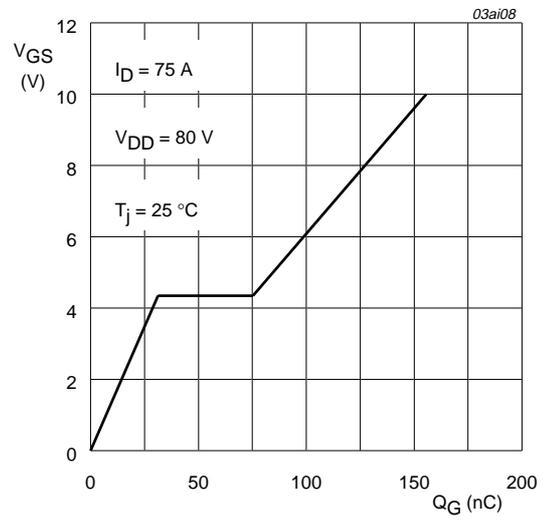
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

Fig 11. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.



$T_j = 25\text{ °C}$  and  $175\text{ °C}$ ;  $V_{GS} = 0\text{ V}$

**Fig 12. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values.**



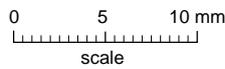
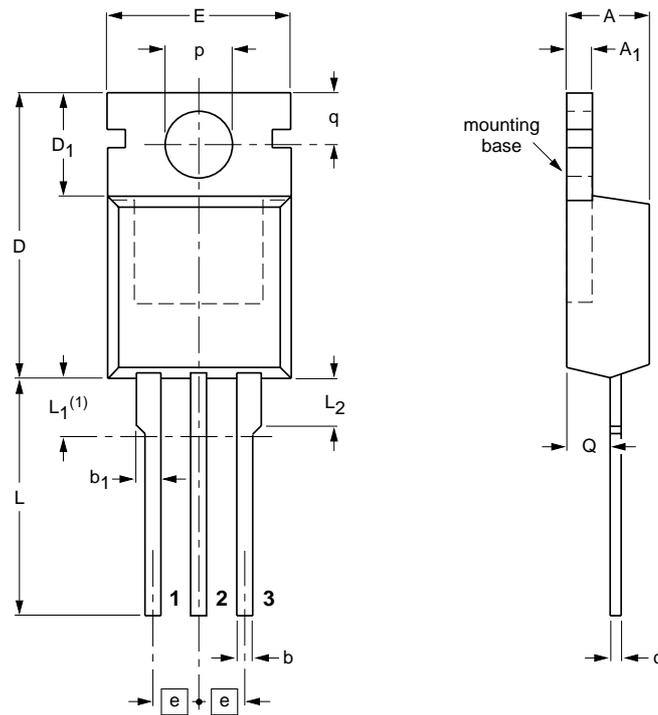
$I_D = 75\text{ A}$ ;  $V_{DD} = 80\text{ V}$

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

9. Package outline

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

SOT78



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub> (1)	L <sub>2</sub> max.	p	q	Q
mm	4.5 4.1	1.39 1.27	0.9 0.7	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

Note

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT78		3-lead TO-220AB	SC-46			00-09-07 01-02-16

Fig 14. SOT78 (TO-220AB).

Plastic single-ended surface mounted package (Philips version of D<sup>2</sup>-PAK); 3 leads  
(one lead cropped)

SOT404

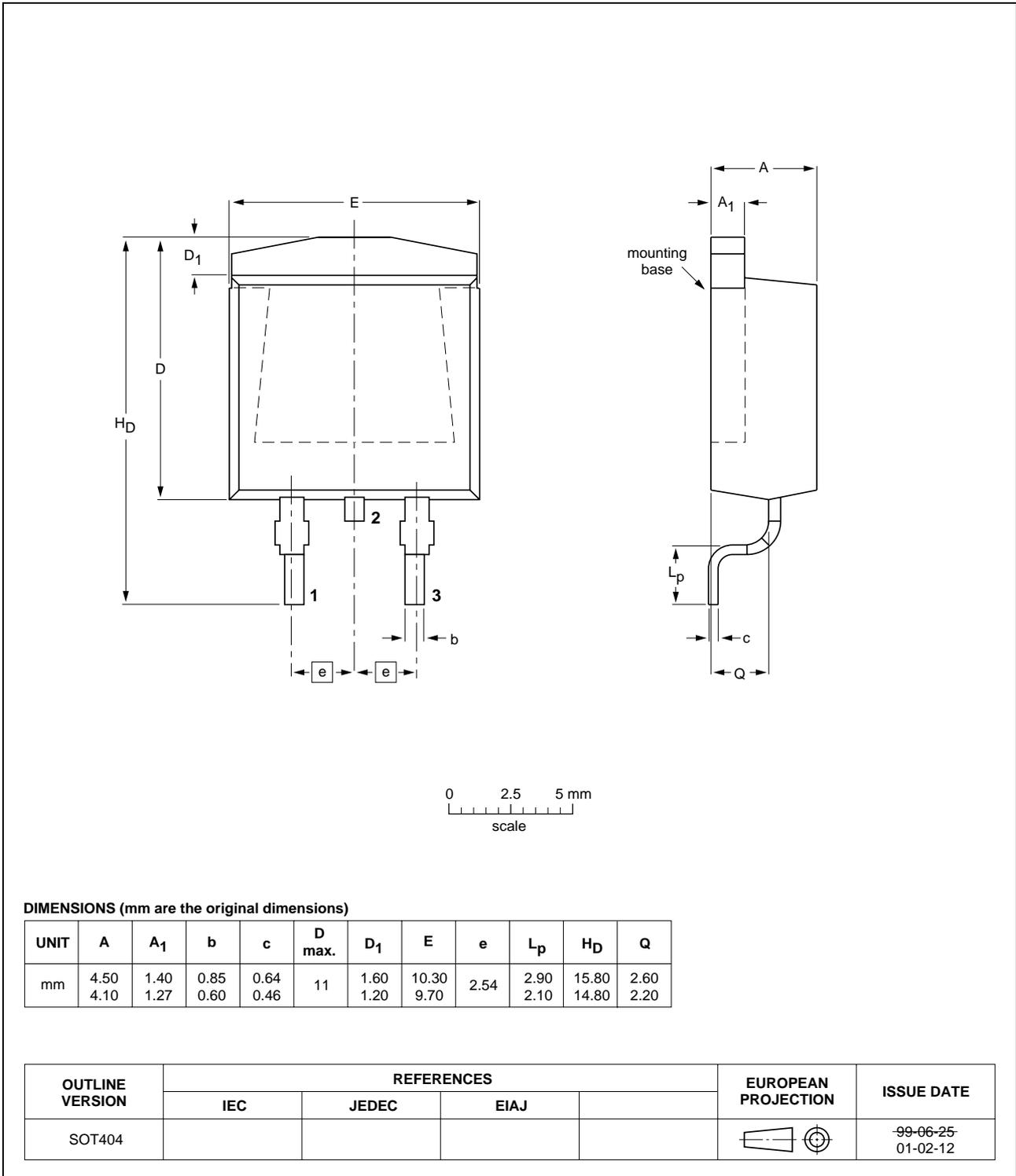


Fig 15. SOT404 (D<sup>2</sup>-PAK)

## 10. Revision history

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**Table 6:** Revision history

Rev	Date	CPCN	Description
01	20020429	-	Product data; initial version

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## 11. Data sheet status

Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup>	Definition
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.
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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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