

PHD16N03T

TrenchMOS™ standard level FET

Rev. 01 — 18 August 2003

Product data

1. Product profile

1.1 Description

N-channel enhancement mode field-effect transistor in a plastic package using TrenchMOS™ technology.

Product availability:

PHD16N03T in SOT428 (D-PAK).

1.2 Features

- Fast Switching
- TrenchMOS™ technology.

1.3 Applications

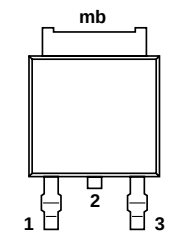
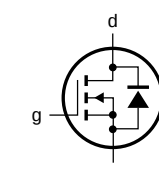
- DC-to-DC converters
- General purpose switch.

1.4 Quick reference data

- $V_{DS} \leq 30 \text{ V}$
- $I_D \leq 13.1 \text{ A}$
- $P_{tot} \leq 32.6 \text{ W}$
- $R_{DS(on)} \leq 100 \text{ m}\Omega$.

2. Pinning information

Table 1: Pinning - 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)		
		Top view MBK091	
		SOT428 (D-PAK)	

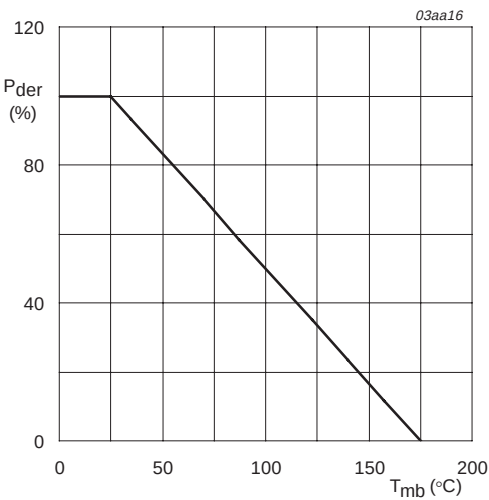
[1] It is not possible to make connection to pin 2 of the SOT428 package.

3. Limiting values

Table 2: Limiting values

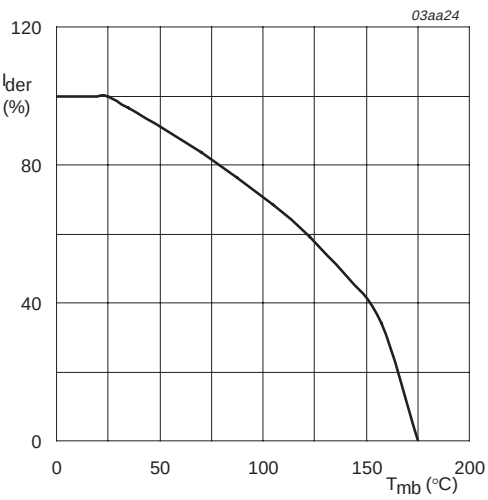
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	30	V
V_{DGR}	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	30	V
V_{GS}	gate-source voltage (DC)		-	± 20	V
V_{GSM}	peak gate-source voltage	$t_p \leq 50\text{ }\mu\text{s}$; pulsed; duty cycle = 25%	-	± 30	V
I_D	drain current (DC)	$T_{mb} = 25\text{ °C}$; $V_{GS} = 10\text{ V}$; Figure 2 and 3	-	13.1	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 10\text{ V}$; Figure 2	-	9.2	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Figure 3	-	52.4	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Figure 1	-	32.6	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)	$T_{mb} = 25\text{ °C}$	-	13.1	A
I_{SM}	peak source (diode forward) current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	52.4	A



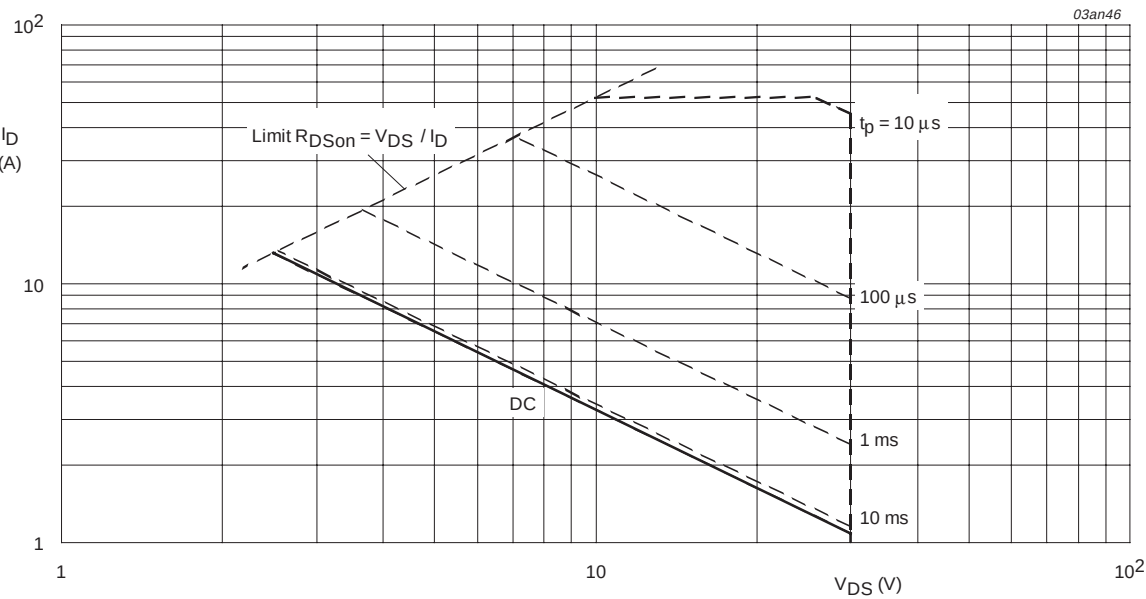
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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; $V_{GS} = 10 V$.

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

4. Thermal characteristics

Table 3: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	4.6	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	SOT428 minimum footprint; vertical in still air; mounted on a PCB	-	75	-	K/W
		SOT404 minimum footprint; vertical in still air; mounted on a PCB	-	50	-	K/W

4.1 Transient thermal impedance

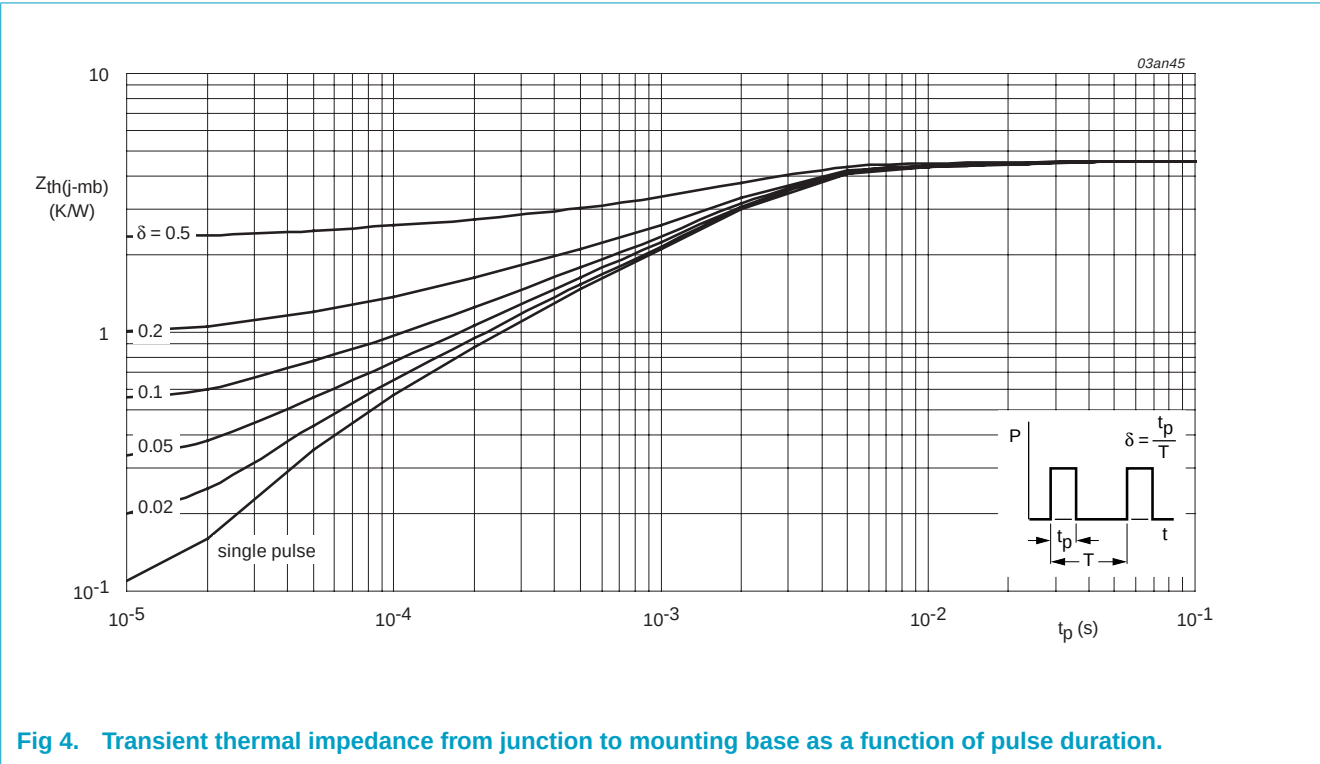


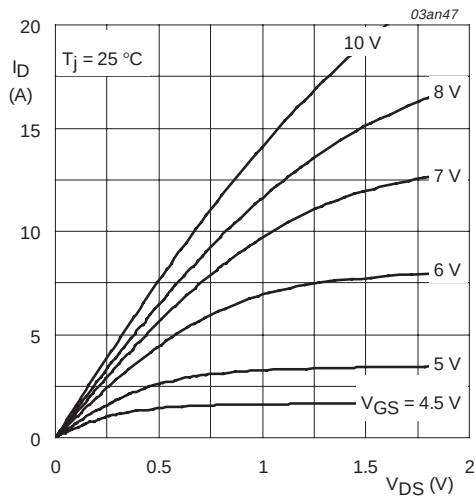
Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

5. Characteristics

Table 4: Characteristics

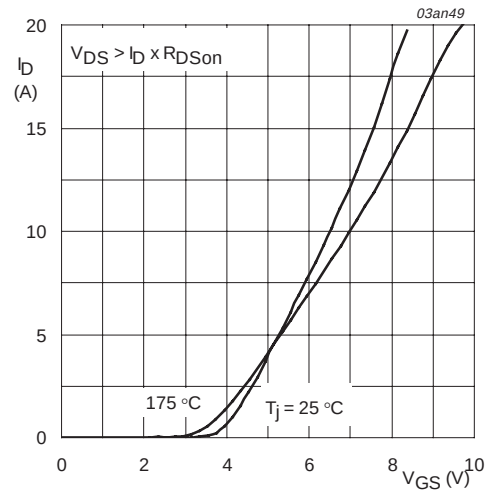
$T_j = 25\text{ °C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	30	-	-	V
		$T_j = -55\text{ °C}$	27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; Figure 9				V
		$T_j = 25\text{ °C}$	2	3	4	V
		$T_j = 175\text{ °C}$	1	-	-	V
		$T_j = -55\text{ °C}$	-	-	4.4	V
I_{DSS}	drain-source leakage current	$V_{DS} = 30\text{ V}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	0.05	10	μA
		$T_j = 175\text{ °C}$	-	-	500	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\text{ V}$; $V_{DS} = 0\text{ V}$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 13\text{ A}$; Figure 7 and 8				
		$T_j = 25\text{ °C}$	-	72	100	m Ω
		$T_j = 175\text{ °C}$	-	137	190	m Ω
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$I_D = 15\text{ A}$; $V_{DD} = 15\text{ V}$; $V_{GS} = 10\text{ V}$; Figure 13	-	5.2	-	nC
Q_{gs}	gate-source charge		-	2.6	-	nC
Q_{gd}	gate-drain (Miller) charge		-	1.2	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 30\text{ V}$; $f = 1\text{ MHz}$; Figure 11	-	180	-	pF
C_{oss}	output capacitance		-	85	-	pF
C_{rss}	reverse transfer capacitance		-	60	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 15\text{ V}$; $R_L = 0.6\text{ }\Omega$;	-	6	-	ns
t_r	rise time	$V_{GS} = 10\text{ V}$; $R_G = 56\text{ }\Omega$	-	45	-	ns
$t_{d(off)}$	turn-off delay time		-	12	-	ns
t_f	fall time		-	23	-	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 10\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 12	-	1	1.2	V



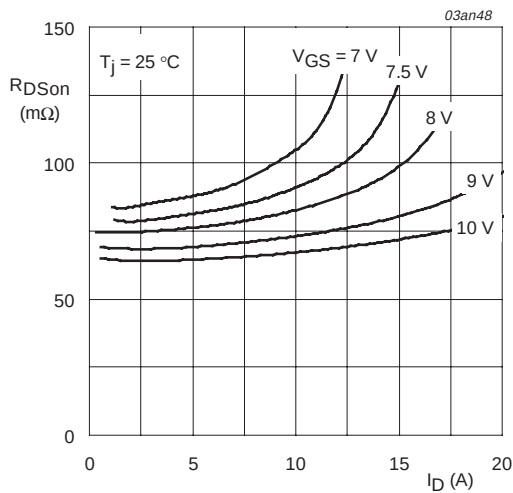
$T_j = 25^\circ\text{C}$

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



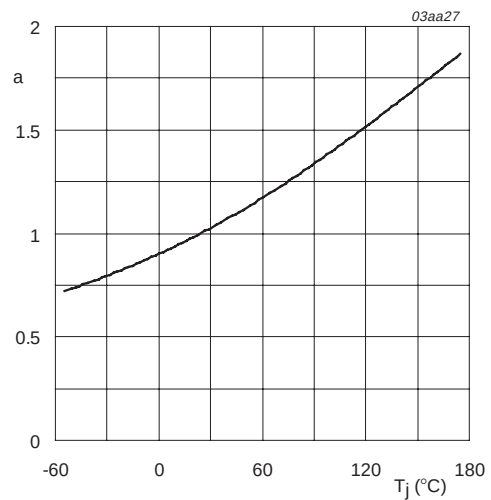
$T_j = 25^\circ\text{C}$ and 175°C ; $V_{DS} > I_D \times R_{DSon}$

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



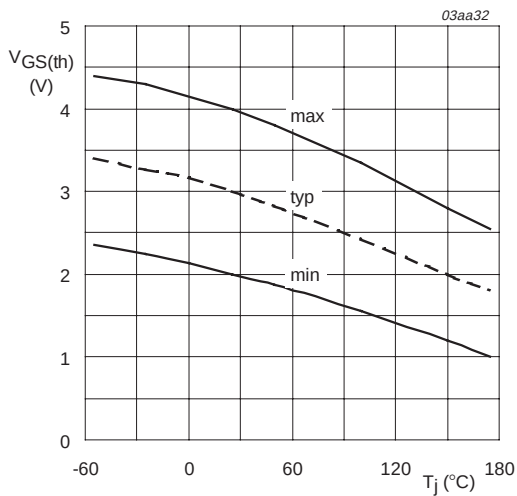
$T_j = 25^\circ\text{C}$

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



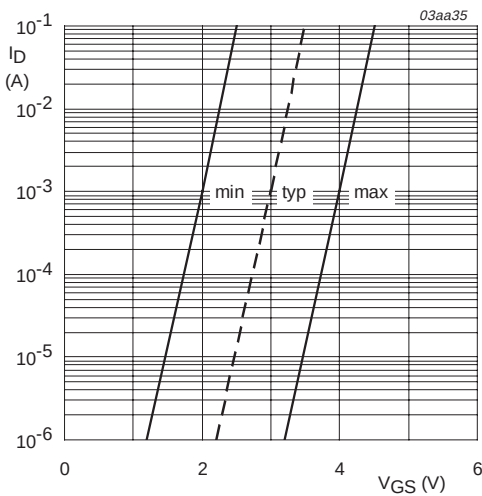
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



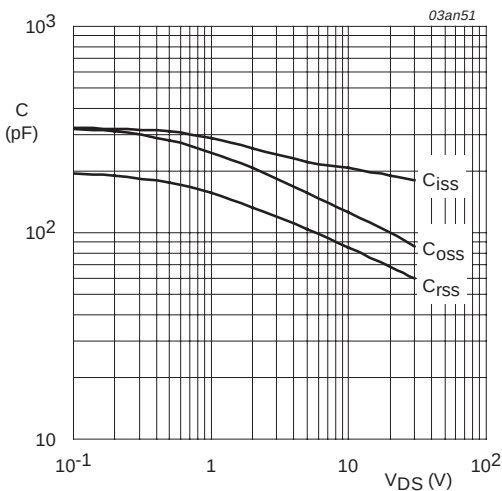
$I_D = 1 \text{ mA}$; $V_{DS} = V_{GS}$

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



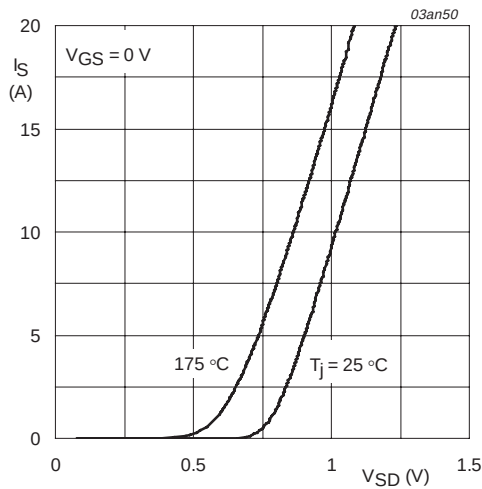
$T_j = 25 \text{ °C}$; $V_{DS} = 5 \text{ V}$

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



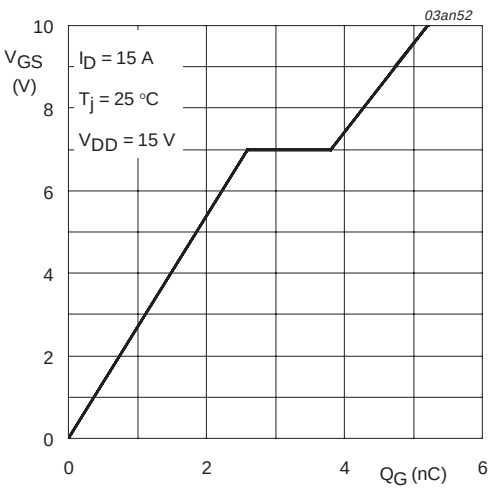
$V_{GS} = 0 \text{ V}$; $f = 1 \text{ MHz}$

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



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

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



$I_D = 15$ A; $V_{DD} = 15$ V

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

6. Package outline

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

SOT428

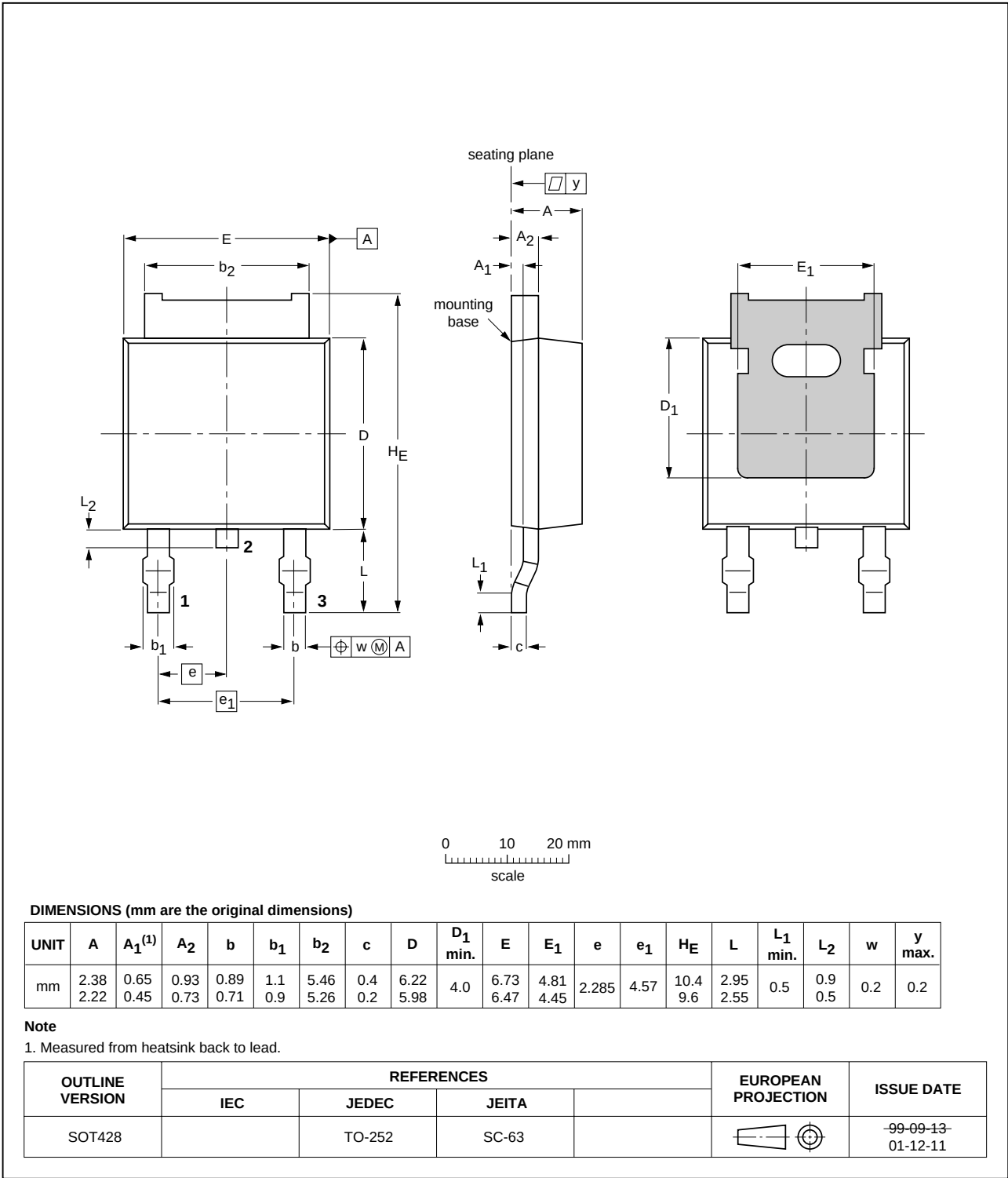


Fig 14. SOT428.

7. Revision history

Table 5: Revision history

Rev	Date	CPCN	Description
01	20030818	-	Product data; initial version (9397 750 11672)

8. Data sheet status

Level	Data sheet status ^[1]	Product status ^{[2][3]}	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.
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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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