

PHP52N06T

N-channel enhancement mode field-effect transistor

Rev. 01 — 9 January 2002

Product data

1. Description

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

Product availability:

PHP52N06T in SOT78 (TO-220AB).

2. Features

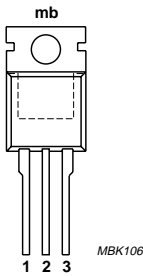
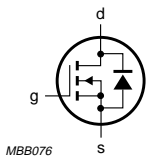
- Low on-state resistance
- 175 °C rated.

3. Applications

- DC to DC converters
- Uninterruptible power supplies
- Switched mode power supplies.

4. Pinning information

Table 1: Pinning - SOT78, simplified outline and symbol

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

SOT78 (TO-220AB)

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

5. Quick reference data

Table 2: Quick reference data

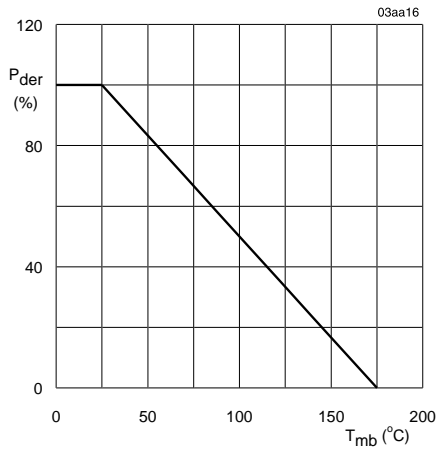
Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)		-	60	V
I_D	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V}$	-	52	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$	-	118	W
T_j	junction temperature		-	175	°C
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}$			
		$T_j = 25\text{ °C}$	17	22	mΩ
		$T_j = 175\text{ °C}$	-	44	mΩ

6. Limiting values

Table 3: Limiting values

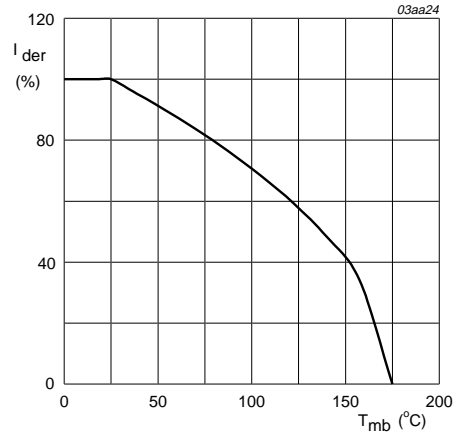
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)		-	60	V
V_{DGR}	drain-gate voltage (DC)	$R_{GS} = 20\text{ k}\Omega$	-	60	V
V_{GS}	gate-source voltage (DC)		-	± 20	V
I_D	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ Figure 2 and 3	-	52	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 10\text{ V};$ Figure 2	-	37	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s};$ Figure 3	-	208	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ Figure 1	-	120	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)	$T_{mb} = 25\text{ °C}$	-	52	A
I_{SM}	peak source (diode forward) current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	208	A
Avalanche ruggedness					
$E_{DS(AL)}$	non-repetitive avalanche energy	unclamped inductive load; $I_D = 48\text{ A};$ $V_{DS} \leq 55\text{ V}; V_{GS} = 10\text{ V}; R_{GS} = 50\text{ }\Omega;$ starting $T_{mb} = 25\text{ °C}$	-	115	mJ



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

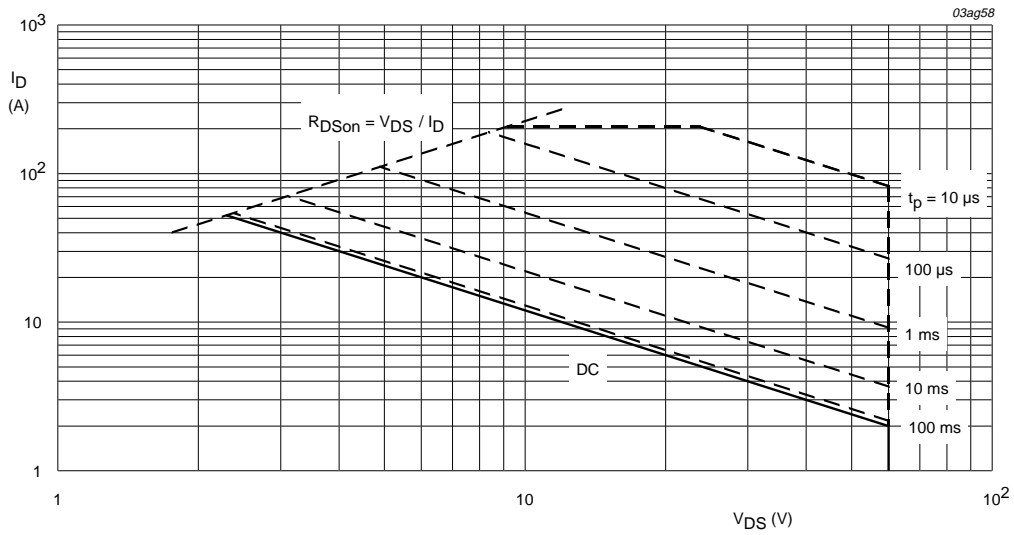
Fig 1. Normalized total power dissipation as a function of mounting base temperature.



V_{GS} ≥ 4.5 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} 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	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	1.25	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	60	-	K/W

7.1 Transient thermal impedance

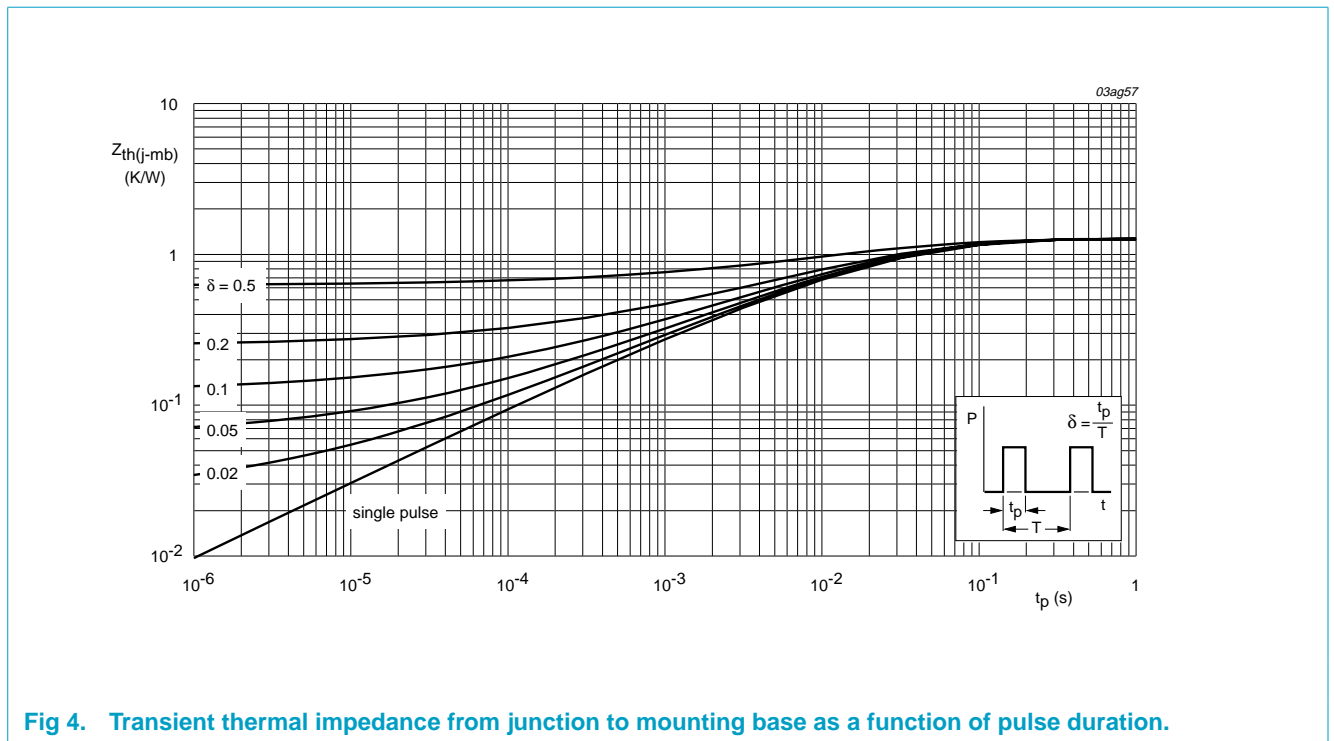
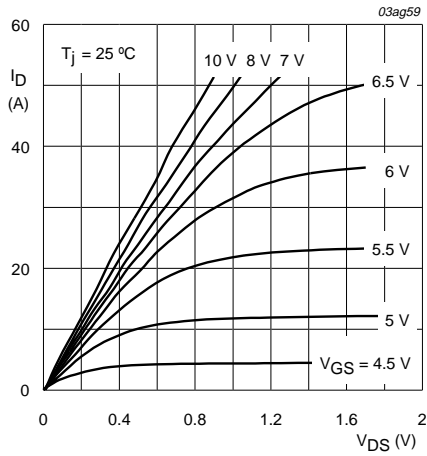


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

8. Characteristics

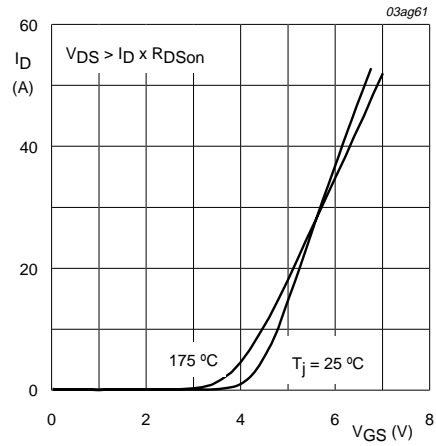
Table 5: Characteristics
 $T_j = 25\text{ °C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}$; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ °C}$	60	-	-	V
		$T_j = -55\text{ °C}$	55	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; Figure 9 $T_j = 25\text{ °C}$	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	$V_{DS} = 55\text{ V}$; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ °C}$	-	0.05	10	μA
		$T_j = 175\text{ °C}$	-	-	500	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\text{ V}$; $V_{DS} = 0\text{ V}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; Figure 7 and 8 $T_j = 25\text{ °C}$	-	17	22	m Ω
		$T_j = 175\text{ °C}$	-	-	44	m Ω
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$V_{DD} = 44\text{ V}$; $I_D = 40\text{ A}$; $V_{GS} = 10\text{ V}$; Figure 13	-	36	-	nC
Q_{gs}	gate-source charge		-	8.4	-	nC
Q_{gd}	gate-drain (Miller) charge		-	11.5	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; Figure 11	-	1200	1592	pF
C_{oss}	output capacitance		-	290	356	pF
C_{rss}	reverse transfer capacitance		-	179	240	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 30\text{ V}$; $R_L = 1.2\ \Omega$;	-	15	-	ns
t_r	rise time	$V_{GS} = 10\text{ V}$; $R_G = 10\ \Omega$;	-	74	-	ns
$t_{d(off)}$	turn-off delay time		-	70	-	ns
t_f	fall time		-	40	-	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 20\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 12	-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$	-	45	-	ns
Q_r	recovered charge	$V_{GS} = -10\text{ V}$; $V_{DS} = 30\text{ V}$	-	110	-	nC



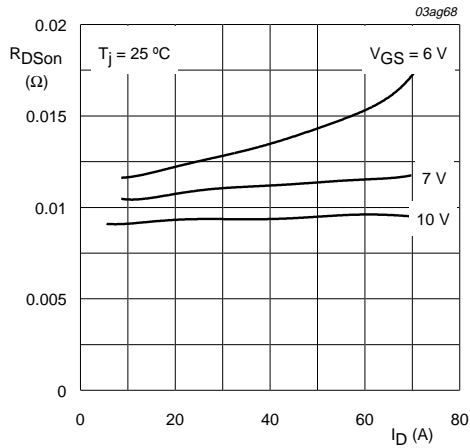
$T_j = 25\text{ }^\circ\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



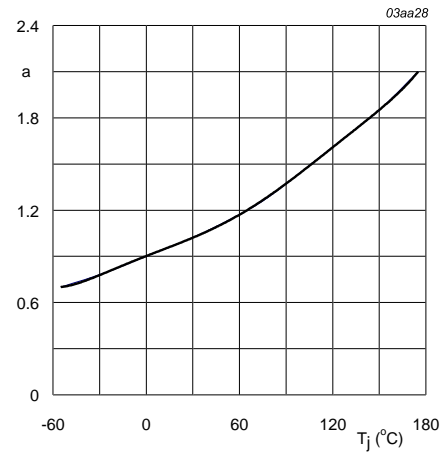
$T_j = 25\text{ }^\circ\text{C}$ and $175\text{ }^\circ\text{C}$; $V_{DS} > I_D \times R_{DSon}$

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



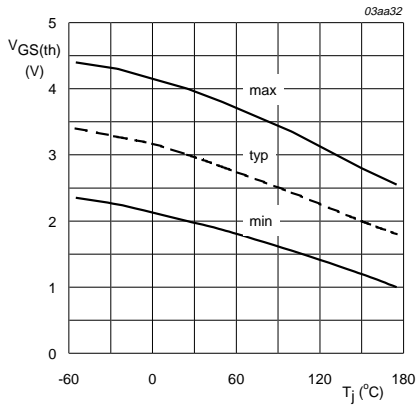
$T_j = 25\text{ }^\circ\text{C}$

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



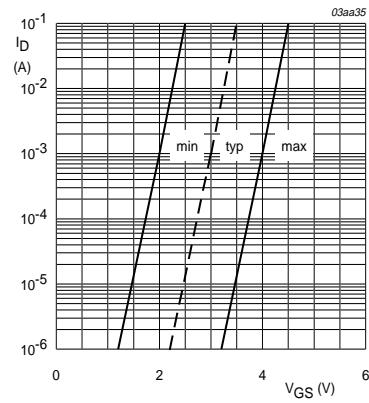
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



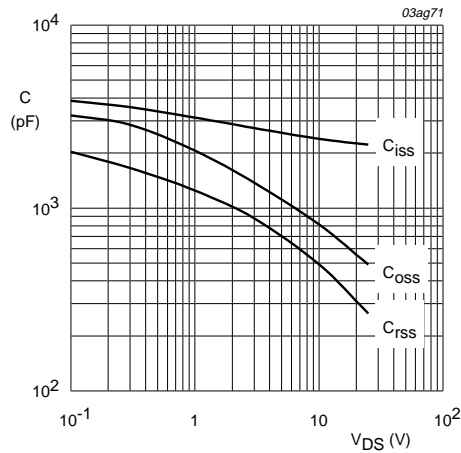
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



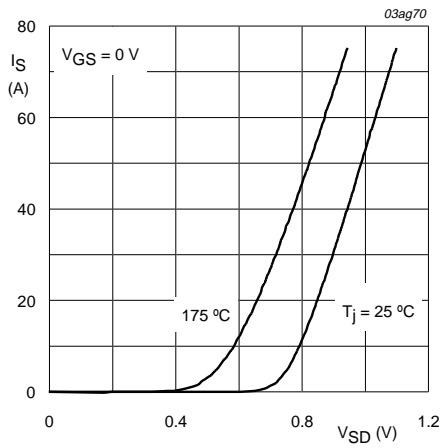
$T_j = 25 \text{ }^{\circ}C; V_{DS} = V_{GS}$

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



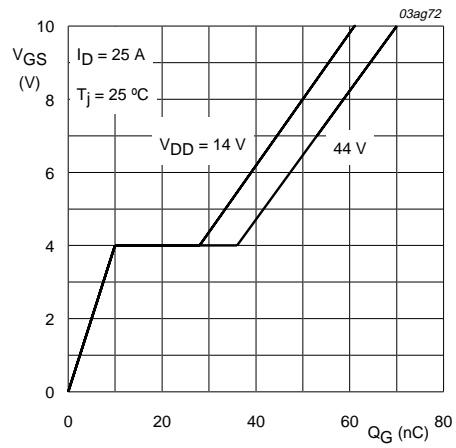
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



$V_{GS} = 0\text{ V}$

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



$T_j = 25\text{ }^\circ\text{C}; I_D = 40\text{ A}$

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

9. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78

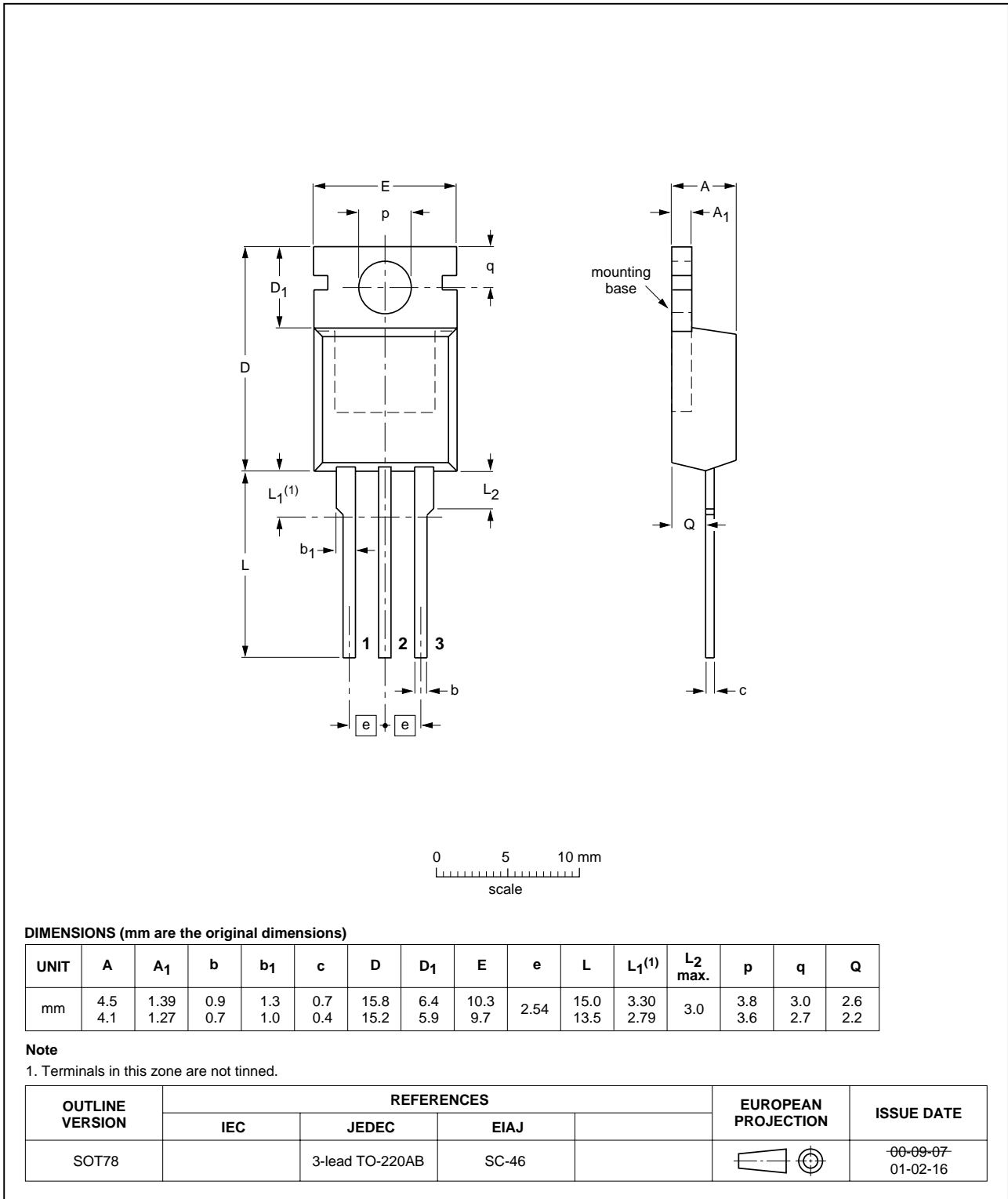


Fig 14. SOT78 (TO-220AB).

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20020109	-	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.
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