

# PHP45NQ11T

N-channel TrenchMOS™ standard level FET

Rev. 01 — 31 March 2004

Product data

## 1. Product profile

### 1.1 Description

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

### 1.2 Features

- Fast switching
- Low on-state resistance.

### 1.3 Applications

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

### 1.4 Quick reference data

- $V_{DS} \leq 105 \text{ V}$
- $I_D \leq 47 \text{ A}$
- $P_{tot} \leq 150 \text{ W}$
- $R_{DSon} \leq 25 \text{ m}\Omega$ .

## 2. Pinning information

Table 1: Pinning - SOT78 (TO-220AB), 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)**



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### 3. Ordering information

Table 2: Ordering information

Type number	Package		Version
	Name	Description	
PHP45NQ11T	TO-220AB	Plastic single-ended package; heatsink mounted; 1 mounting hole; 3 leads	SOT78

### 4. Limiting values

Table 3: Limiting values

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

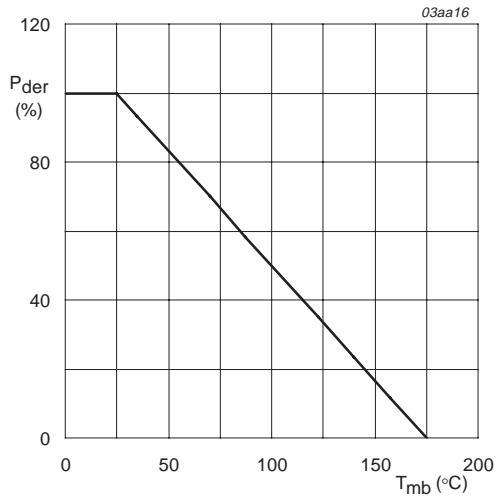
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	105	V
$V_{DGR}$	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	105	V
$V_{GS}$	gate-source voltage (DC)		-	$\pm 20$	V
$I_D$	drain current (DC)	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <b>Figure 2 and 3</b>	-	47	A
		$T_{mb} = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <b>Figure 2</b>	-	33	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <b>Figure 3</b>	-	188	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <b>Figure 1</b>	-	150	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)	$T_{mb} = 25\text{ °C}$	-	47	A
$I_{SM}$	peak source (diode forward) current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	188	A

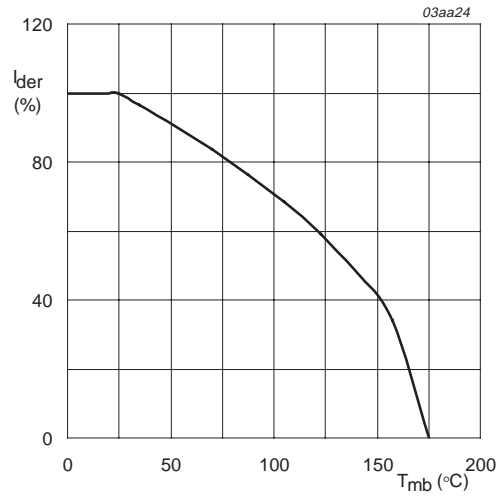
#### Avalanche ruggedness

$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_{AS} = 18\text{ A}$ ; $t_p = 120\text{ }\mu\text{s}$ ; $V_{DD} \leq 100\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; starting at $T_j = 25\text{ °C}$	-	160	mJ
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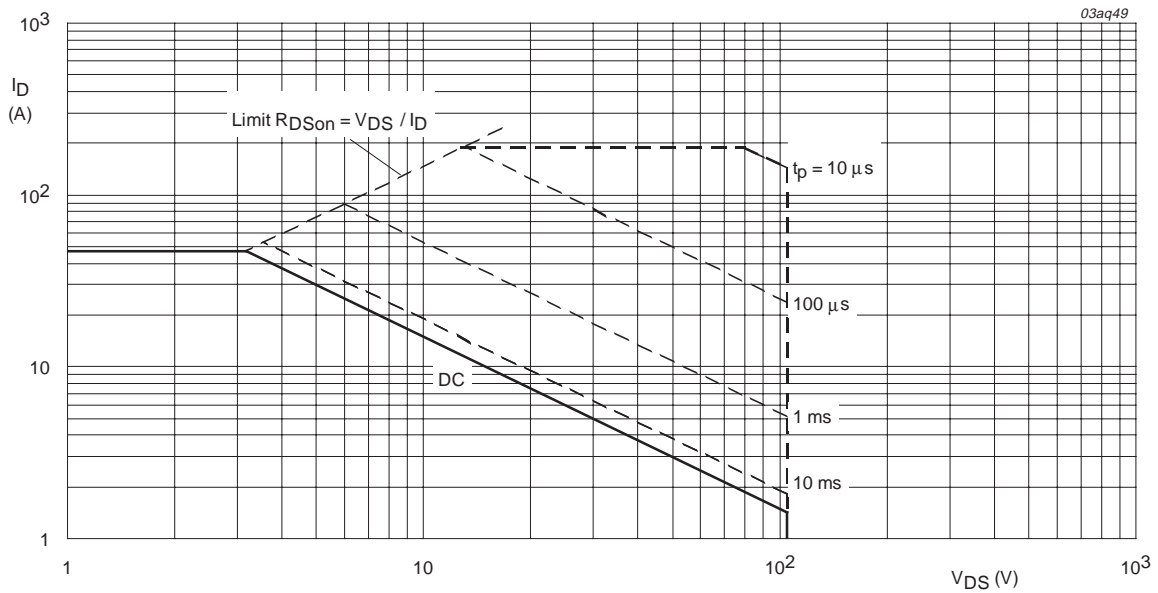
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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<sub>mb</sub> = 25 °C; I<sub>DM</sub> is single pulse

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

5. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	1	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	60	-	K/W

5.1 Transient thermal impedance

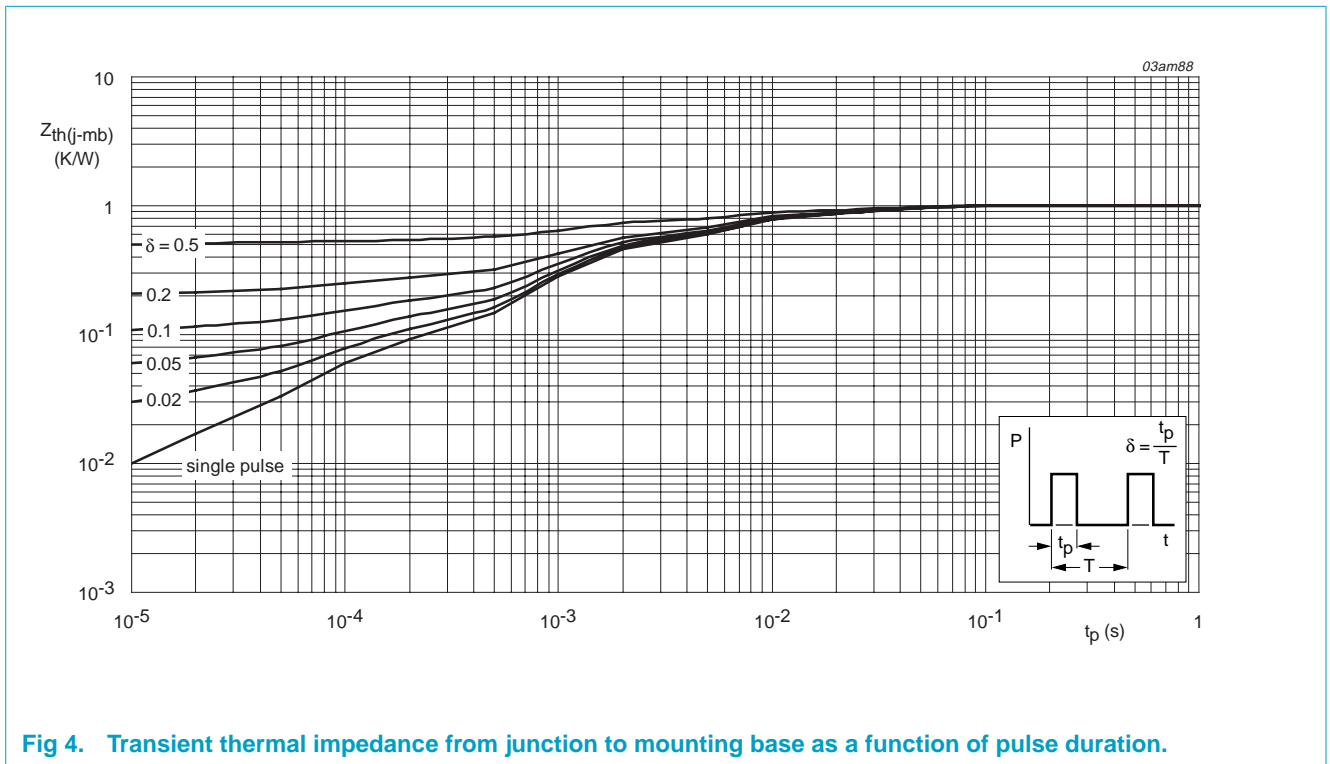


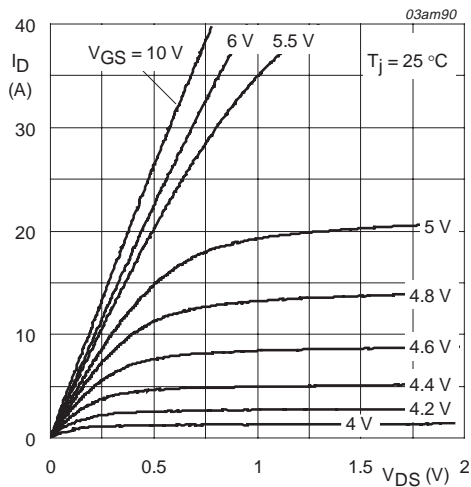
Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

## 6. Characteristics

**Table 5: Characteristics**

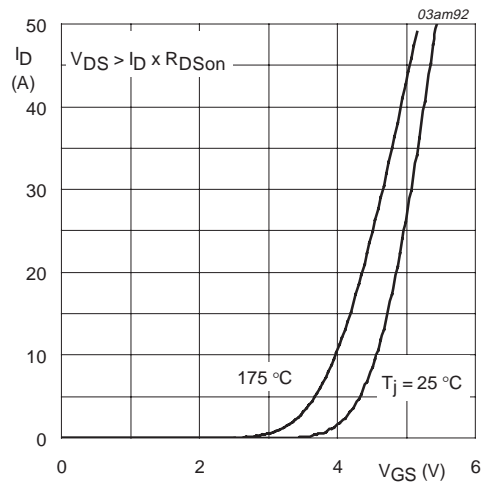
$T_j = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$ ; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	105	-	-	V
		$T_j = -55\text{ °C}$	95	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$ ; $V_{DS} = V_{GS}$ ; <b>Figure 9</b>				
		$T_j = 25\text{ °C}$	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	$V_{DS} = 100\text{ V}$ ; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	-	10	$\mu\text{A}$
		$T_j = 175\text{ °C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	gate-source leakage current	$V_{GS} = \pm 10\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	0.02	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; <b>Figure 7 and 8</b>				
		$T_j = 25\text{ °C}$	-	19	25	m $\Omega$
		$T_j = 175\text{ °C}$	-	51.3	68	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{g(tot)}$	total gate charge	$I_D = 45\text{ A}$ ; $V_{DD} = 80\text{ V}$ ; $V_{GS} = 10\text{ V}$ ;	-	60	-	nC
$Q_{gs}$	gate-source charge	<b>Figure 13</b>	-	11.2	-	nC
$Q_{gd}$	gate-drain (Miller) charge		-	23.2	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 25\text{ V}$ ; $f = 1\text{ MHz}$ ;	-	2930	-	pF
$C_{oss}$	output capacitance	<b>Figure 11</b>	-	245	-	pF
$C_{rss}$	reverse transfer capacitance		-	160	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 50\text{ V}$ ; $R_D = 1.8\text{ }\Omega$ ;	-	11.5	-	ns
$t_r$	rise time	$V_{GS} = 10\text{ V}$ ; $R_G = 5.6\text{ }\Omega$	-	40	-	ns
$t_{d(off)}$	turn-off delay time		-	40	-	ns
$t_f$	fall time		-	45	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain (diode forward) voltage	$I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; <b>Figure 12</b>	-	0.87	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20\text{ A}$ ; $dI_S/dt = -100\text{ A}/\mu\text{s}$ ;	-	82	-	ns
$Q_r$	recovered charge	$V_{GS} = 0\text{ V}$ ; $V_R = 30\text{ V}$	-	117	-	nC



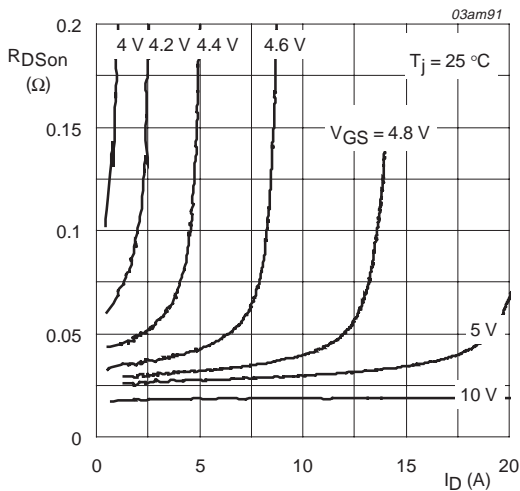
$T_j = 25\text{ }^\circ\text{C}$

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



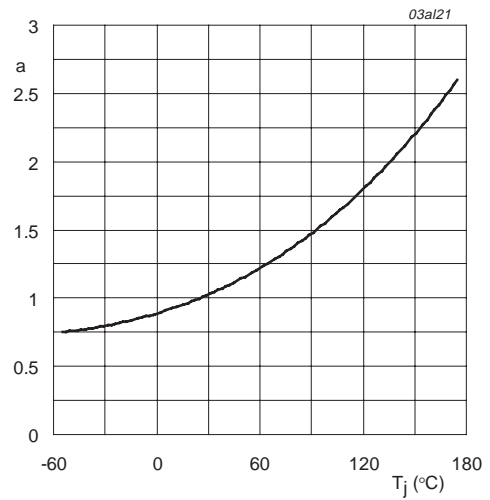
$T_j = 25\text{ }^\circ\text{C}$  and  $175\text{ }^\circ\text{C}$ ;  $V_{DS} > I_D \times R_{DSon}$

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



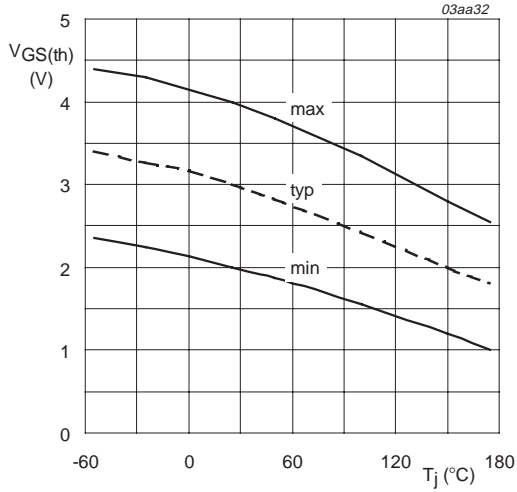
$T_j = 25\text{ }^\circ\text{C}$

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



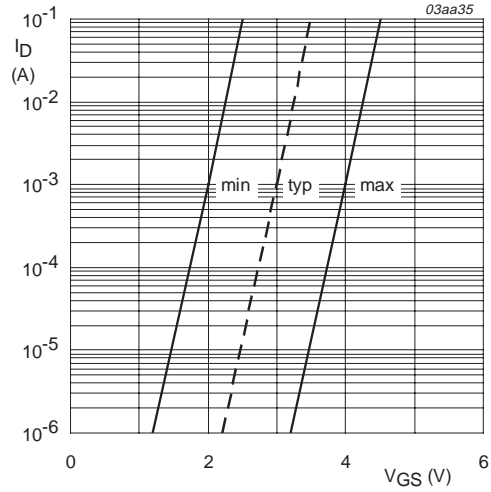
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



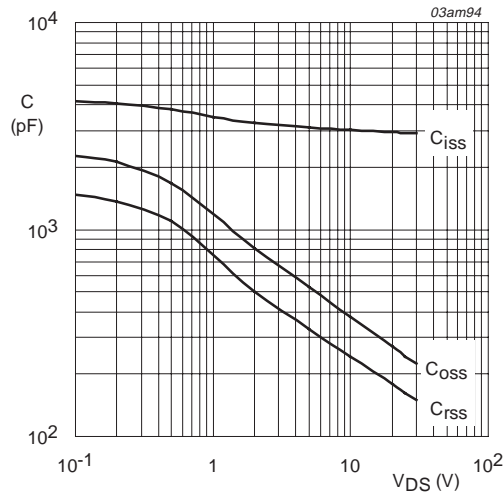
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



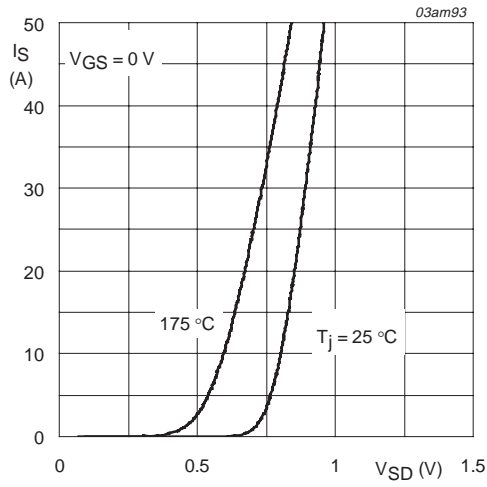
$T_j = 25 \text{ }^\circ\text{C}; V_{DS} = 5 \text{ V}$

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



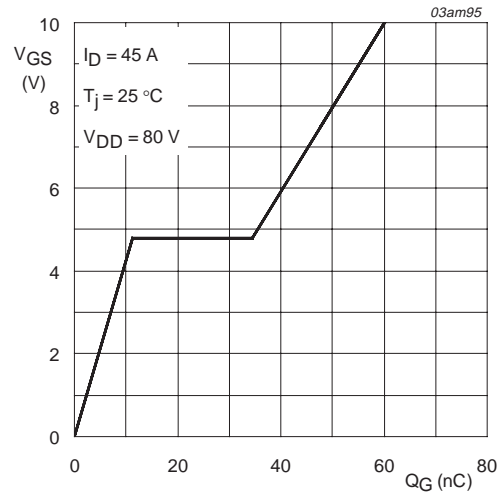
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



$T_j = 25^\circ\text{C}$  and  $175^\circ\text{C}$ ;  $V_{GS} = 0\text{ V}$

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



$I_D = 45\text{ A}$ ;  $V_{DD} = 80\text{ V}$

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



7. Package outline

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

SOT78

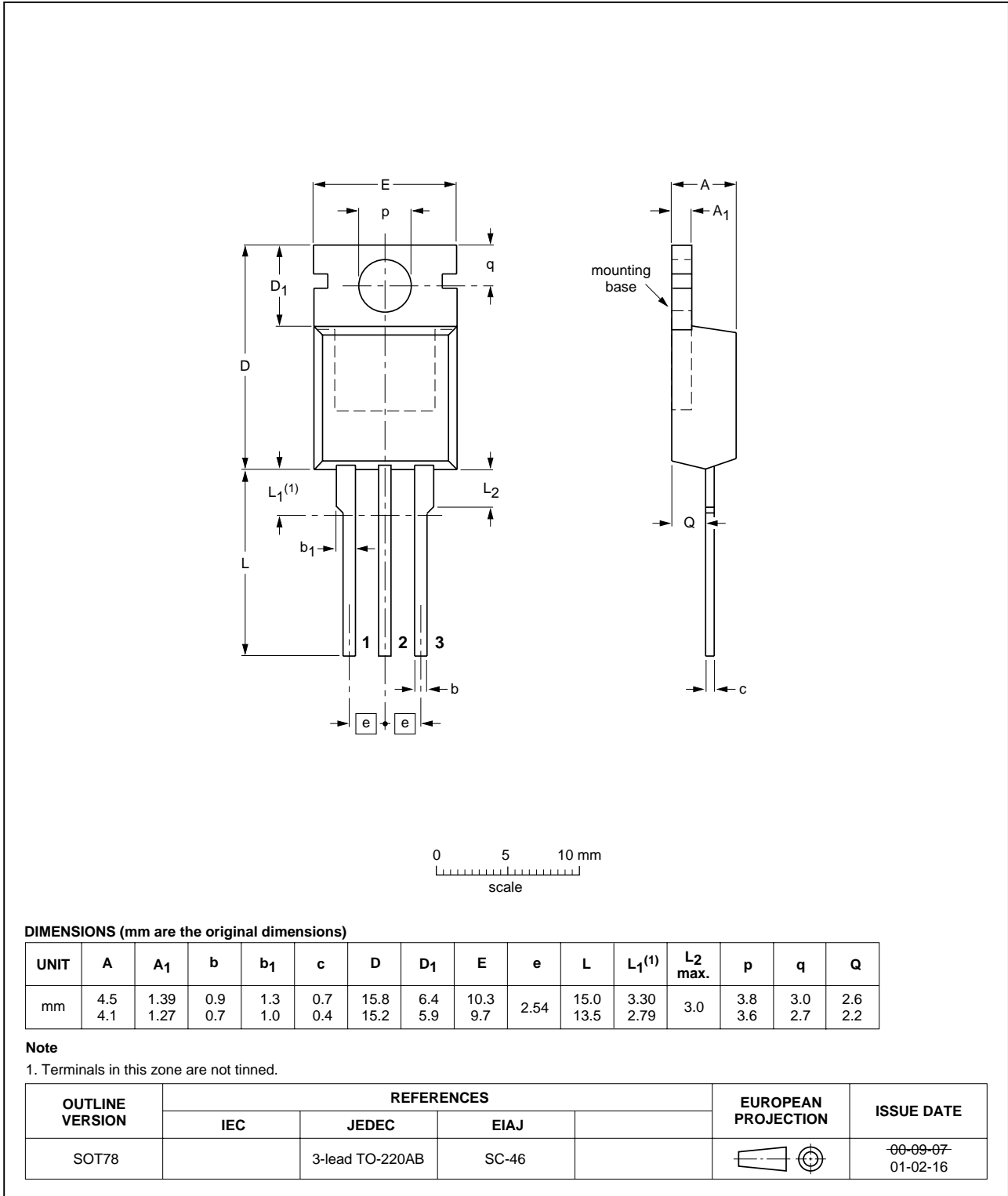


Fig 14. SOT78 (TO-220AB).

## 8. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20040331	-	Product data (9397 750 13059)

## 9. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2][3]</sup>	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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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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