

# PHD83N03LT

N-channel enhancement mode field-effect transistor

Rev. 01 — 16 July 2001

Product data

## 1. Description

N-channel logic level field-effect power transistor in a plastic package using TrenchMOS™<sup>1</sup> technology.

Product availability:

PHD83N03LT in a SOT428 (D-PAK).

## 2. Features

- Low on-state resistance
- Fast switching.

## 3. Applications

- High frequency computer motherboard DC to DC converters

## 4. Pinning information

Table 1: Pinning - SOT428, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)	<p>Top view MBK091</p> <p><b>SOT428 (D-Pak)</b></p>	<p>MBB076</p>
2	drain (d) <span style="color: red;">[1]</span>		
3	source (s)		
mb	mounting base, connected to drain (d)		

[1] It is not possible to make connection to pin 2 of the SOT428 package.

1. TrenchMOS is a trademark of Royal Phillips Electronics.



## 5. Quick reference data

**Table 2: Quick reference data**

Symbol	Parameter	Conditions	Typ	Max	Unit
$V_{DS}$	drain-source voltage (DC)	$T_j = 25$ to $175$ °C	–	25	V
$I_D$	drain current (DC)	$T_{mb} = 25$ °C; $V_{GS} = 5$ V	–	72	A
$P_{tot}$	total power dissipation	$T_{mb} = 25$ °C	–	107	W
$T_j$	junction temperature		–	175	°C
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ °C	6.5	9	mΩ
		$V_{GS} = 5$ V; $I_D = 25$ A; $T_j = 25$ °C	10	12	mΩ

## 6. Limiting values

**Table 3: Limiting values**

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

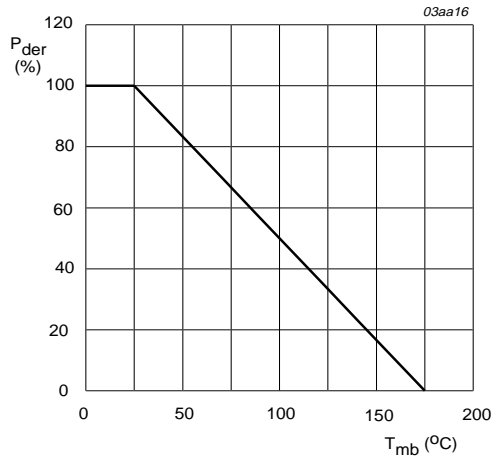
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage (DC)	$T_j = 25$ to $175$ °C	–	25	V
$V_{DGR}$	drain-gate voltage (DC)	$T_j = 25$ to $175$ °C; $R_{GS} = 20$ kΩ	–	25	V
$V_{GS}$	gate-source voltage (DC)		–	±15	V
$V_{GSM}$	gate-source voltage	$t_p \leq 50$ μs; pulsed; duty cycle 25%; $T_j \leq 150$ °C	–	±20	V
$I_D$	drain current (DC)	$T_{mb} = 25$ °C; $V_{GS} = 5$ V; <b>Figure 2 and 3</b>	–	72	A
		$T_{mb} = 100$ °C; $V_{GS} = 5$ V; <b>Figure 2</b>	–	51	A
$I_{DM}$	peak drain current	$T_{mb} = 25$ °C; pulsed; $t_p \leq 10$ μs; <b>Figure 3</b>	–	240	A
$P_{tot}$	total power dissipation	$T_{mb} = 25$ °C; <b>Figure 1</b>	–	107	W
$T_{stg}$	storage temperature		–55	+175	°C
$T_j$	operating junction temperature		–55	+175	°C

### Source-drain diode

$I_S$	source (diode forward) current (DC)	$T_{mb} = 25$ °C	–	75	A
$I_{SM}$	peak source (diode forward) current	$T_{mb} = 25$ °C; pulsed; $t_p \leq 10$ μs	–	240	A

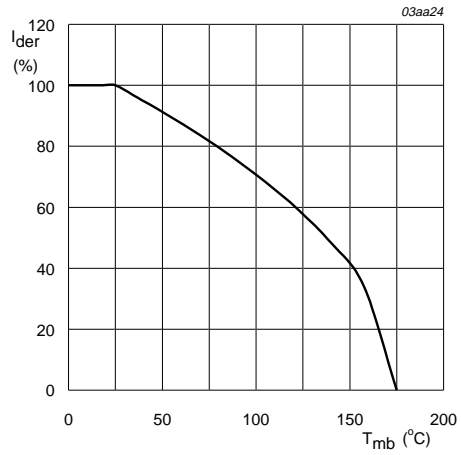
### Avalanche ruggedness

$E_{AS}$	non-repetitive avalanche energy	unclamped inductive load; $I_D = 75$ A; $t_p = 0.1$ ms; $V_{DD} = 15$ V; $R_{GS} = 50$ Ω; $V_{GS} = 5$ V; starting $T_j = 25$ °C	–	120	mJ
$I_{AS}$	non-repetitive avalanche current	unclamped inductive load; $V_{DD} = 15$ V; $R_{GS} = 50$ Ω; $V_{GS} = 5$ V; starting $T_j = 25$ °C	–	72	A



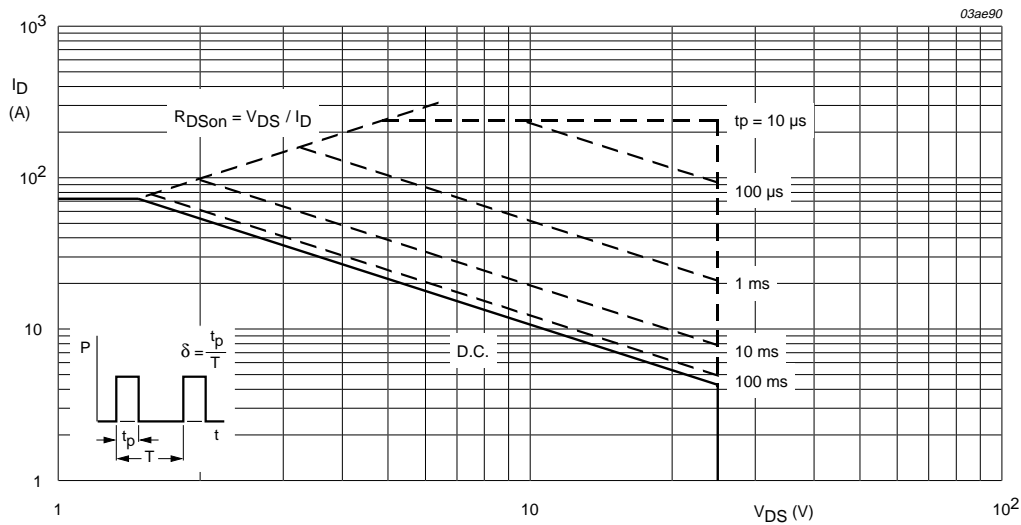
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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	Value	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	1.4	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on a printed circuit board; minimum footprint	50	K/W

### 7.1 Transient thermal impedance

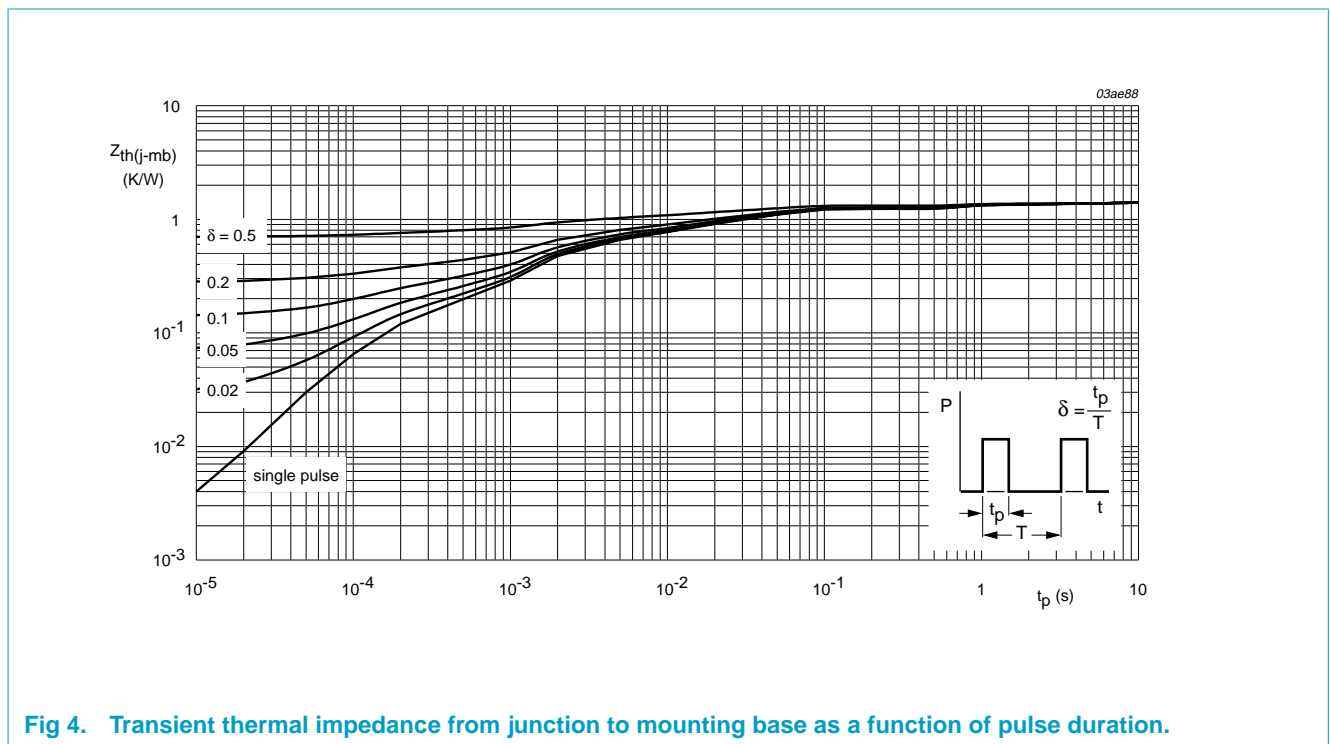


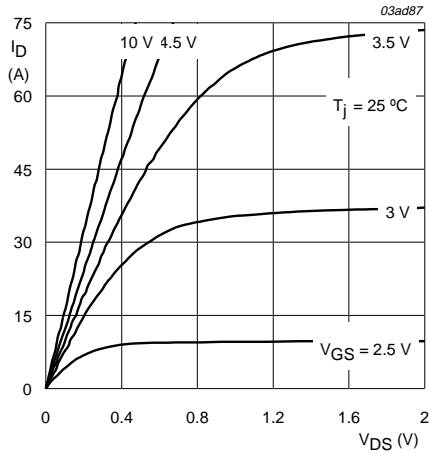
Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

## 8. Characteristics

**Table 5: Characteristics**

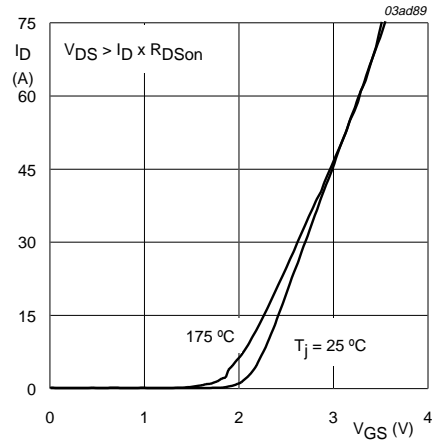
$T_j = 25\text{ °C}$  unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}$ ; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ °C}$	25	–	–	V
		$T_j = -55\text{ °C}$	22	–	–	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$ ; $V_{DS} = V_{GS}$ ; <b>Figure 9</b> $T_j = 25\text{ °C}$	1	1.5	2	V
		$T_j = 175\text{ °C}$	0.5	–	–	V
		$T_j = -55\text{ °C}$	–	–	2.3	V
$I_{DSS}$	drain-source leakage current	$V_{DS} = 25\text{ V}$ ; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ °C}$	–	0.05	10	$\mu\text{A}$
		$T_j = 175\text{ °C}$	–	–	500	$\mu\text{A}$
$I_{GSS}$	gate-source leakage current	$V_{GS} = \pm 5\text{ V}$ ; $V_{DS} = 0\text{ V}$	–	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5\text{ V}$ ; $I_D = 25\text{ A}$ ; <b>Figure 7 and 8</b> $T_j = 25\text{ °C}$	–	10	12	$\text{m}\Omega$
		$T_j = 175\text{ °C}$	–	17	20.5	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; <b>Figure 7 and 8</b> $T_j = 25\text{ °C}$	–	6.5	9	$\text{m}\Omega$
<b>Dynamic characteristics</b>						
$g_{fs}$	forward transconductance	$V_{DS} = 25\text{ V}$ ; $I_D = 30\text{ A}$	–	55	–	S
$Q_{g(tot)}$	total gate charge	$I_D = 30\text{ A}$ ; $V_{DD} = 15\text{ V}$ ; $V_{GS} = 5\text{ V}$ ; <b>Figure 13</b>	–	33	–	nC
$Q_{gs}$	gate-source charge		–	7	–	nC
$Q_{gd}$	gate-drain (Miller) charge		–	12.5	–	nC
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 25\text{ V}$ ; $f = 1\text{ MHz}$ ; <b>Figure 11</b>	–	1660	–	pF
$C_{oss}$	output capacitance		–	590	–	pF
$C_{rss}$	reverse transfer capacitance		–	380	–	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 15\text{ V}$ ; $I_D = 1\text{ A}$ ; $V_{GS} = 10\text{ V}$ ; $R_G = 6\text{ }\Omega$ ; resistive load	–	9	20	ns
$t_r$	turn-on rise time		–	14	30	ns
$t_{d(off)}$	turn-off delay time		–	75	95	ns
$t_f$	turn-off fall time		–	60	80	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain (diode forward) voltage	$I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; <b>Figure 12</b>	–	0.9	1.2	V
		$I_S = 40\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; <b>Figure 12</b>	–	0.95	–	V



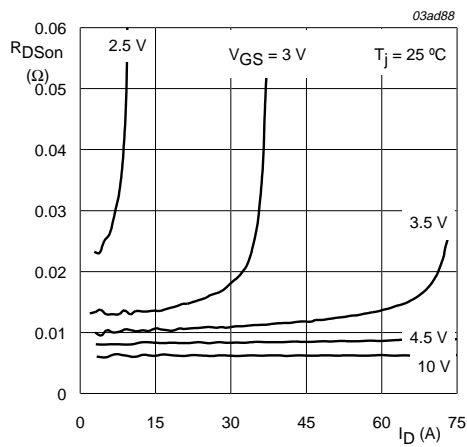
T<sub>j</sub> = 25 °C

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



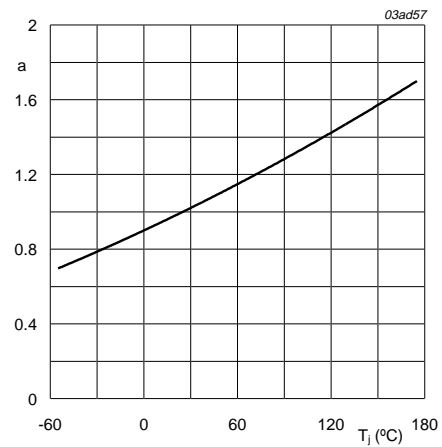
T<sub>j</sub> = 25 °C and 175 °C; V<sub>DS</sub> ≥ I<sub>D</sub> × R<sub>DSon</sub>

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



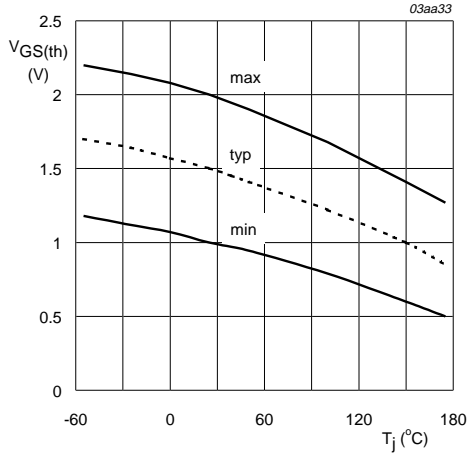
T<sub>j</sub> = 25 °C

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



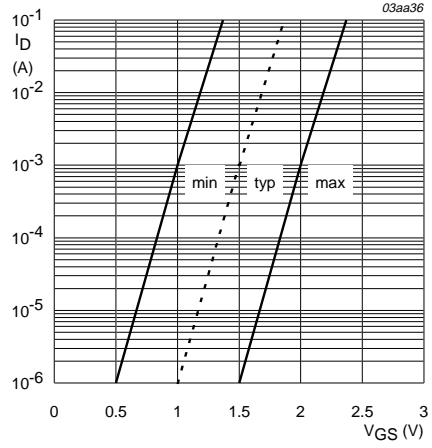
$$a = \frac{R_{DSon}}{R_{DSon}(25^{\circ}C)}$$

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



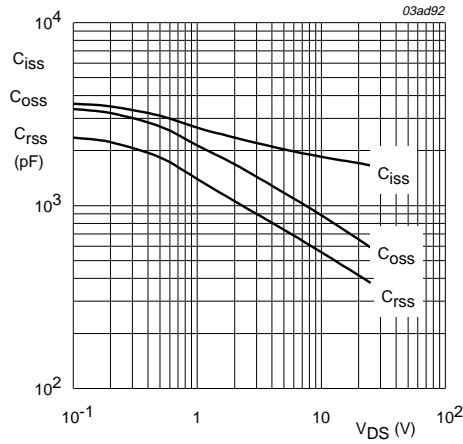
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



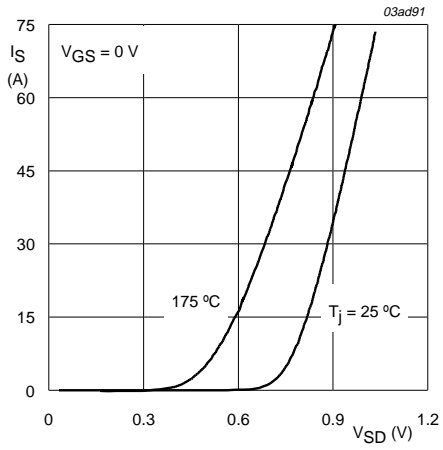
$T_j = 25 \text{ °C}; V_{DS} = 5 \text{ V}$

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



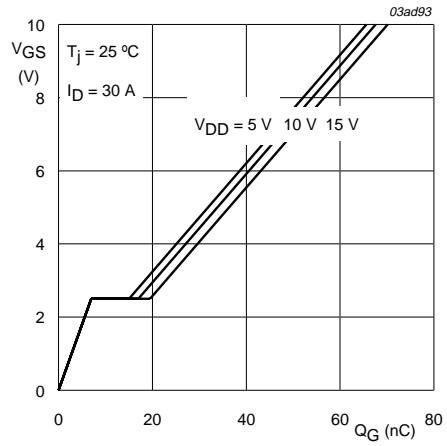
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



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

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



$I_D = 30\text{ A}$ ;  $V_{DD} = 15\text{ V}$ ,  $10\text{ V}$  and  $5\text{ V}$

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



9. Package outline

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

SOT428

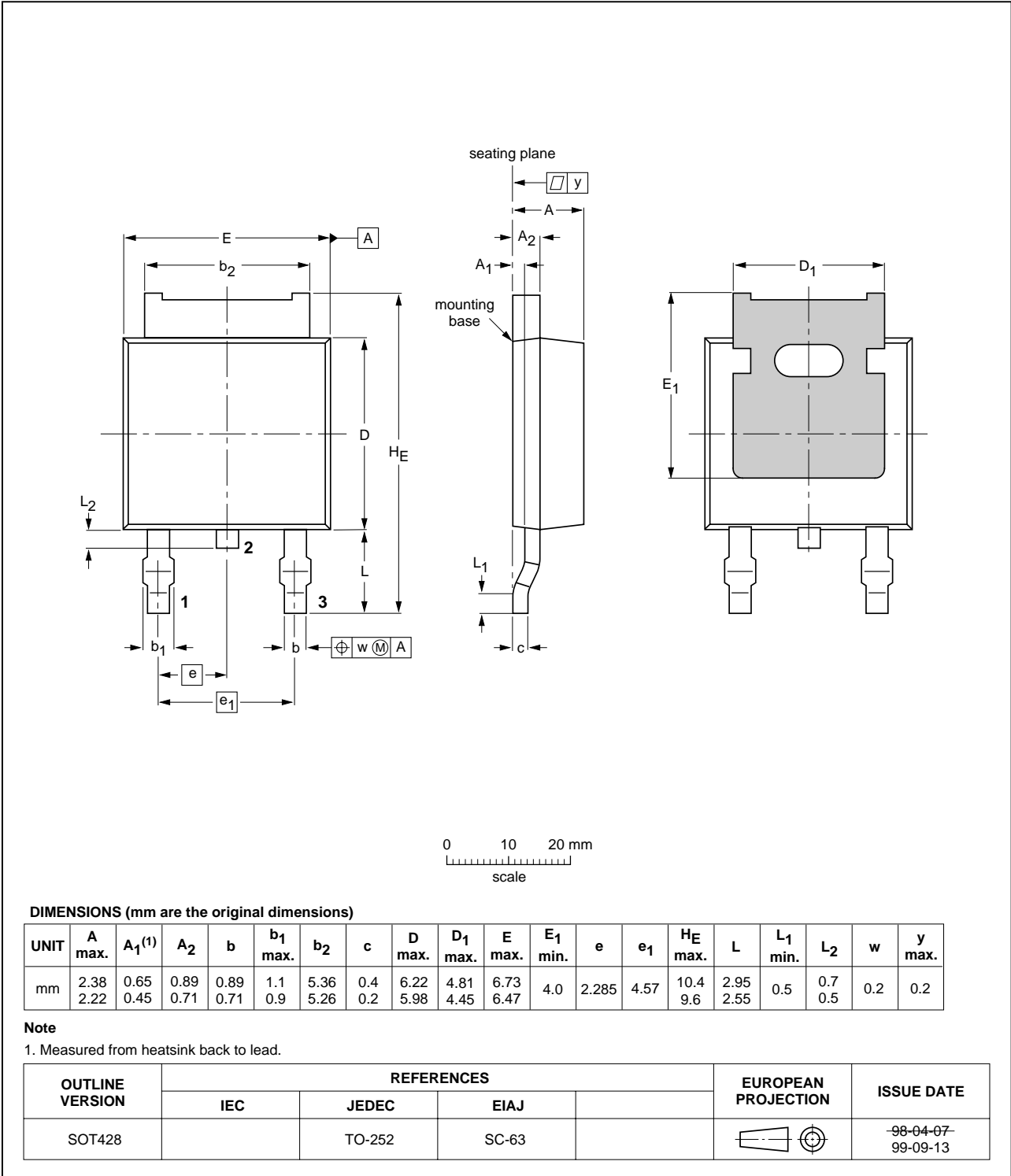


Fig 14. SOT428 (D-PAK).

## 10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20010716	-	Product specification; initial version

## 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.
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.
Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A.

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

[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>.

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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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**Argentina:** see South America

**Australia:** Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

**Austria:** Tel. +43 160 101, Fax. +43 160 101 1210

**Belarus:** Tel. +375 17 220 0733, Fax. +375 17 220 0773

**Belgium:** see The Netherlands

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**Bulgaria:** Tel. +359 268 9211, Fax. +359 268 9102

**Canada:** Tel. +1 800 234 7381

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**Denmark:** Tel. +45 3 288 2636, Fax. +45 3 157 0044

**Finland:** Tel. +358 961 5800, Fax. +358 96 158 0920

**France:** Tel. +33 1 4728 6600, Fax. +33 1 4728 6638

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**India:** Tel. +91 22 493 8541, Fax. +91 22 493 8722

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**Ireland:** Tel. +353 17 64 0000, Fax. +353 17 64 0200

**Israel:** Tel. +972 36 45 0444, Fax. +972 36 49 1007

**Italy:** Tel. +39 039 203 6838, Fax. +39 039 203 6800

**Japan:** Tel. +81 33 740 5130, Fax. +81 3 3740 5057

**Korea:** Tel. +82 27 09 1412, Fax. +82 27 09 1415

**Malaysia:** Tel. +60 37 50 5214, Fax. +60 37 57 4880

**Mexico:** Tel. +9-5 800 234 7381

**Middle East:** see Italy

**For all other countries apply to:** Philips Semiconductors,  
Marketing Communications,  
Building BE, P.O. Box 218, 5600 MD EINDHOVEN,  
The Netherlands, Fax. +31 40 272 4825

**Netherlands:** Tel. +31 40 278 2785, Fax. +31 40 278 8399

**New Zealand:** Tel. +64 98 49 4160, Fax. +64 98 49 7811

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**Portugal:** see Spain

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**Russia:** Tel. +7 095 755 6918, Fax. +7 095 755 6919

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