PHP210N03LT; PHB210N03LT

N-channel enhancement mode field-effect transistor

Rev. 01 — 13 September 2001 **Product data**

1. Description

N-channel logic level3 field-effect power transistor in a plastic package using TrenchMOS™[1] technology.

Product availability:

PHP210N03LT in SOT78 (TO-220AB)

PHB210N03LT in SOT404 (D^2-PAK)

2. Features

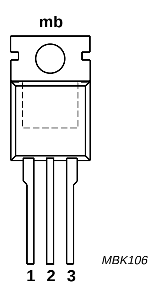
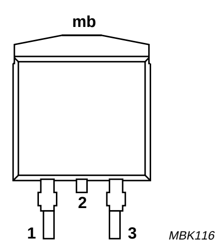
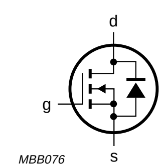
- Low on-state resistance
- Fast switching.

3. Applications

- High frequency computer motherboard DC to DC converters
- OR-ing applications.

4. Pinning information

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

Pin	Description	Simplified outline		Symbol
1	gate (g)	 SOT78 (TO-220AB)	 SOT404 (D^2-PAK)	
2	drain (d) [1]			
3	source (s)			
mb	drain (d)			

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

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

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5. Quick reference data

Table 2: Quick reference data

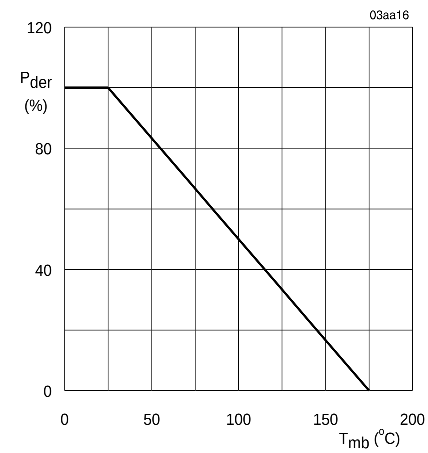
Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)	T_j = 25 to 175 °C	–	30	V
I_D	drain current (DC)	T_{mb} = 25 °C; V_{GS} = 5 V	–	75	A
P_{tot}	total power dissipation	T_{mb} = 25 °C	–	230	W
T_j	junction temperature		–	175	°C
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C	2.3	2.7	mΩ
		V_{GS} = 5 V; I_D = 25 A; T_j = 25 °C	3.0	3.5	mΩ

6. Limiting values

Table 3: Limiting values

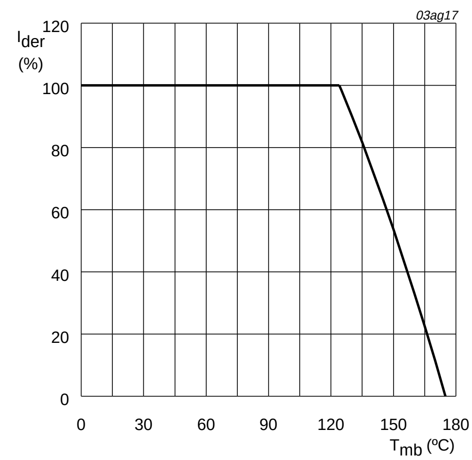
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	T_j = 25 to 175 °C	–	30	V
V_{DGR}	drain-gate voltage (DC)	T_j = 25 to 175 °C; R_{GS} = 20 kΩ	–	30	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	–	75	A
		T_{mb} = 100 °C; V_{GS} = 5 V; Figure 2	–	75	A
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; $t_p \leq$ 10 µs; Figure 3	–	400	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Figure 1	–	230	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	–	400	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	–	500	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	–	75	A



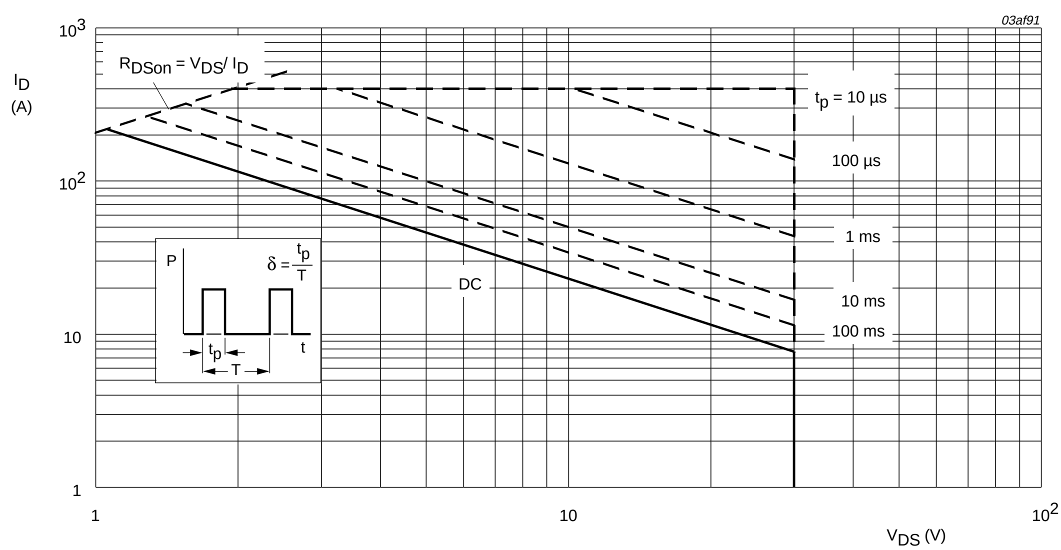
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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.

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	0.65	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 package	50	K/W

7.1 Transient thermal impedance

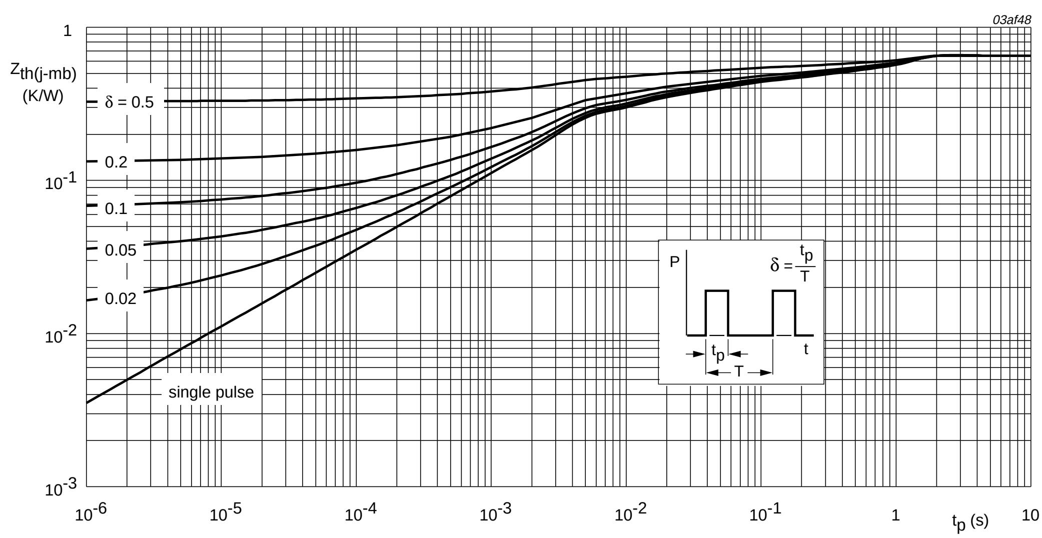


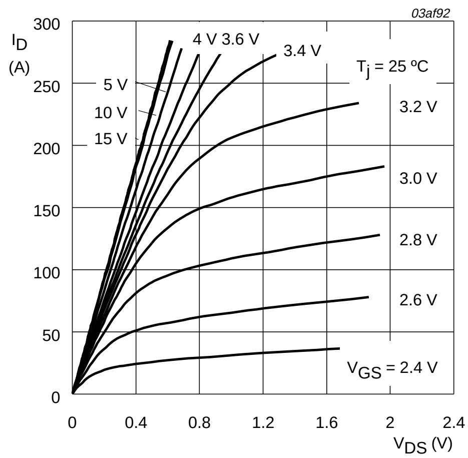
Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

8. Characteristics

Table 5: Characteristics

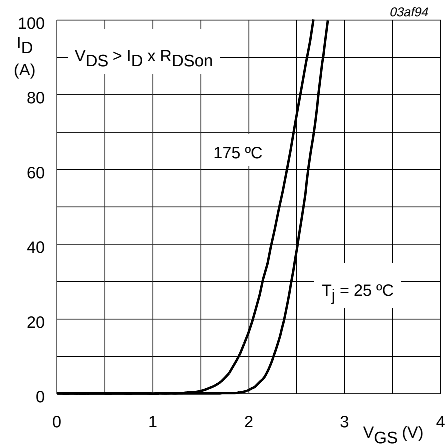
T_j = 25 °C unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 0.25 mA; V_{GS} = 0 V				
		T_j = 25 °C	30	–	–	V
		T_j = –55 °C	27	–	–	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; Figure 9				
		T_j = 25 °C	1	1.5	2	V
		T_j = 175 °C	0.4	–	–	V
		T_j = –55 °C	–	–	2.3	V
I_{DSS}	drain-source leakage current	V_{DS} = 30 V; V_{GS} = 0 V				
		T_j = 25 °C	–	0.02	1	µA
		T_j = 175 °C	–	–	500	µA
I_{GSS}	gate-source leakage current	V_{GS} = ±15 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	–	3.0	3.5	mΩ
		T_j = 175 °C	–	5.4	6.3	mΩ
		V_{GS} = 10 V; I_D = 25 A; Figure 7 and 8				
		T_j = 25 °C	–	2.3	2.7	mΩ
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	I_D = 75 A; V_{DD} = 15 V; V_{GS} = 5 V; Figure 13	–	140	–	nC
Q_{gs}	gate-source charge		–	32	–	nC
Q_{gd}	gate-drain (Miller) charge		–	54	–	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; Figure 11	–	11000	–	pF
C_{oss}	output capacitance		–	1770	–	pF
C_{rss}	reverse transfer capacitance		–	1210	–	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = 15 V; I_D = 12 A; V_{GS} = 5 V; R_G = 6 Ω; resistive load	–	60	–	ns
t_r	turn-on rise time		–	166	–	ns
$t_{d(off)}$	turn-off delay time		–	325	–	ns
t_f	turn-off fall time		–	220	–	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	I_S = 25 A; V_{GS} = 0 V; Figure 12	–	0.8	1.2	V



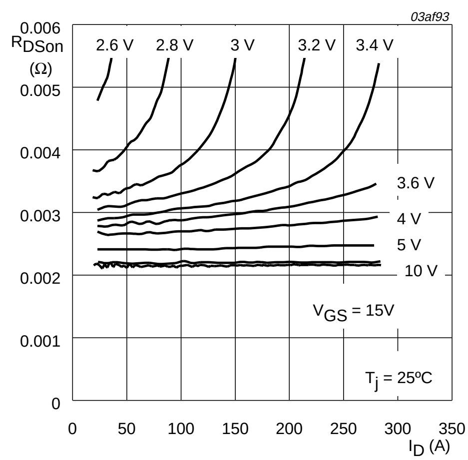
T_j = 25 °C

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



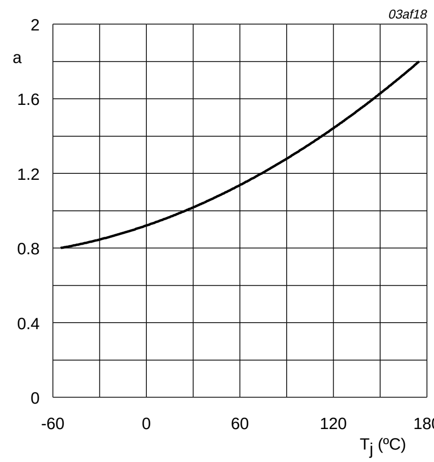
T_j = 25 °C and 175 °C; $V_{DS} > I_D \times R_{DSon}$

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



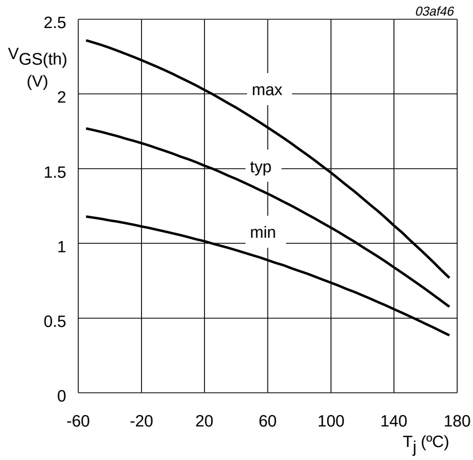
T_j = 25 °C

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



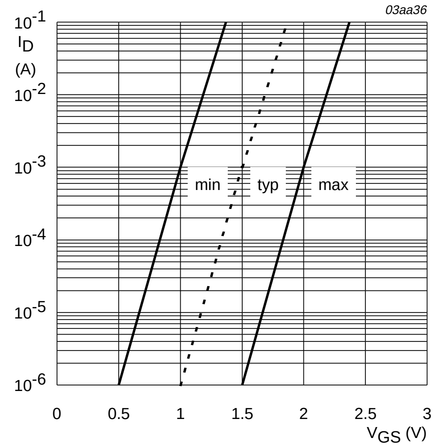
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



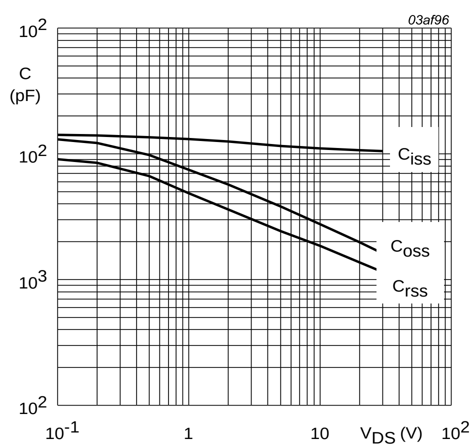
I_D = 1 mA; V_{DS} = V_{GS}

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



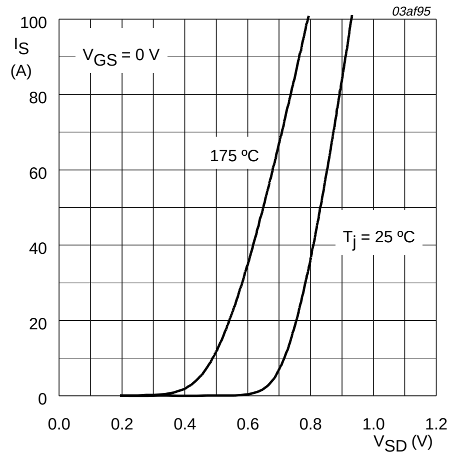
T_j = 25 °C; V_{DS} = 5 V

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



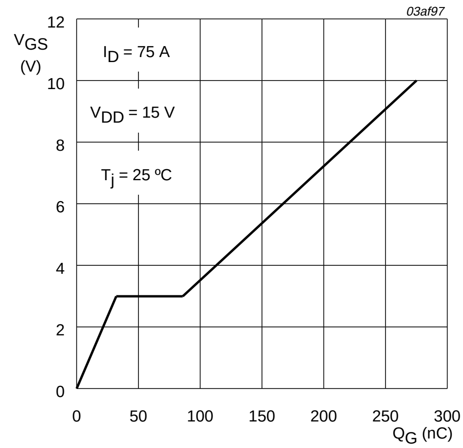
V_{GS} = 0 V; f = 1 MHz

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.

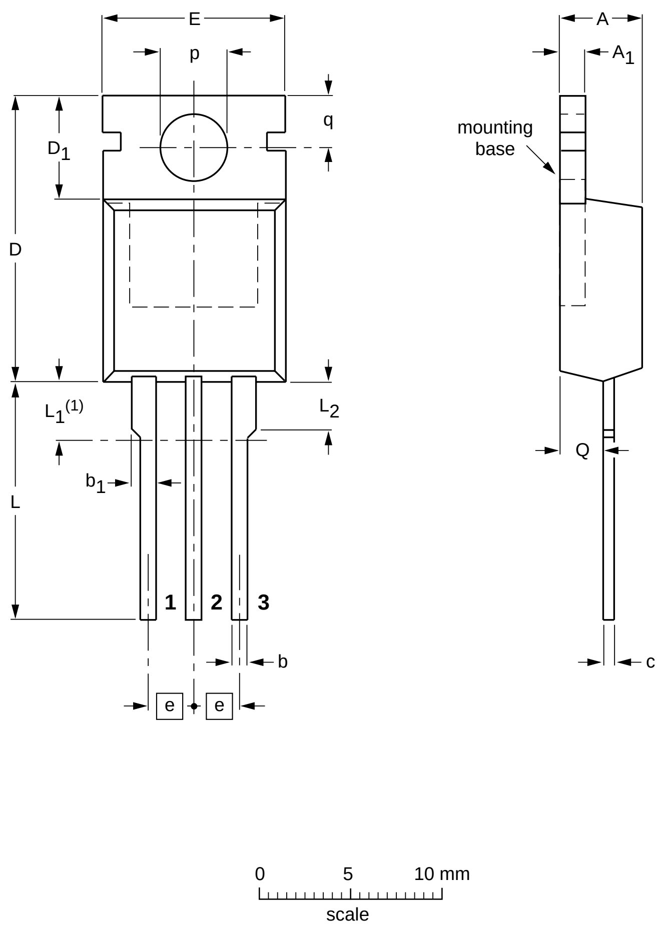


I_D = 75 A; V_{DD} = 15 V

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**



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

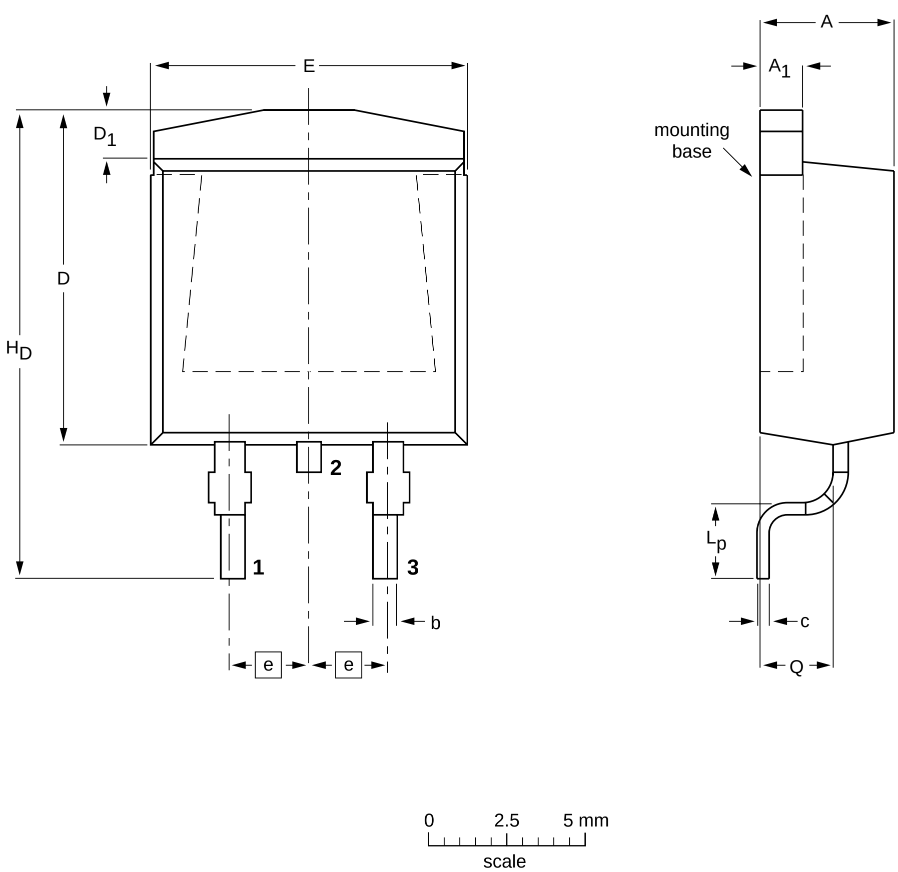
Note

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 14. SOT78 (TO-220AB).

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 15. SOT404 (D²-PAK)

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20010913		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.
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.

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