

# DATA SHEET

**PHE13009**

Silicon Diffused Power Transistor

Product specification

March 1999



**Silicon Diffused Power Transistor**

**PHE13009**

**GENERAL DESCRIPTION**

The PHE13009 is a silicon npn power switching transistor in the TO220AB envelope intended for use in high frequency electronic lighting ballast applications, converters, inverters, switching regulators, motor control systems, etc.

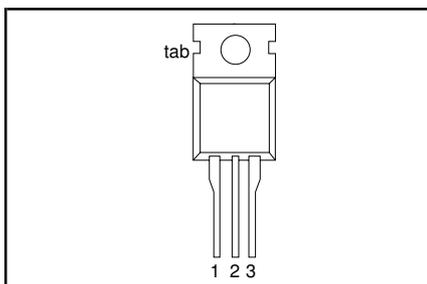
**QUICK REFERENCE DATA**

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$V_{CESM}$	Collector-emitter voltage peak value	$V_{BE} = 0\text{ V}$	-	700	V
$V_{CBO}$	Collector-Base voltage (open emitter)		-	700	V
$V_{CEO}$	Collector-emitter voltage (open base)		-	400	V
$I_C$	Collector current (DC)		-	12	A
$I_{CM}$	Collector current peak value		-	24	A
$P_{tot}$	Total power dissipation	$T_{mb} \leq 25\text{ °C}$	-	80	W
$V_{CEsat}$	Collector-emitter saturation voltage	$I_C = 5.0\text{ A}; I_B = 1.0\text{ A}$	0.32	1.0	V
$h_{FEsat}$		$I_C = 5.0\text{ A}; V_{CE} = 5\text{ V}$	-	40	
$t_f$	Fall time	$I_C = 5.0\text{ A}; I_{B1} = 1.0\text{ A}$	0.1	0.5	$\mu\text{s}$

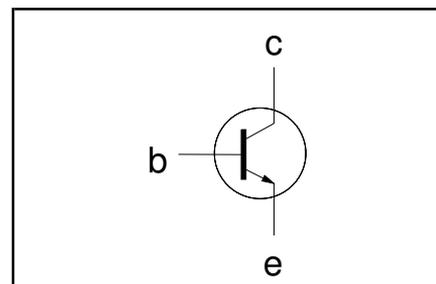
**PINNING - TO220AB**

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

**PIN CONFIGURATION**



**SYMBOL**



**LIMITING VALUES**

Limiting values in accordance with the Absolute Maximum Rating System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CESM}$	Collector to emitter voltage	$V_{BE} = 0\text{ V}$	-	700	V
$V_{CEO}$	Collector to emitter voltage (open base)		-	400	V
$V_{CBO}$	Collector to base voltage (open emitter)		-	700	V
$I_C$	Collector current (DC)		-	12	A
$I_{CM}$	Collector current peak value		-	24	A
$I_B$	Base current (DC)		-	6	A
$I_{BM}$	Base current peak value		-	12	A
$P_{tot}$	Total power dissipation	$T_{mb} \leq 25\text{ °C}$	-	80	W
$T_{stg}$	Storage temperature		-65	150	$^{\circ}\text{C}$
$T_j$	Junction temperature		-	150	$^{\circ}\text{C}$

**THERMAL RESISTANCES**

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-mb}$	Junction to mounting base		-	1.56	K/W
$R_{th\ ja}$	Junction to ambient	in free air	60	-	K/W

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**STATIC CHARACTERISTICS** $T_{mb} = 25\text{ °C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{CES}, I_{CBO}$ $I_{CES}$	Collector cut-off current <sup>1</sup>	$V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ $V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ $T_j = 125\text{ °C}$	-	-	1.0 5.0	mA mA
$I_{CEO}$ $I_{EBO}$ $V_{CEOsust}$	Collector cut-off current Emitter cut-off current Collector-emitter sustaining voltage	$V_{CEO} = V_{CEOMmax} (400V)$ $V_{EB} = 9\text{ V}; I_C = 0\text{ A}$ $I_B = 0\text{ A}; I_C = 10\text{ mA};$ $L = 25\text{ mH}$	-	-	0.1 1 -	mA mA V
$V_{CEsat}$	Collector-emitter saturation voltage	$I_C = 5.0\text{ A}; I_B = 1.0\text{ A}$ $I_C = 8.0\text{ A}; I_B = 1.6\text{ A}$	-	0.32 -	1.0 2.0	V V
$V_{BEsat}$	Base-emitter saturation voltage	$I_C = 5.0\text{ A}; I_B = 1.0\text{ A}$ $I_C = 8.0\text{ A}; I_B = 1.6\text{ A}$	-	1.0 1.1	1.3 1.6	V V
$h_{FE}$ $h_{FEsat}$	DC current gain	$I_C = 5.0\text{ A}; V_{CE} = 5\text{ V}$ $I_C = 8.0\text{ A}; V_{CE} = 5\text{ V}$	8 6	- -	40 30	

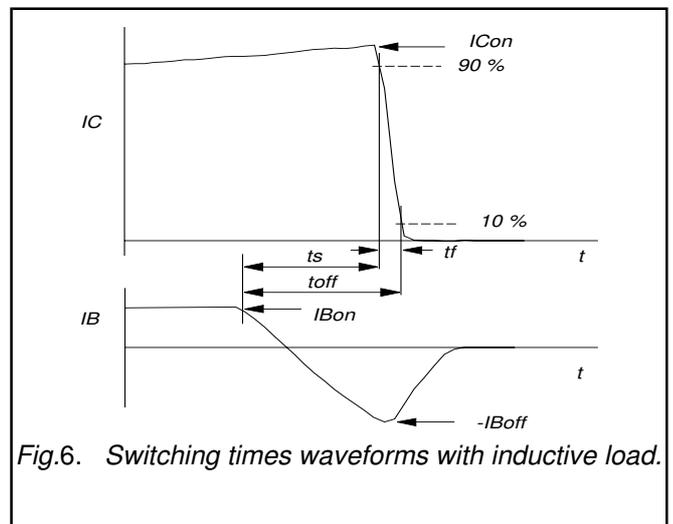
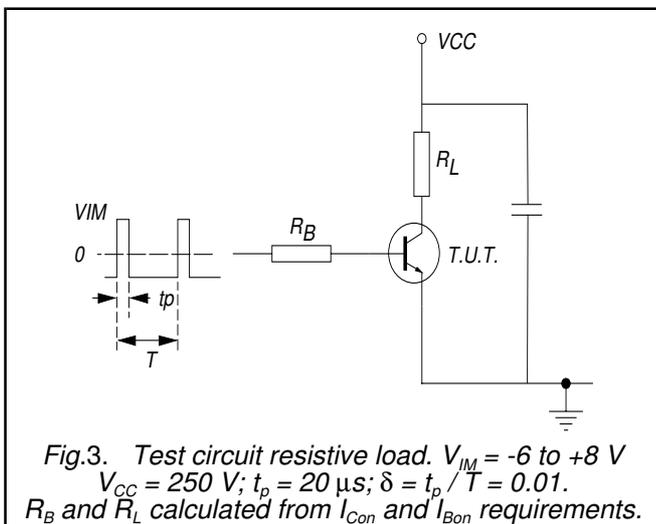
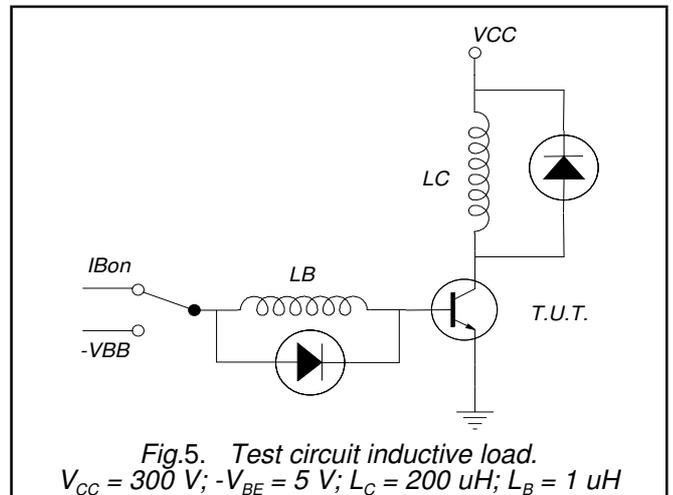
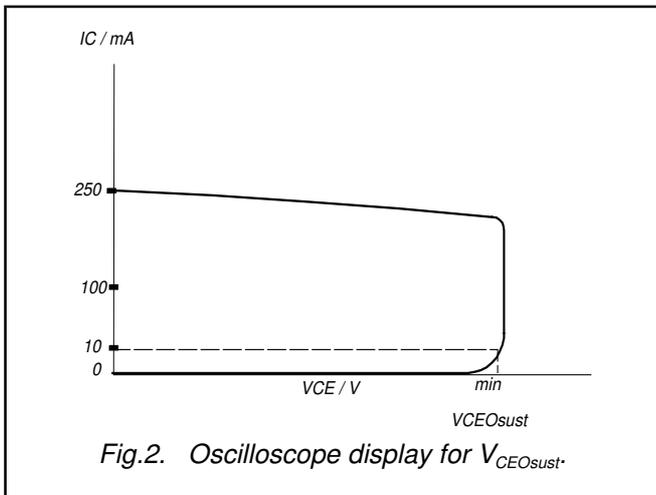
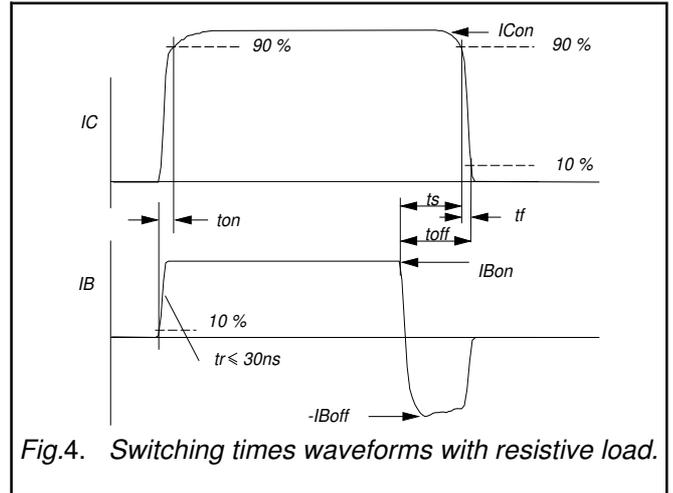
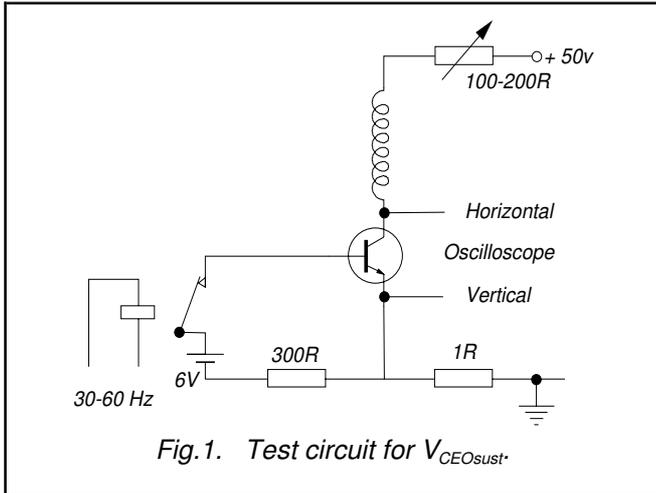
**DYNAMIC CHARACTERISTICS** $T_{mb} = 25\text{ °C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	$I_{Con} = 5\text{ A}; I_{Bon} = -I_{Boff} = 1\text{ A};$ $R_L = 75\text{ ohms}; V_{BB2} = 4\text{ V};$			
$t_s$ $t_f$	Turn-off storage time Turn-off fall time		2.2 0.26	3.3 0.7	$\mu\text{s}$ $\mu\text{s}$
	Switching times (inductive load)	$I_{Con} = 5\text{ A}; I_{Bon} = 1\text{ A}; L_B = 1\text{ }\mu\text{H};$ $-V_{BB} = 5\text{ V}$			
$t_s$ $t_f$	Turn-off storage time Turn-off fall time		1.35 0.1	2.3 0.5	$\mu\text{s}$ $\mu\text{s}$
	Switching times (inductive load)	$I_{Con} = 5\text{ A}; I_{Bon} = 1\text{ A}; L_B = 1\text{ }\mu\text{H};$ $-V_{BB} = 5\text{ V}; T_j = 100\text{ °C}$			
$t_s$ $t_f$	Turn-off storage time Turn-off fall time		- -	3.2 0.9	$\mu\text{s}$ $\mu\text{s}$

<sup>1</sup> Measured with half sine-wave voltage (curve tracer).

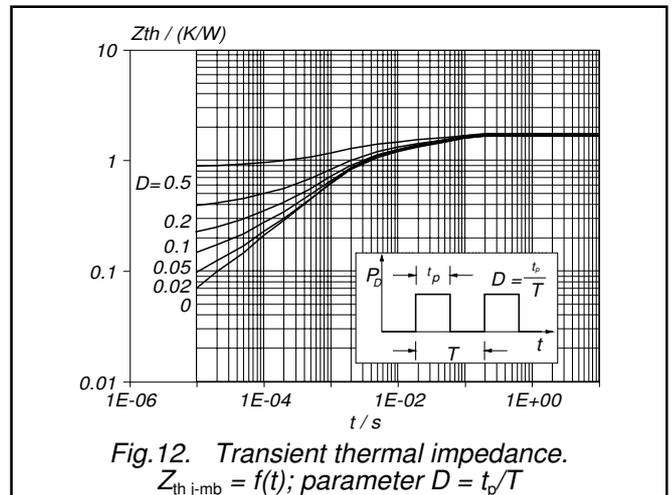
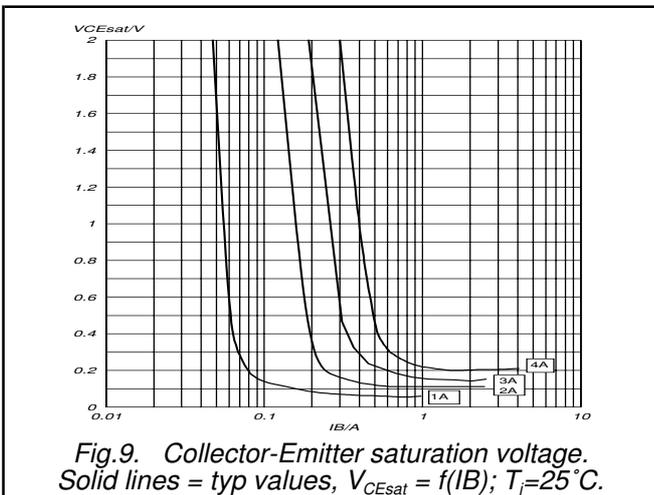
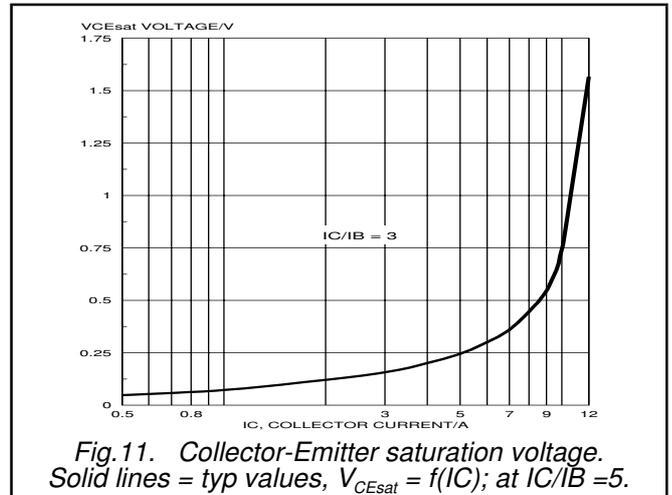
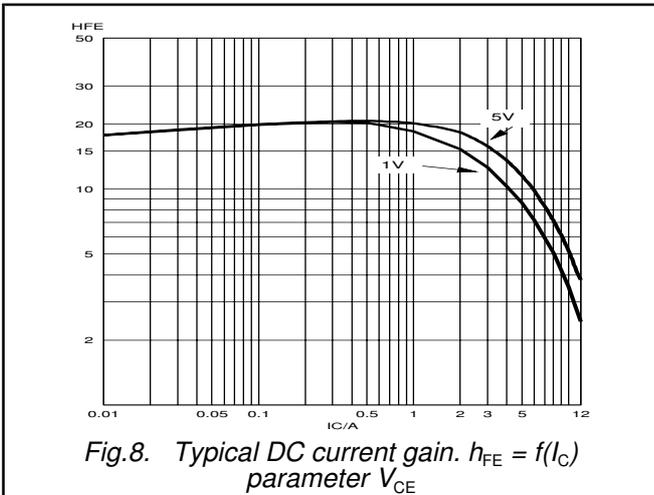
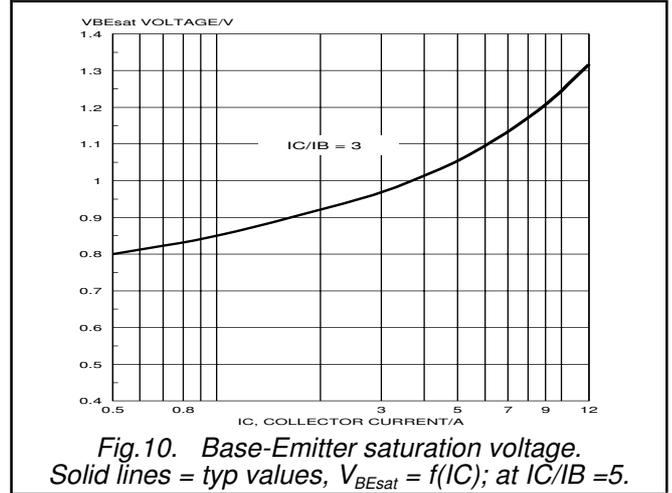
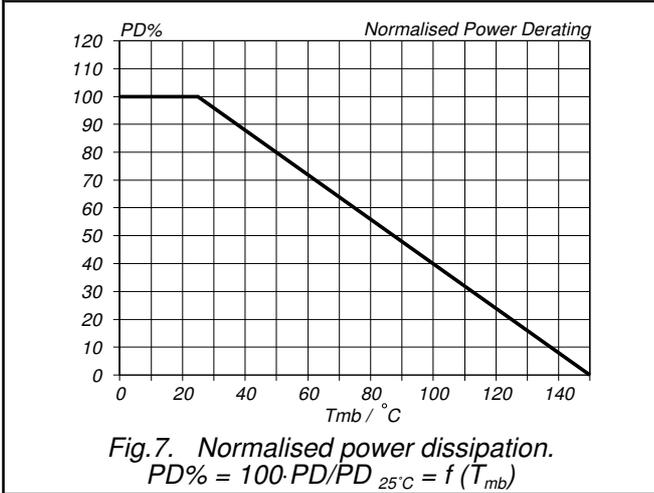
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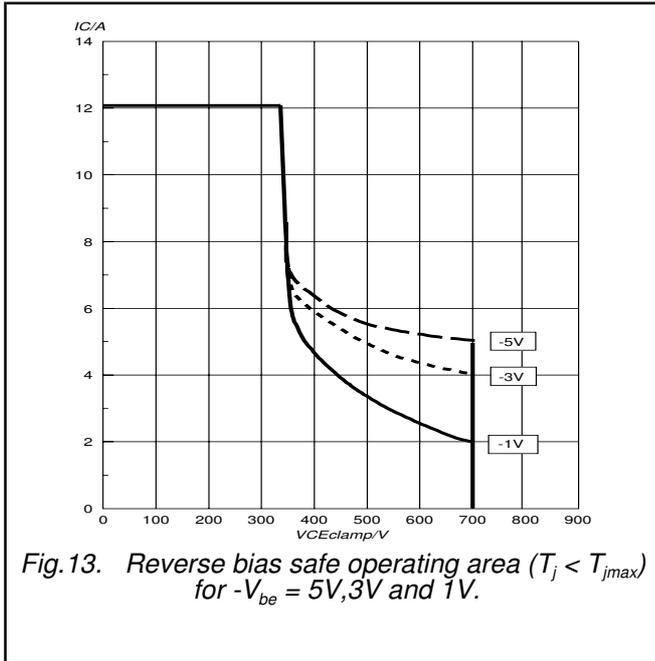


Fig.13. Reverse bias safe operating area ( $T_j < T_{jmax}$ ) for  $-V_{be} = 5V, 3V$  and  $1V$ .

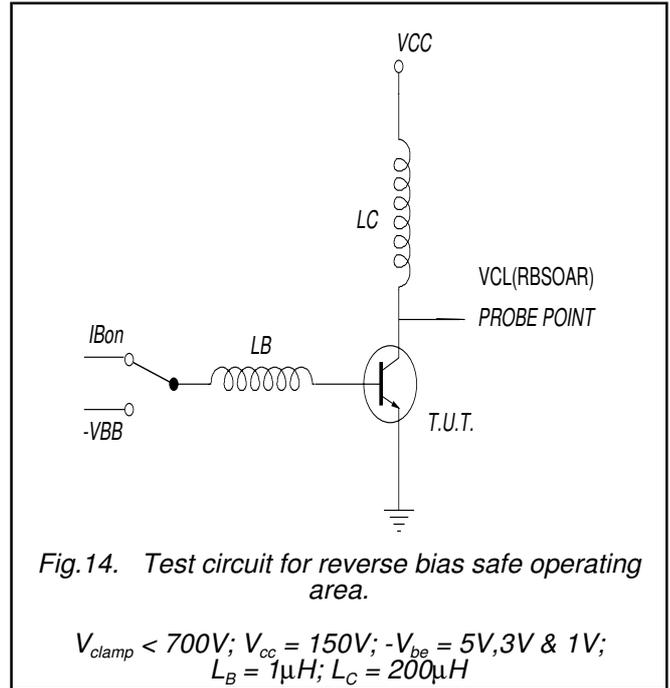


Fig.14. Test circuit for reverse bias safe operating area.

$V_{clamp} < 700V$ ;  $V_{cc} = 150V$ ;  $-V_{be} = 5V, 3V$  &  $1V$ ;  
 $L_B = 1\mu H$ ;  $L_C = 200\mu H$

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**MECHANICAL DATA**

*Dimensions in mm*

*Net Mass: 2 g*

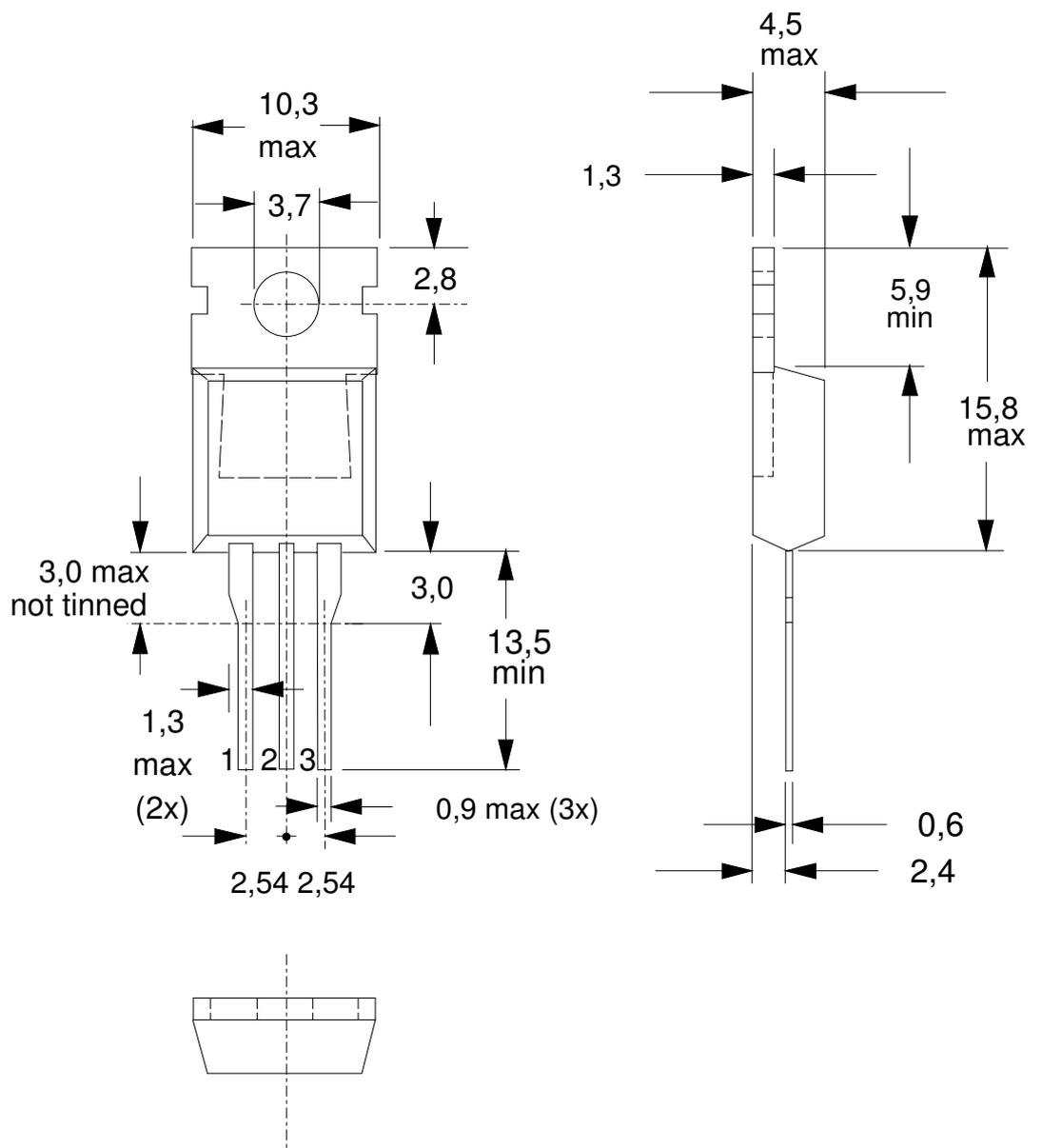


Fig.15. TO220AB; pin 2 connected to mounting base.

**Notes**

1. Refer to mounting instructions for TO220 envelopes.
2. Epoxy meets UL94 V0 at 1/8".

## Legal information

### DATA SHEET STATUS

DOCUMENT STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)</sup>	DEFINITION
Objective data sheet	Development	This document contains data from the objective specification for product development.
Preliminary data sheet	Qualification	This document contains data from the preliminary specification.
Product data sheet	Production	This document contains the product specification.

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