

PHP55N03LTA;PHB55N03LTA; PHD55N03LTA

N-channel enhancement mode field-effect transistor

Rev. 02 — 2 August 2001

Product data

1. Description

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

Product availability:

PHP55N03LTA in a SOT78 (TO-220AB)

PHB55N03LTA in a SOT404 (D²-PAK)

PHD55N03LTA in a SOT428 (D-PAK).

2. Features

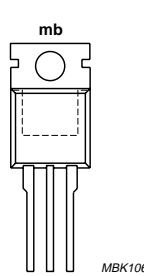
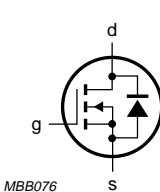
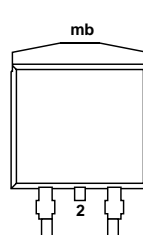
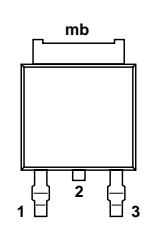
- Low on-state resistance
- Fast switching.

3. Applications

- Computer motherboard high frequency DC to DC converters.

4. Pinning information

Table 1: Pinning - SOT78, SOT404, SOT428 simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d) [1]		
3	source (s)		
mb	mounting base, connected to drain (d)	 	
		<p>SOT78 (TO-220AB) SOT404 (D²-PAK) SOT428 (D-PAK)</p>	

[1] It is not possible to make connection to pin 2 of the SOT404 and SOT428 packages.

1. TrenchMOS is a trademark of Royal Phillips Electronics.



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5. Quick reference data

Table 2: Quick reference data

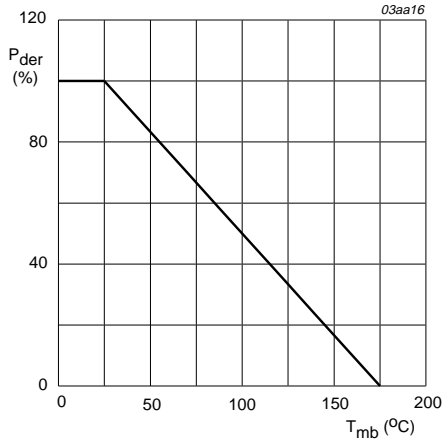
Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)	$T_j = 25$ to 175 °C	-	25	V
I_D	drain current (DC)	$T_{mb} = 25$ °C; $V_{GS} = 5$ V	-	55	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C	-	85	W
T_j	junction temperature		-	175	°C
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ °C	11	14	mΩ
		$V_{GS} = 5$ V; $I_D = 25$ A; $T_j = 25$ °C	15	18	mΩ

6. Limiting values

Table 3: Limiting values

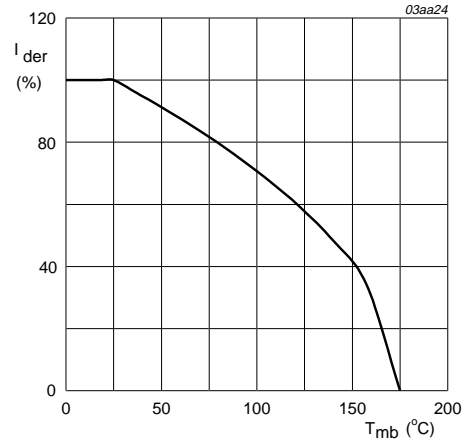
In accordance with the Absolute Maximum Rating System (IEC 60134).

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; Figure 2 and 3	-	55	A
		$T_{mb} = 100$ °C; $V_{GS} = 5$ V; Figure 2	-	38	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; pulsed; $t_p \leq 10$ μs; Figure 3	-	220	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Figure 1	-	85	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	-	55	A
I_{SM}	peak source (diode forward) current	$T_{mb} = 25$ °C; pulsed; $t_p \leq 10$ μs	-	220	A
Avalanche ruggedness					
E_{AS}	non-repetitive avalanche energy	unclamped inductive load; $I_D = 55$ A; $t_p = 0.1$ ms; $V_{DD} = 15$ V; $R_{GS} = 50$ Ω; $V_{GS} = 5$ V; starting $T_j = 25$ °C	-	60	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	-	55	A



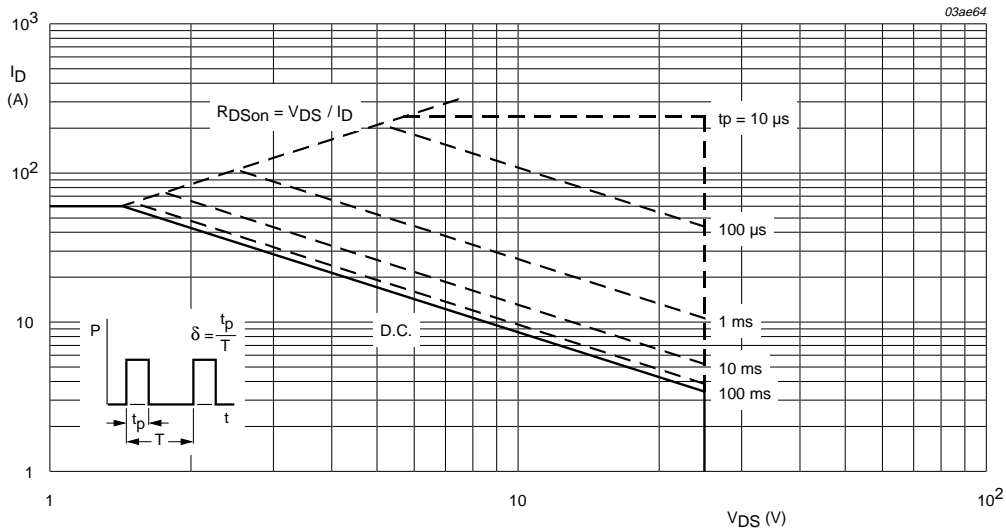
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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.



$T_{mb} = 25^{\circ}C$; 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	Value	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	1.75	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air; SOT78 package	60	K/W
		mounted on a printed circuit board; minimum footprint; SOT404 and SOT428 packages	50	K/W

7.1 Transient thermal impedance

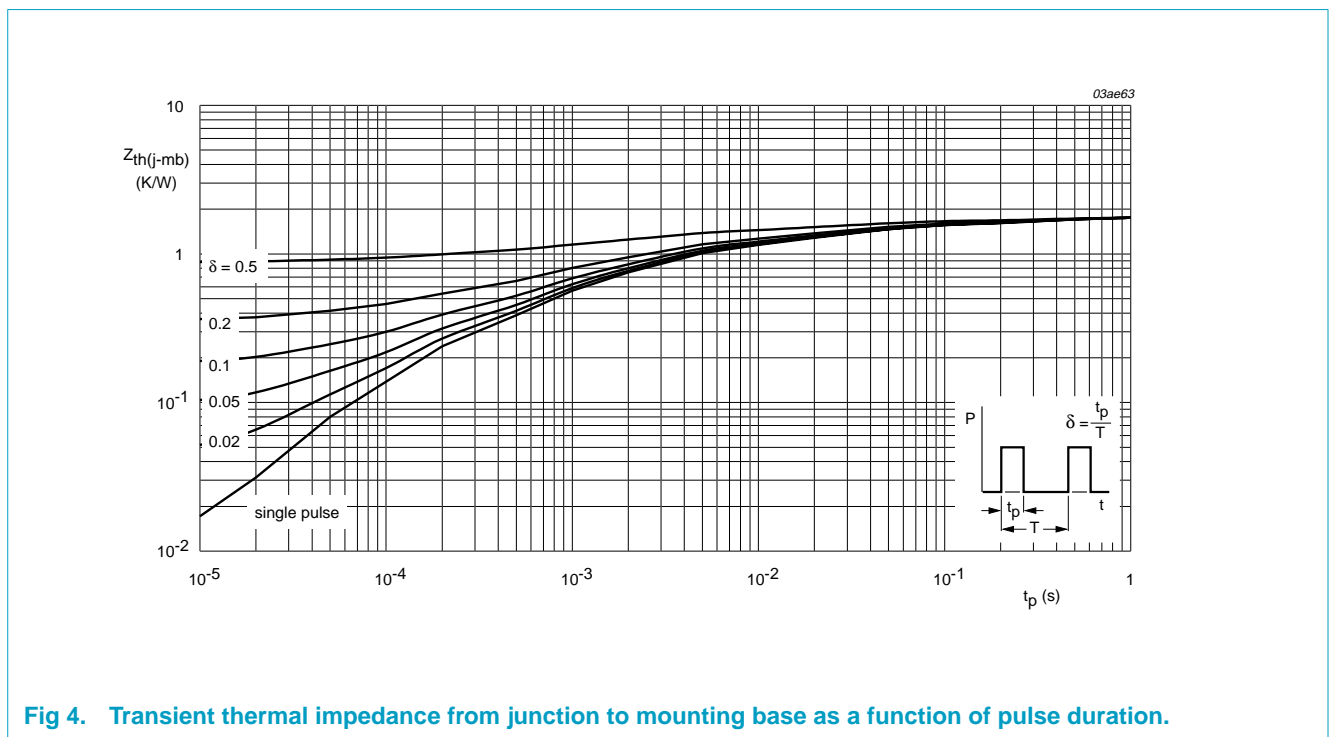
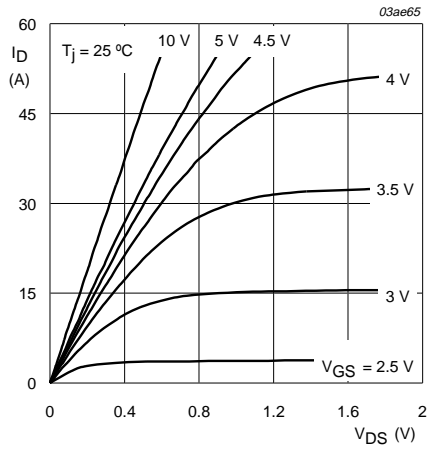


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

8. Characteristics

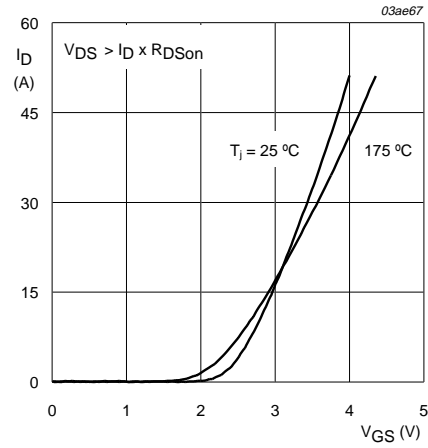
Table 5: Characteristics
 $T_j = 25\text{ }^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}$; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$	25	-	-	V
		$T_j = -55\text{ }^\circ\text{C}$	22	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; Figure 9 $T_j = 25\text{ }^\circ\text{C}$	1	1.5	2	V
		$T_j = 175\text{ }^\circ\text{C}$	0.5	-	-	V
		$T_j = -55\text{ }^\circ\text{C}$	-	-	2.3	V
I_{DSS}	drain-source leakage current	$V_{DS} = 25\text{ V}$; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$	-	0.05	10	μA
		$T_j = 175\text{ }^\circ\text{C}$	-	-	500	μA
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	$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; Figure 7 and 8 $T_j = 25\text{ }^\circ\text{C}$	-	15	18	m Ω
		$T_j = 175\text{ }^\circ\text{C}$	-	25.5	30.6	m Ω
		$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$ $T_j = 25\text{ }^\circ\text{C}$	-	11	14	m Ω
Dynamic characteristics						
g_{fs}	forward transconductance	$V_{DS} = 25\text{ V}$; $I_D = 25\text{ A}$	-	32	-	S
$Q_{g(tot)}$	total gate charge	$I_D = 55\text{ A}$; $V_{DD} = 15\text{ V}$; $V_{GS} = 5\text{ V}$; Figure 13	-	20	-	nC
Q_{gs}	gate-source charge		-	8	-	nC
Q_{gd}	gate-drain (Miller) charge		-	7	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; Figure 11	-	950	-	pF
C_{oss}	output capacitance		-	340	-	pF
C_{rss}	reverse transfer capacitance		-	230	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 15\text{ V}$; $I_D = 55\text{ A}$; $V_{GS} = 10\text{ V}$; $R_G = 5\text{ }\Omega$; resistive load	-	8	15	ns
t_r	turn-on rise time		-	45	80	ns
$t_{d(off)}$	turn-off delay time		-	45	80	ns
t_f	turn-off fall time		-	40	60	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 12	-	0.95	1.2	V
		$I_S = 55\text{ A}$; $V_{GS} = 0\text{ V}$	-	1.2	-	V



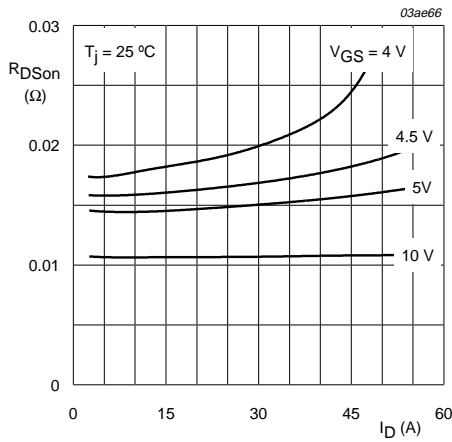
$T_j = 25\text{ }^\circ\text{C}$

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



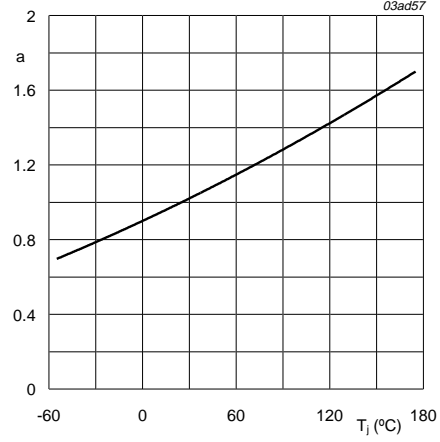
$T_j = 25\text{ }^\circ\text{C}$ and $175\text{ }^\circ\text{C}$; $V_{DS} > I_D \times R_{DSon}$

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



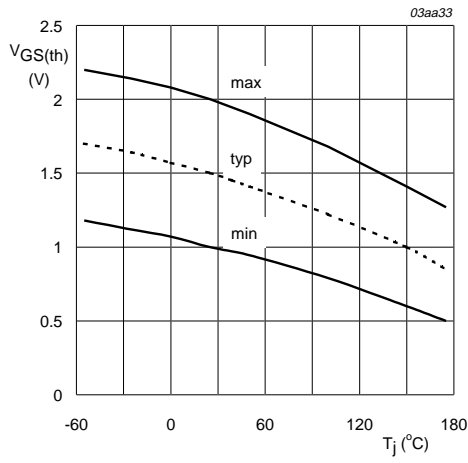
$T_j = 25\text{ }^\circ\text{C}$

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



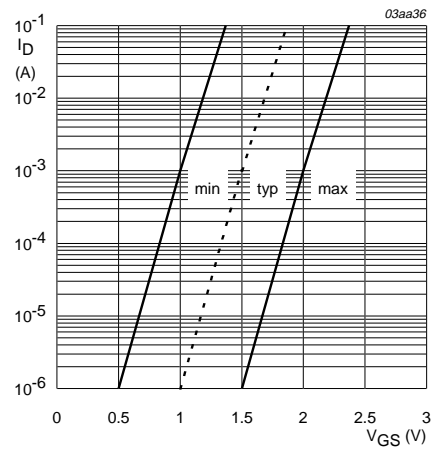
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



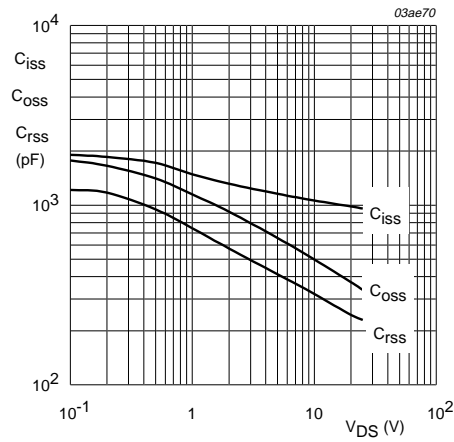
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



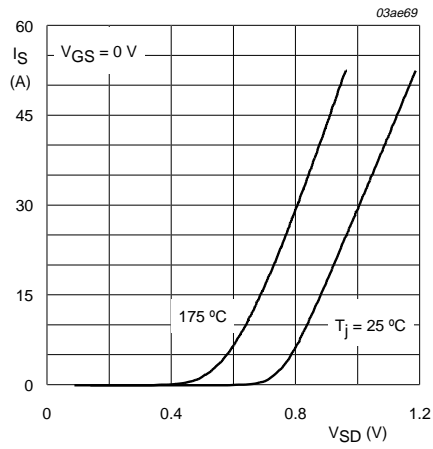
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 5 \text{ V}$

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



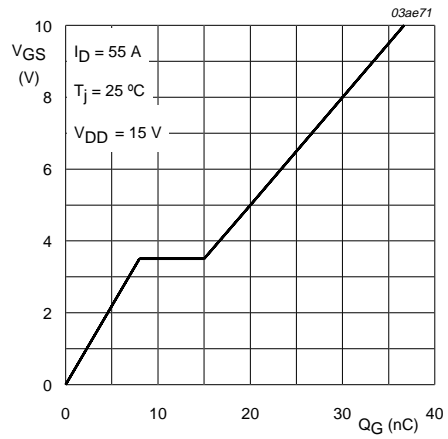
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



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

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



$I_D = 55\text{ A}$; $V_{DD} = 15\text{ V}$

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



Fig 14. SOT78 (TO-220AB).

Plastic single-ended surface mounted package (Philips version of D²-PAK); 3 leads
(one lead cropped)

SOT404



Fig 15. SOT404 (D²-PAK)

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

SOT428

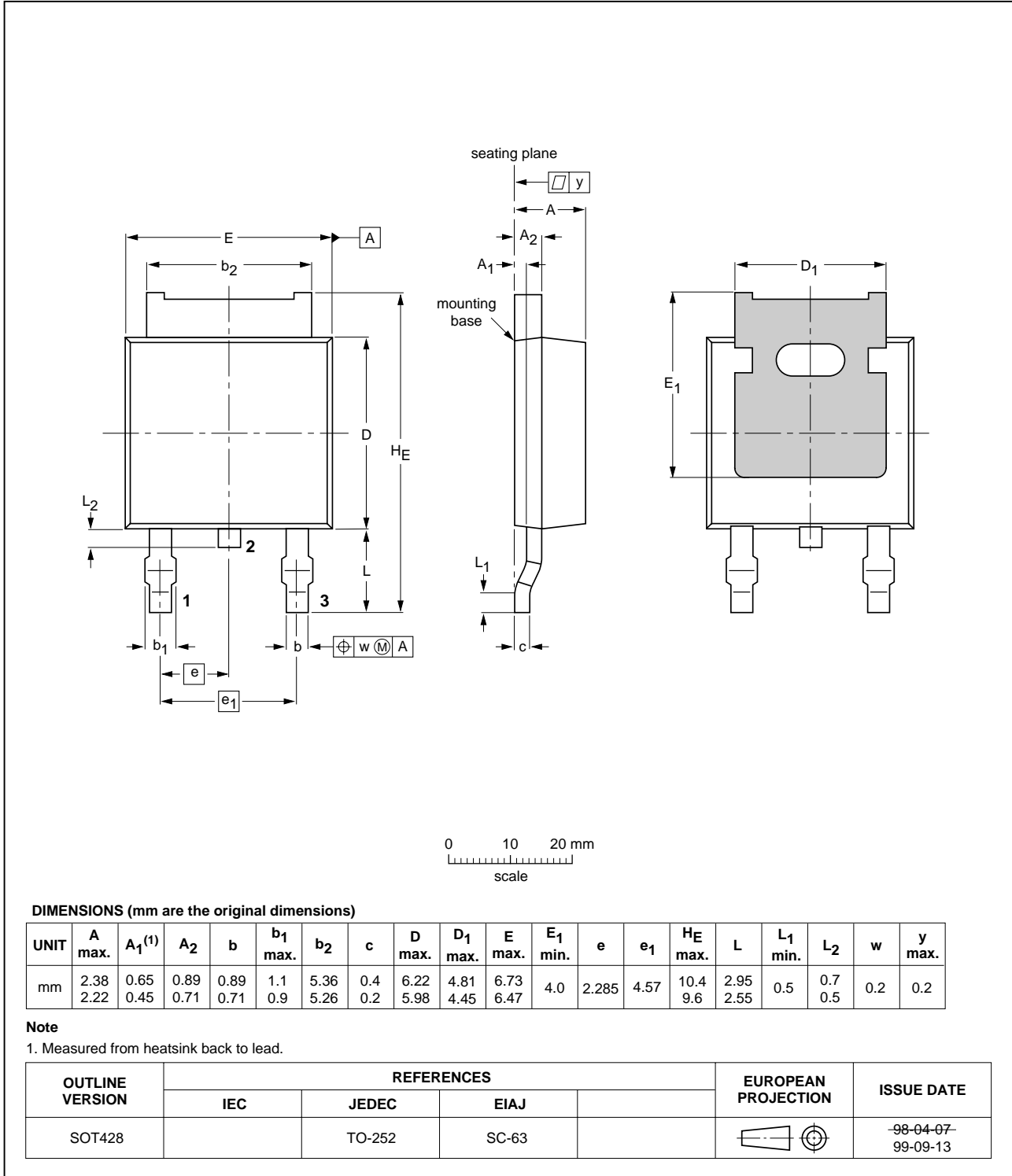


Fig 16. SOT428 (D-PAK)

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
02	20010802	-	Product data; Addition of SOT428 package
01	20010330	-	Product data; initial version

11. Data sheet status

Data sheet status ^[1]	Product status ^[2]	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.
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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>.

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