PHB/PHD38N02LT

TrenchMOS™ logic level FET

Rev. 01 — 30 June 2003 **Product data**

1. Product profile

1.1 Description

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

Product availability:

PHB38N02LT in SOT404 (D^2-PAK)

PHD38N02LT in SOT428 (D-PAK).

1.2 Features

- Low on-state resistance
- 2.5 V gate drive.

1.3 Applications

- Linear regulator for DDR memory.

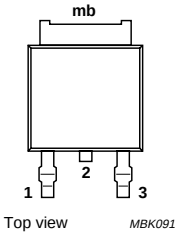
1.4 Quick reference data

- V_{DS} = 20 V
- I_D = 44.7 A
- P_{tot} = 57.6 W
- $R_{DSon} \leq 16\ m\Omega$

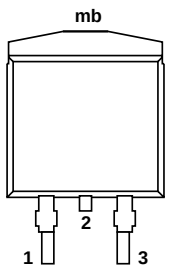
2. Pinning information

Table 1: Pinning - SOT404 and SOT428 simplified outlines and symbol

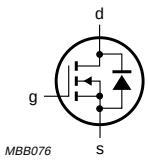
Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d) [1]		
3	source (s)		
mb	mounting base; connected to drain (d)		



SOT428 (D-PAK)



SOT404 (D^2-PAK)



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

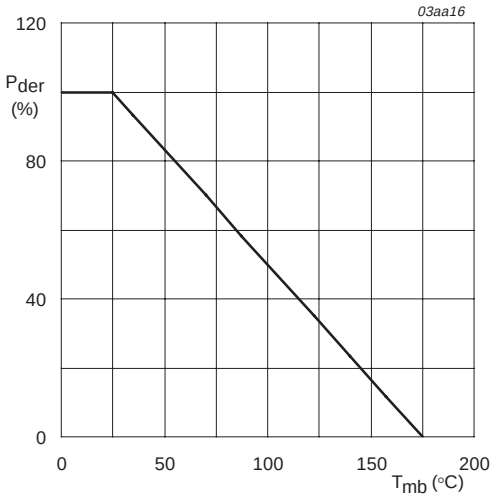
PHILIPS

3. Limiting values

Table 2: Limiting values

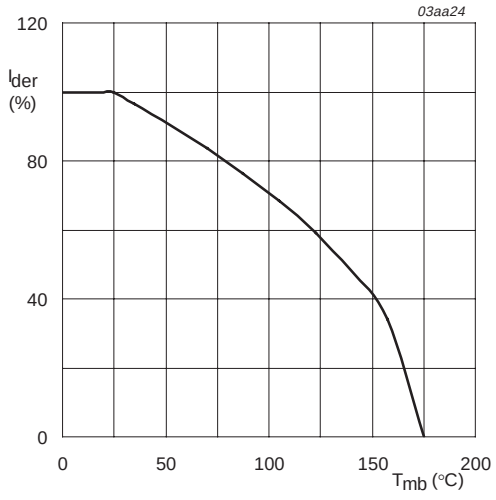
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	25 °C ≤ T_j ≤ 175 ºC	-	20	V
V_{DGR}	drain-gate voltage (DC)	25 °C ≤ T_j ≤ 175 ºC; R_{GS} = 20 kΩ	-	20	V
V_{GS}	gate-source voltage (DC)		-	12	V
I_D	drain current (DC)	T_{mb} = 25 °C; V_{GS} = 5 V; Figure 2 and 3	-	44.7	A
		T_{mb} = 100 °C; V_{GS} = 5 V; Figure 2	-	31.6	A
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; t_p ≤ 10 µs; Figure 3	-	179	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Figure 1	-	57.6	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 °C	-	44.7	A
I_{SM}	peak source (diode forward) current	T_{mb} = 25 °C; pulsed; t_p ≤ 10 µs	-	179	A



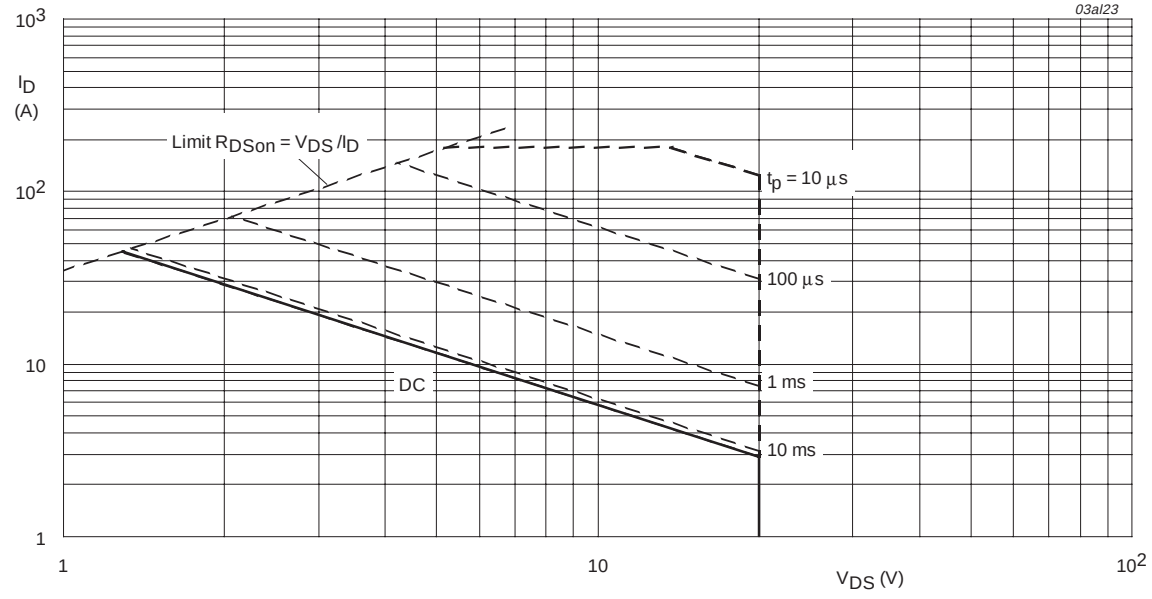
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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 °C; I_{DM} is single pulse; V_{GS} = 5 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	-	-	2.6	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient					
	SOT428	SOT428 minimum footprint; mounted on a PCB	-	75	-	K/W
		SOT404 minimum footprint; mounted on a PCB	-	50	-	K/W
	SOT404	SOT404 minimum footprint; mounted on a PCB	-	50	-	K/W

4.1 Transient thermal impedance

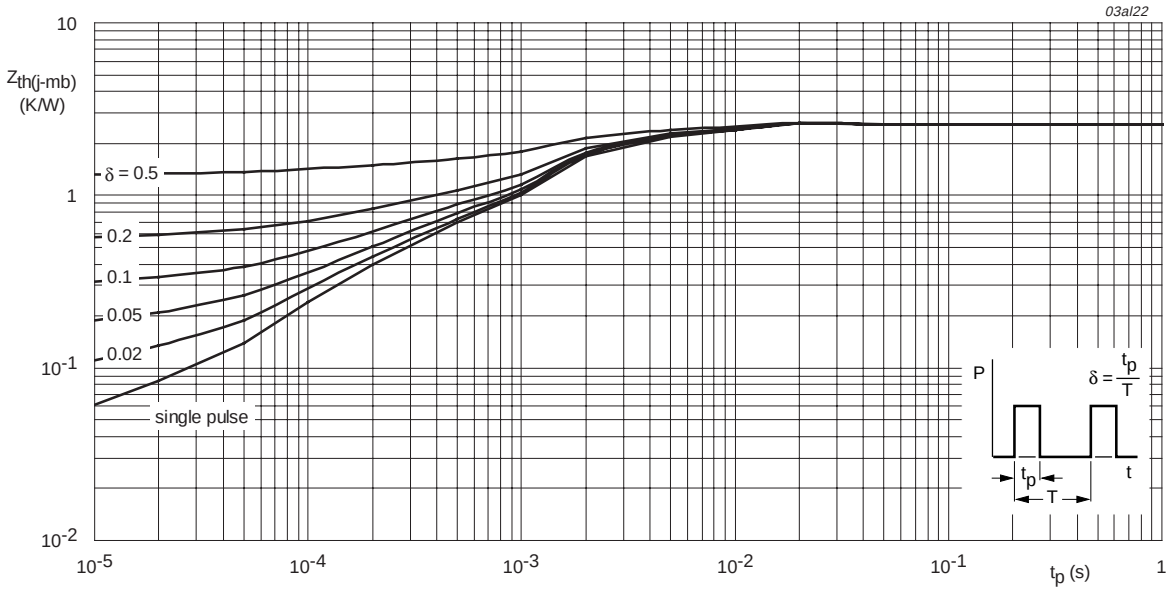


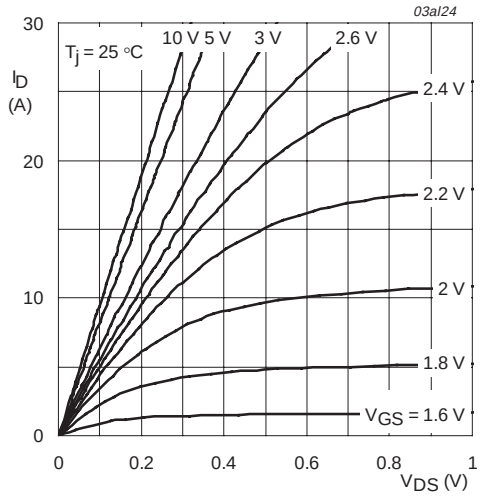
Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

5. Characteristics

Table 4: Characteristics

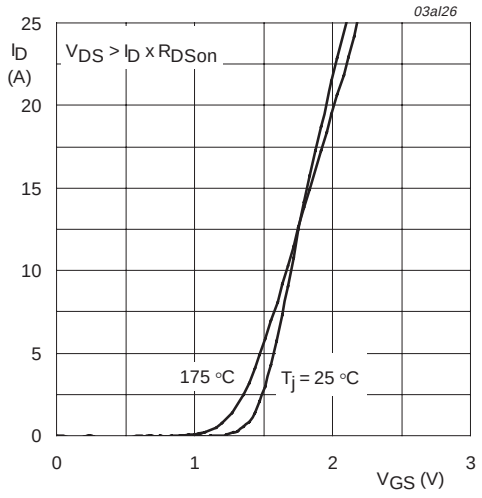
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V				
		T_j = 25 °C	20	-	-	V
		T_j = –55 °C	18	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; Figure 9				
		T_j = 25 °C	0.5	1	1.5	V
		T_j = 175 °C	0.3	-	-	V
		T_j = –55 °C	-	-	1.8	V
I_{DSS}	drain-source leakage current	V_{DS} = 20 V; V_{GS} = 0 V				
		T_j = 25 °C	-	0.05	1	µA
		T_j = 175 °C	-	-	500	µA
I_{GSS}	gate-source leakage current	V_{GS} = ±12 V; V_{DS} = 0 V	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 5 V; I_D = 25 A; Figure 7 and 8				
		T_j = 25 °C	-	13.5	16	mΩ
		T_j = 175 °C	-	24.3	28.8	mΩ
		V_{GS} = 2.5 V; I_D = 8 A; Figure 8	-	20	30	mΩ
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	I_D = 25 A; V_{DD} = 10 V; V_{GS} = 5 V; Figure 13	-	15.1	-	nC
Q_{gs}	gate-source charge		-	4.5	-	nC
Q_{gd}	gate-drain (Miller) charge		-	4.2	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 20 V; f = 1 MHz; Figure 11	-	800	-	pF
C_{oss}	output capacitance		-	260	-	pF
C_{rss}	reverse transfer capacitance		-	190	-	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = 10 V; I_D = 25 A; V_{GS} = 10 V; R_G = 5.6 Ω	-	4	-	ns
t_r	rise time		-	12.5	-	ns
$t_{d(off)}$	turn-off delay time		-	30	-	ns
t_f	fall time		-	23	-	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	I_S = 25 A; V_{GS} = 0 V; Figure 12	-	0.98	1.2	V



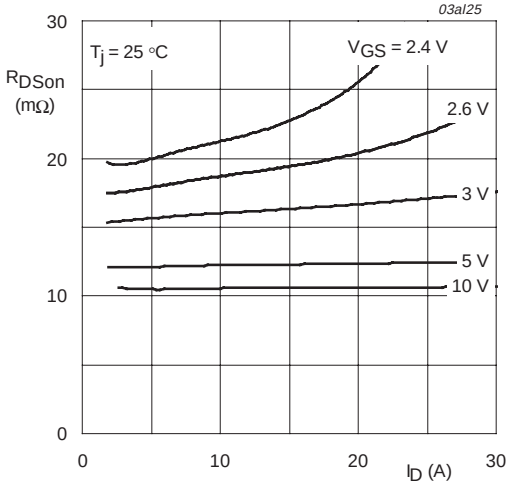
T_j = 25 °C

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



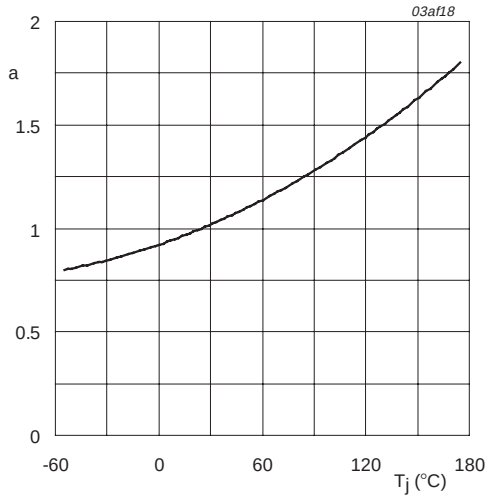
T_j = 25 °C and 175 °C; $V_{DS} > I_D \times R_{DSon}$

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



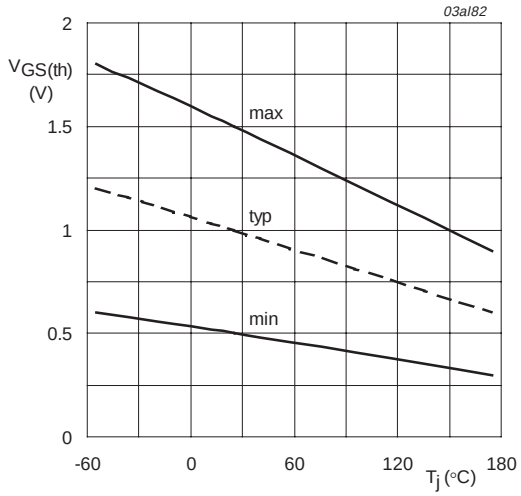
T_j = 25 °C

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



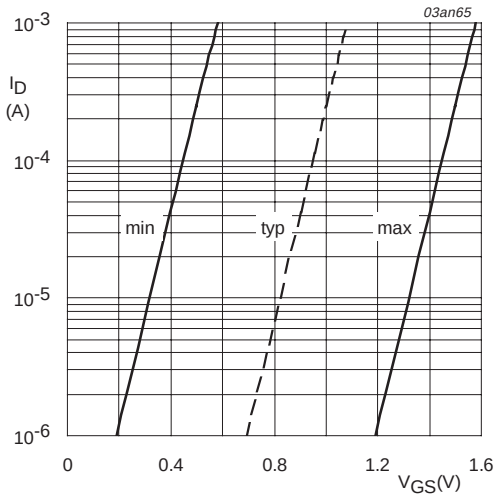
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



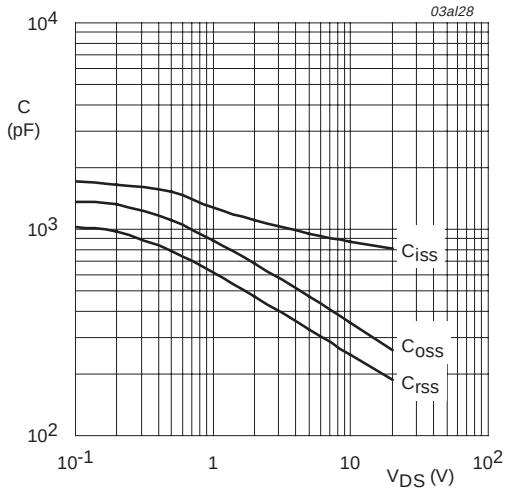
I_D = 0.25 mA; V_{DS} = V_{GS}

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



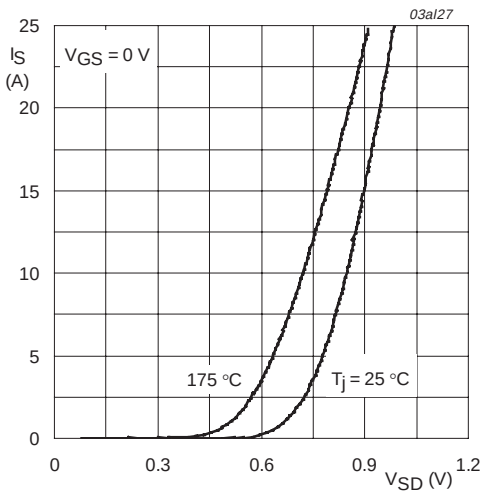
T_j = 25 °C; V_{DS} = 5 V

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



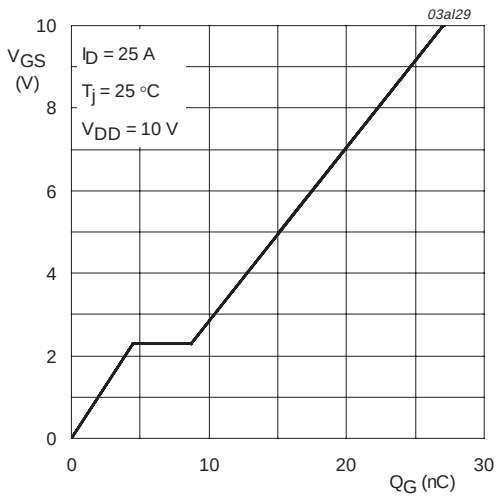
V_{GS} = 0 V; f = 1 MHz

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.

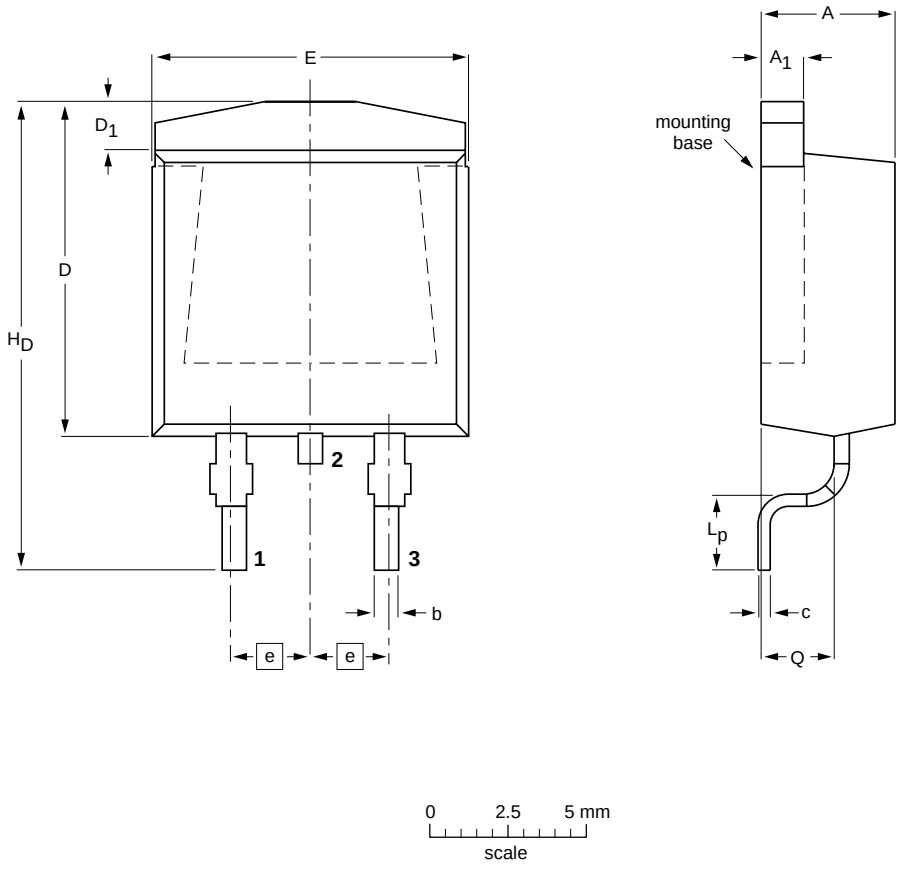


I_D = 25 A; V_{DD} = 10 V

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 D²-PAK); 3 leads (one lead cropped) **SOT404**



DIMENSIONS (mm are the original dimensions)

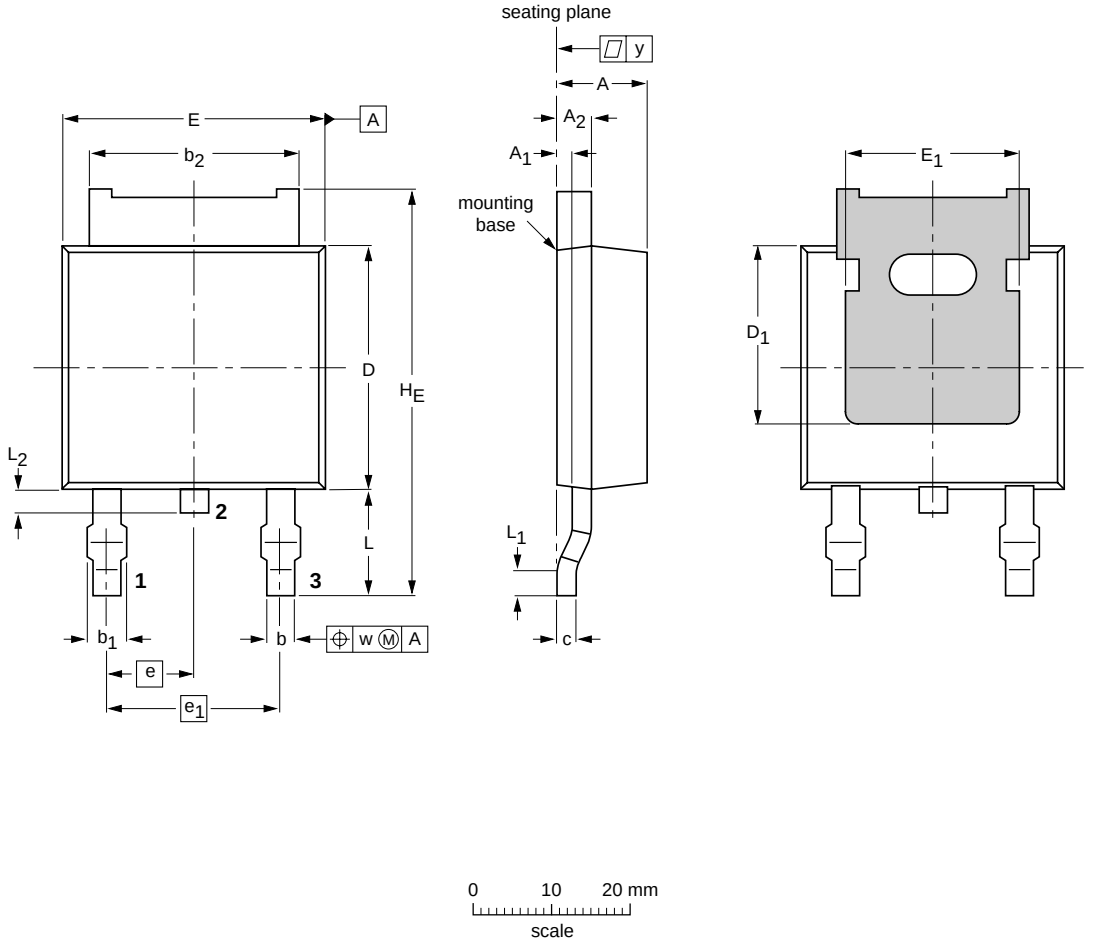
UNIT	A	A_1	b	c	D max.	D_1	E	e	L_p	H_D	Q
mm	4.50 4.10	1.40 1.27	0.85 0.60	0.64 0.46	11	1.60 1.20	10.30 9.70	2.54	2.90 2.10	15.80 14.80	2.60 2.20

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT404						~~99-06-25~~ 01-02-12

Fig 14. SOT404 (D²-PAK).

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

SOT428



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 (1)	A_2	b	b_1	b_2	c	D	D_1 min.	E	E_1	e	e_1	H_E	L	L_1 min.	L_2	w	y max.
mm	2.38 2.22	0.65 0.45	0.93 0.73	0.89 0.71	1.1 0.9	5.46 5.26	0.4 0.2	6.22 5.98	4.0	6.73 6.47	4.81 4.45	2.285	4.57	10.4 9.6	2.95 2.55	0.5	0.9 0.5	0.2	0.2

Note

1. Measured from heatsink back to lead.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT428		TO-252	SC-63			~~99-09-13~~ 01-12-11

Fig 15. SOT428 (D-PAK).

7. Revision history

Table 5: Revision history

Rev	Date	CPCN	Description
01	20030630	-	Product data (9397 750 11614)

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.
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.
III	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. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[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.

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

9. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

10. Disclaimers

Life support — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes in the products - including circuits, standard cells, and/or software - described or contained herein in order to improve design and/or performance. When the product is in full production (status 'Production'), relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no licence or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

11. Trademarks

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

Contact information

For additional information, please visit **http://www.semiconductors.philips.com**.
For sales office addresses, send e-mail to: **sales.addresses@www.semiconductors.philips.com**.

Fax: +31 40 27 24825

9397 750 11614

Contents

Date of release: 30 June 2003 **Document order number: 9397 750 11614**