PHP47NQ10T; PHB47NQ10T

N-channel enhancement mode field-effect transistor

Rev. 01 — 16 May 2001 **Product data**

1. Description

N-channel enhancement mode field-effect power transistor in a plastic package using TrenchMOS™[1] technology.

Product availability:

PHP47NQ10T in SOT78 (TO-220AB)

PHB47NQ10T in SOT404 (D^2-PAK).

2. Features

- Fast switching
- Very low on-state resistance.

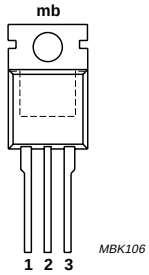
3. Applications

- DC to DC converters
- Switched mode power supplies.

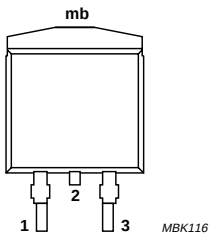
4. Pinning information

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

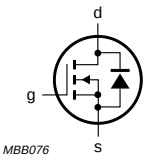
Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d) [1]		
3	source (s)		
mb	mounting base; connected to drain (d)		



SOT78 (TO-220AB)



SOT404 (D^2-PAK)



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

1. TrenchMOS is a trademark of Royal Philips Electronics.

PHILIPS

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	–	100	V
I_D	drain current (DC)	T_{mb} = 25 °C; V_{GS} = 10 V	–	47	A
P_{tot}	total power dissipation	T_{mb} = 25 °C	–	166	W
T_j	junction temperature		–	175	°C
R_{DSon}	drain-source on-state resistance	T_j = 25 °C; V_{GS} = 10 V; I_D = 25 A	20	28	mΩ

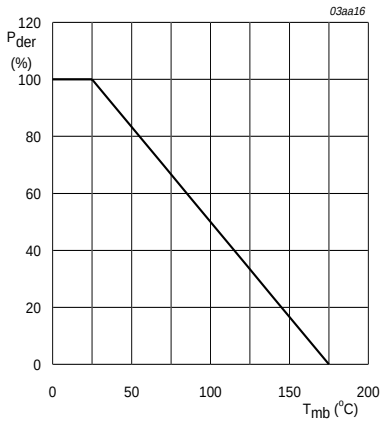
6. Limiting values

Table 3: Limiting values

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

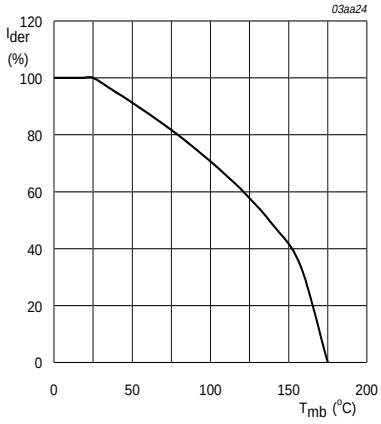
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	T_j = 25 to 175 °C	–	100	V
V_{DGR}	drain-gate voltage (DC)	T_j = 25 to 175 °C; R_{GS} = 20 kΩ	–	100	V
V_{GS}	gate-source voltage (DC)		–	±20	V
I_D	drain current (DC)	T_{mb} = 25 °C; V_{GS} = 10 V Figure 2 and 3	–	47	A
		T_{mb} = 100 °C; V_{GS} = 10 V Figure 2	–	33	A
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs; Figure 3	–	187	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Figure 1	–	166	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	–	47	A
I_{SM}	peak source (diode forward) current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs	–	187	A
Avalanche ruggedness					
E_{AS}	non-repetitive avalanche energy	unclamped inductive load; I_{AS} = 30 A; t_p = 0.1 ms; $V_{DD} \leq 25$ V; R_{GS} = 50 Ω; V_{GS} = 5 V; starting T_j = 25 °C; Figure 4	–	45	mJ

© Philips Electronics N.V. 2001. All rights reserved.



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

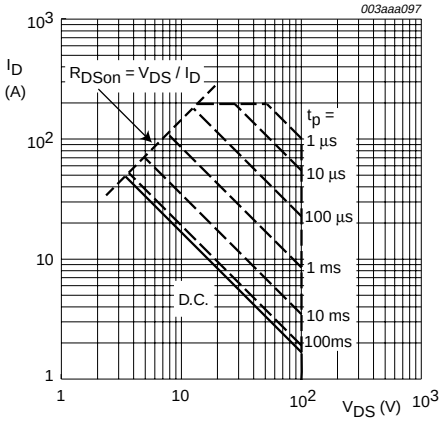
Fig 1. Normalized total power dissipation as a function of mounting base temperature.



$V_{GS} \geq 10$ V

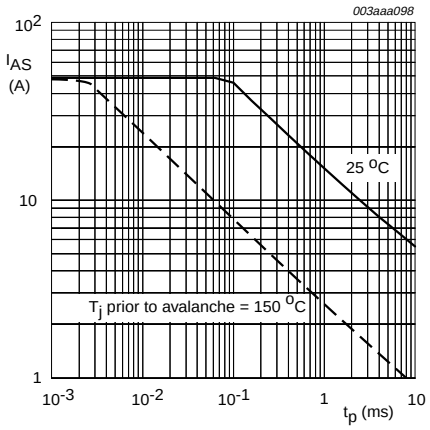
$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\%$$

Fig 2. Normalized continuous drain current as a function of mounting base temperature.



T_{mb} = 25 °C; I_{DM} is single pulse.

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



Unclamped inductive load; $V_{DD} \leq 25$ V; $R_{GS} = 50\ \Omega$; $V_{GS} = 5$ V; starting $T_j = 25$ °C and 150 °C.

Fig 4. Non-repetitive avalanche ruggedness current as a function of pulse duration.

© Philips Electronics N.V. 2001. All rights reserved.

7. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Value	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 5	0.9	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	SOT78 package; vertical in still air.	60	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	SOT404 package; mounted on printed circuit board; minimum footprint.	50	K/W

7.1 Transient thermal impedance

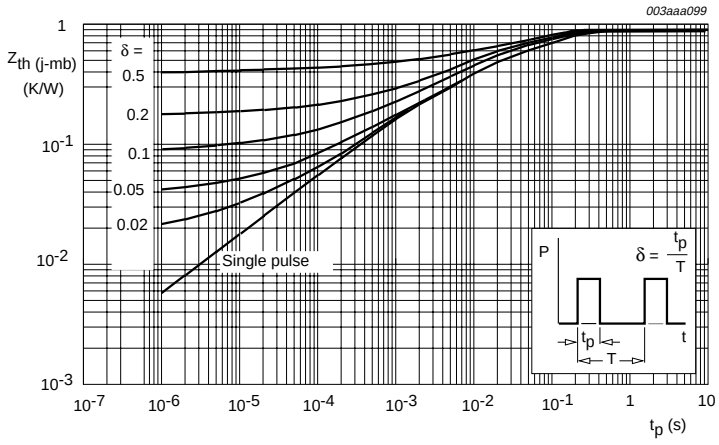


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

© Philips Electronics N.V. 2001. All rights reserved.

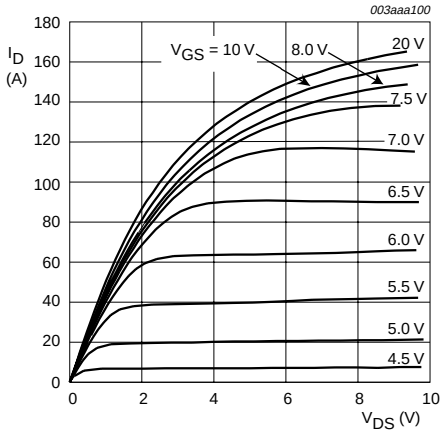
8. Characteristics

Table 5: Characteristics

T_j = 25 °C unless otherwise specified

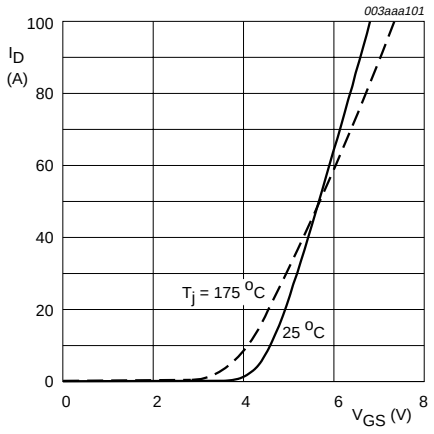
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V	100	–	–	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; Figure 10				
		T_j = 25 °C	2	3	4	V
		T_j = 175 °C	1	–	–	V
I_{DSS}	drain-source leakage current	V_{GS} = 0 V; V_{DS} = 100 V				
		T_j = 25 °C	–	0.05	10	µA
		T_j = 175 °C	–	–	500	µA
I_{GSS}	gate-source leakage current	V_{DS} = 0 V; V_{GS} = ±20 V	–	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; Figure 8 and 9				
		T_j = 25 °C	–	20	28	mΩ
		T_j = 175 °C	–	–	76	mΩ
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	I_D = 40 A; V_{DD} = 80 V; V_{GS} = 10 V; Figure 15	–	66	–	nC
Q_{gs}	gate-source charge		–	12	–	nC
Q_{gd}	gate-drain (Miller) charge		–	21	–	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; Figure 13	–	2320	3100	pF
C_{oss}	output capacitance		–	315	378	pF
C_{rss}	reverse transfer capacitance		–	187	256	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = 30 V; R_D = 1.2 Ω; V_{GS} = 10 V; R_G = 10 Ω	–	15	23	ns
t_r	rise time		–	70	105	ns
$t_{d(off)}$	turn-off delay time		–	83	116	ns
t_f	fall time		–	45	63	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	I_S = 25 A; V_{GS} = 0 V; Figure 14	–	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 47 A; dI_S/dt = –100 A/µs; V_{GS} = -10 V; V_R = 30 V	–	66	–	ns
Q_r	recovered charge		–	0.24	–	µC

© Philips Electronics N.V. 2001. All rights reserved.



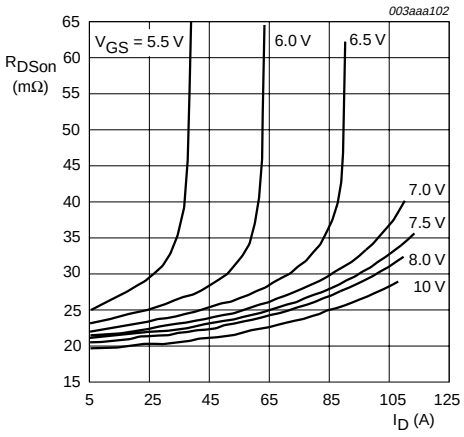
T_j = 25 °C

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



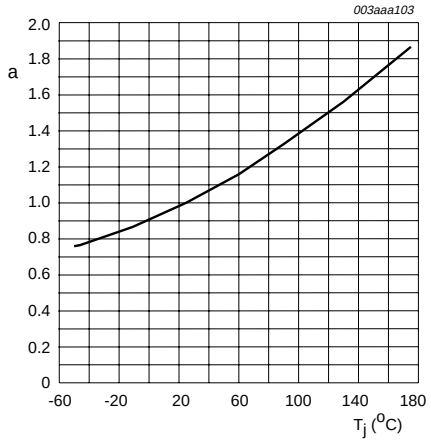
T_j = 25 °C and 175 °C; $V_{DS} > I_D \times R_{DSon}$

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values.



T_j = 25 °C

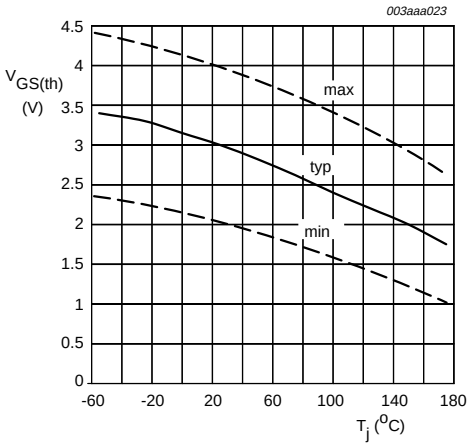
Fig 8. Drain-source on-state resistance as a function of drain current; typical values.



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

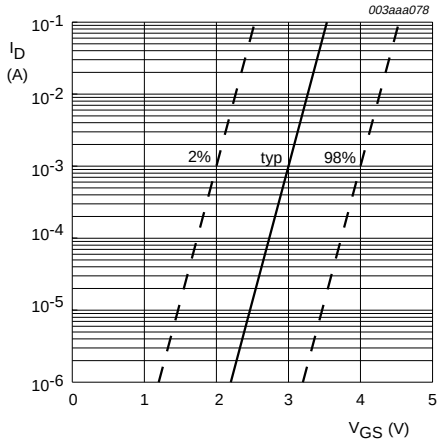
Fig 9. Normalized drain-source on-state resistance factor as a function of junction temperature.

© Philips Electronics N.V. 2001. All rights reserved.



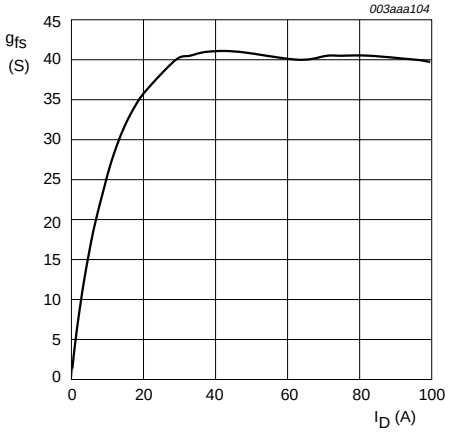
I_D = 1 mA; V_{DS} = V_{GS}

Fig 10. Gate-source threshold voltage as a function of junction temperature.



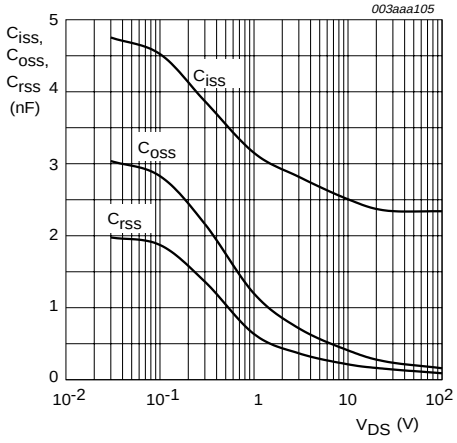
T_j = 25 °C

Fig 11. Sub-threshold drain current as a function of gate-source voltage.



T_j = 25 °C; V_{DS} = 25 V

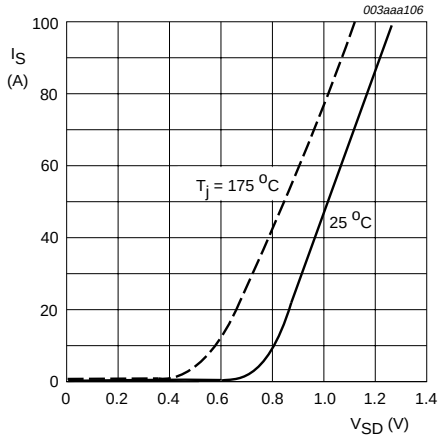
Fig 12. Forward transconductance as a function of drain current; typical values.



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

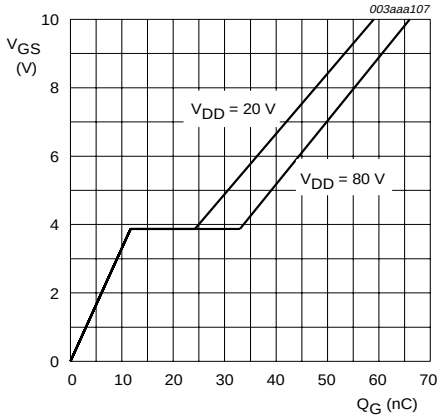
Fig 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.

© Philips Electronics N.V. 2001. All rights reserved.



T_j = 25 °C and 175 °C; V_{GS} = 0 V

Fig 14. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values.



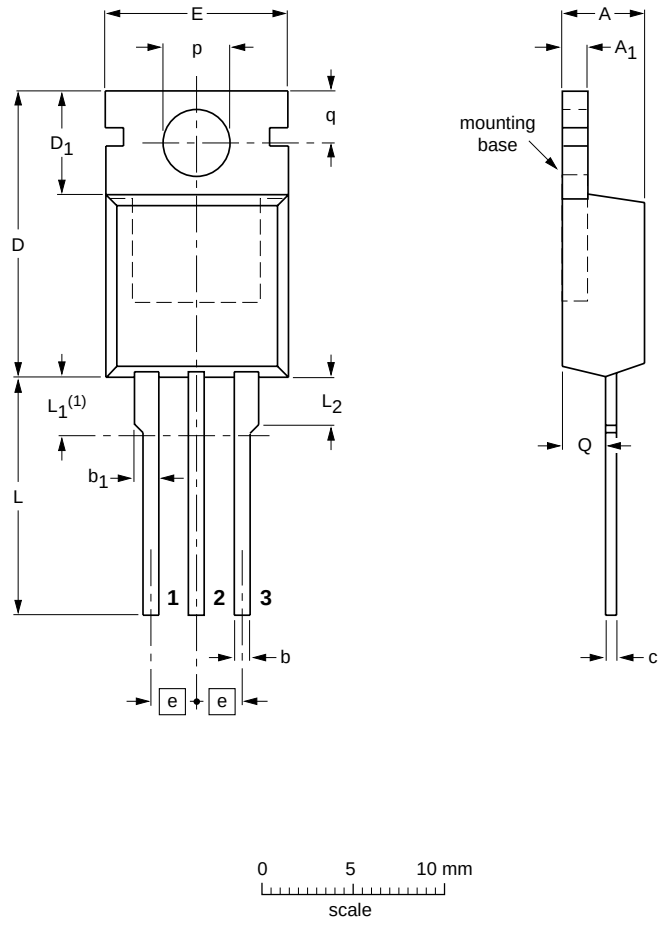
I_D = 40 A; V_{DD} = 20 V and 80 V

Fig 15. Gate-source voltage as a function of gate charge; typical values.

© Philips Electronics N.V. 2001. All rights reserved.

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_1	b	b_1	c	D	D_1	E	e	L	L_1(1)	L_2 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

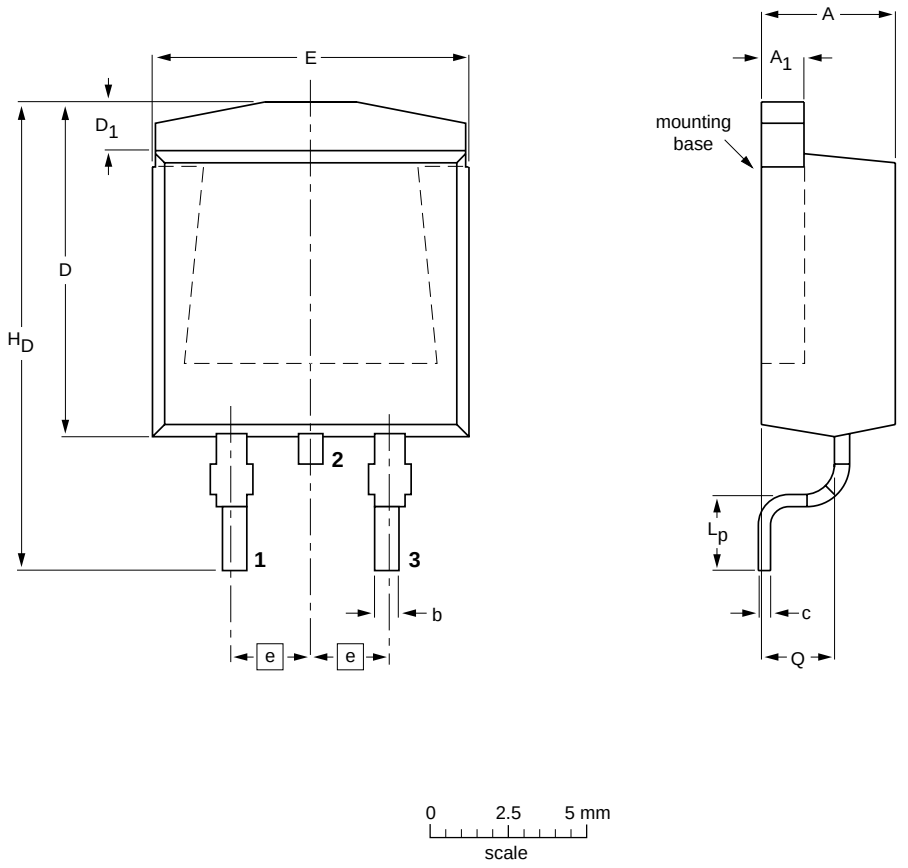
1. Terminals in this zone are not tinned.

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

Fig 16. SOT78 (TO-220AB)

© Philips Electronics N.V. 2001. All rights reserved.

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 17. SOT404 (D²-PAK).

© Philips Electronics N.V. 2001. All rights reserved.

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20010516	-	Product data. Initial version.

© Philips Electronics N.V. 2001. All rights reserved.

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.
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.

12. 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.

13. 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, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. 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.

© Philips Electronics N.V. 2001 All rights reserved.

Philips Semiconductors - a worldwide company

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
Brazil: see South America
Bulgaria: Tel. +359 268 9211, Fax. +359 268 9102
Canada: Tel. +1 800 234 7381
China/Hong Kong: Tel. +852 2 319 7888, Fax. +852 2 319 7700
Colombia: see South America
Czech Republic: see Austria
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
Germany: Tel. +49 40 23 5360, Fax. +49 402 353 6300
Hungary: Tel. +36 1 382 1700, Fax. +36 1 382 1800
India: Tel. +91 22 493 8541, Fax. +91 22 493 8722
Indonesia: see Singapore
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
Norway: Tel. +47 22 74 8000, Fax. +47 22 74 8341
Philippines: Tel. +63 28 16 6380, Fax. +63 28 17 3474
Poland: Tel. +48 22 5710 000, Fax. +48 22 5710 001
Portugal: see Spain
Romania: see Italy
Russia: Tel. +7 095 755 6918, Fax. +7 095 755 6919
Singapore: Tel. +65 350 2538, Fax. +65 251 6500
Slovakia: see Austria
Slovenia: see Italy
South Africa: Tel. +27 11 471 5401, Fax. +27 11 471 5398
South America: Tel. +55 11 821 2333, Fax. +55 11 829 1849
Spain: Tel. +34 33 01 6312, Fax. +34 33 01 4107
Sweden: Tel. +46 86 32 2000, Fax. +46 86 32 2745
Switzerland: Tel. +41 14 88 2686, Fax. +41 14 81 7730
Taiwan: Tel. +886 22 134 2451, Fax. +886 22 134 2874
Thailand: Tel. +66 23 61 7910, Fax. +66 23 98 3447
Turkey: Tel. +90 216 522 1500, Fax. +90 216 522 1813
Ukraine: Tel. +380 44 264 2776, Fax. +380 44 268 0461
United Kingdom: Tel. +44 208 730 5000, Fax. +44 208 754 8421
United States: Tel. +1 800 234 7381
Uruguay: see South America
Vietnam: see Singapore
Yugoslavia: Tel. +381 11 3341 299, Fax. +381 11 3342 553

Internet: http://www.semiconductors.philips.com

(SCA72)

© Philips Electronics N.V. 2001. All rights reserved.

Contents

1	**Description**	1
2	**Features**	1
3	**Applications**	1
4	**Pinning information**	1
5	**Quick reference data**	2
6	**Limiting values**	2
7	**Thermal characteristics**	4
7.1	Transient thermal impedance	4
8	**Characteristics**	5
9	**Package outline**	9
10	**Revision history**	11
11	**Data sheet status**	12
12	**Definitions**	12
13	**Disclaimers**	12

© Philips Electronics N.V. 2001. **Printed in The Netherlands**

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Date of release: 16 May 2001 **Document order number: 9397 750 08243**

PHILIPS

Let's make things better.