

## 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.

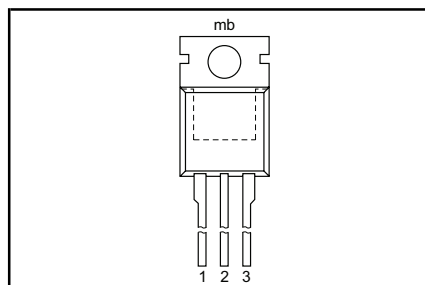
## QUICK REFERENCE DATA

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	$\mu\text{s}$

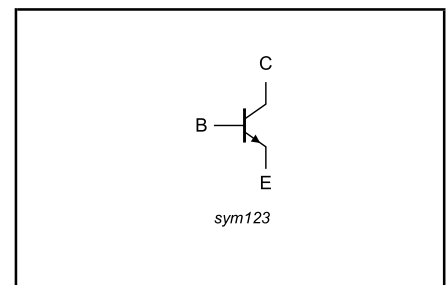
## PINNING - TO220AB

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
$R_{th\ j-a}$	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	

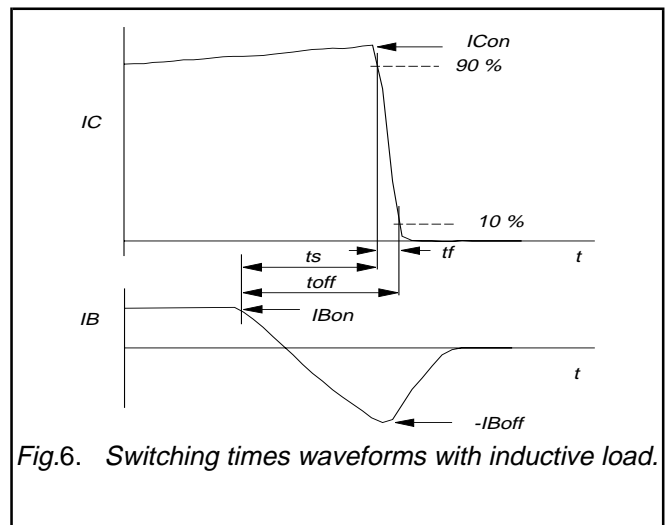
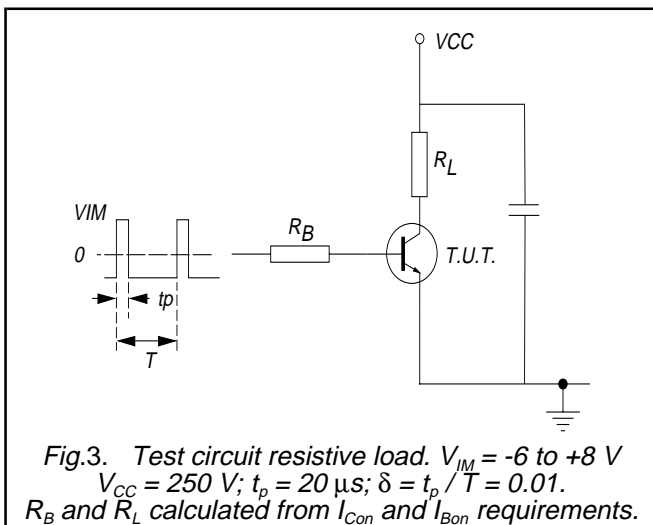
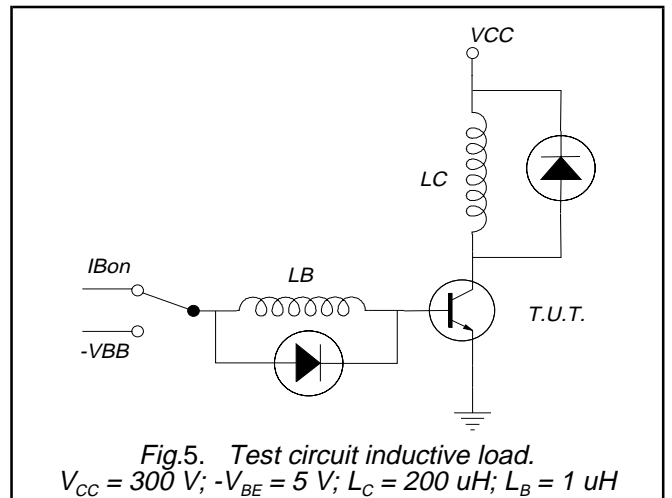
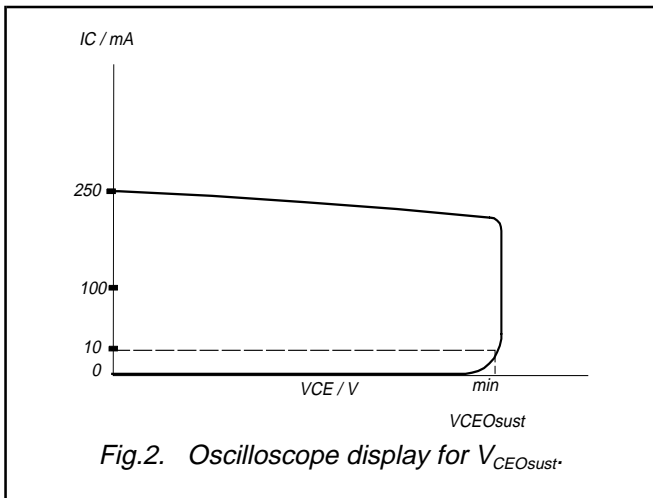
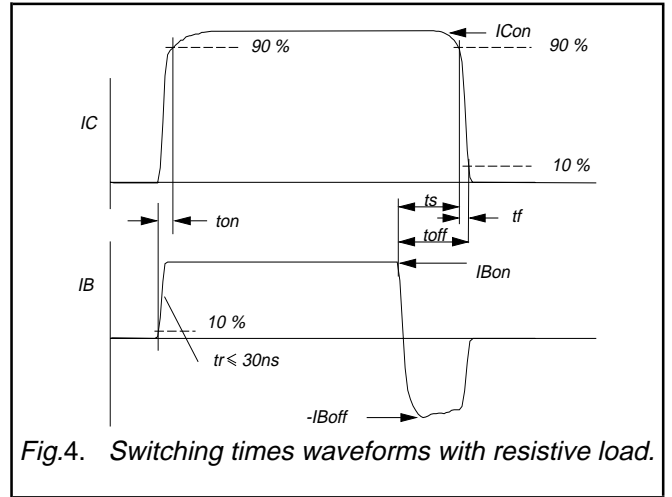
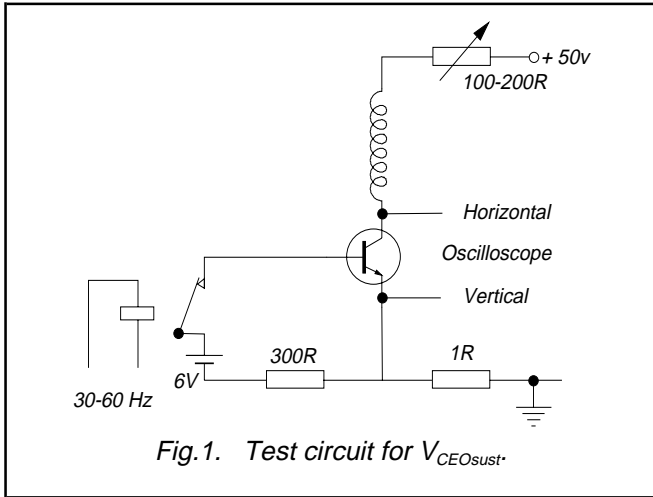
**DYNAMIC CHARACTERISTICS** $T_{mb} = 25\text{ °C}$  unless otherwise specified

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

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

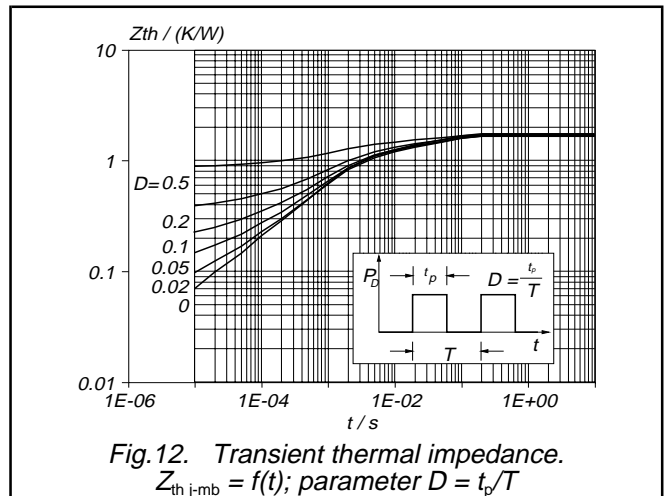
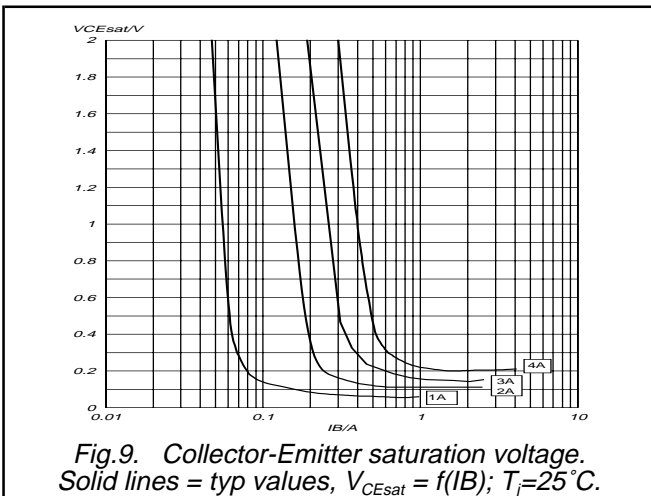
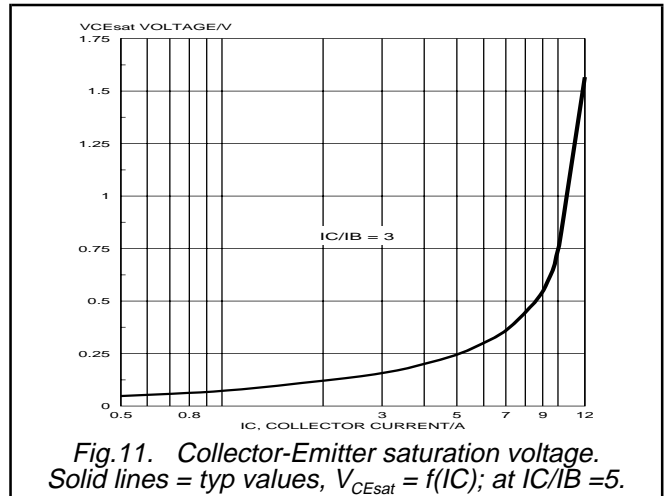
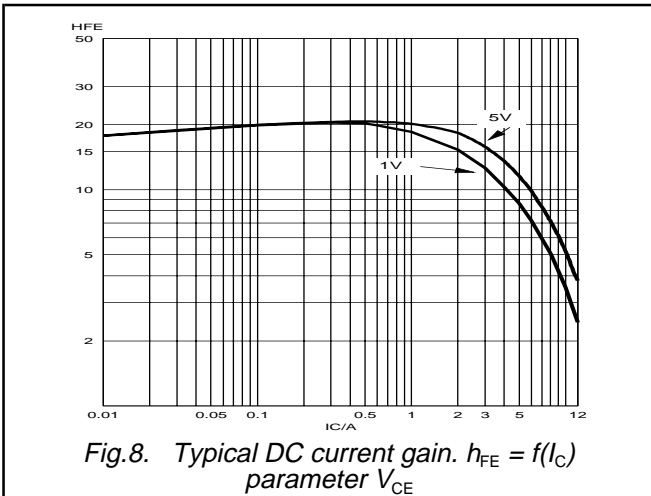
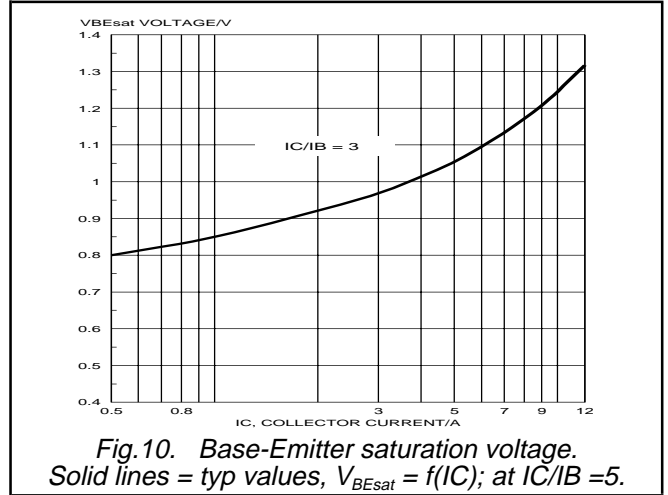
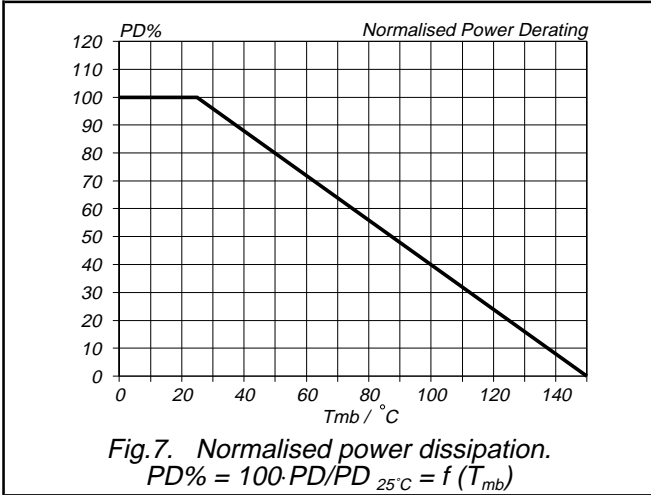
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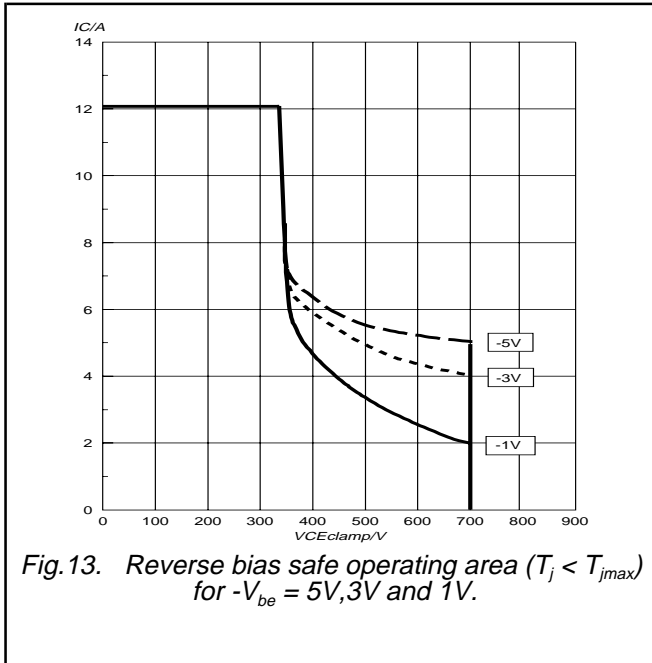


Fig.13. Reverse bias safe operating area ( $T_j < T_{jmax}$ ) for  $-V_{be} = 5V, 3V$  and  $1V$ .

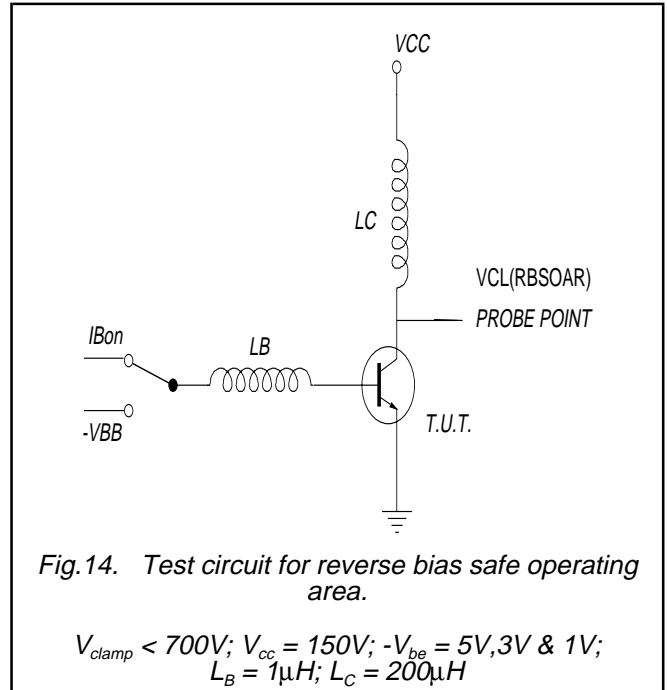


Fig.14. Test circuit for reverse bias safe operating area.

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

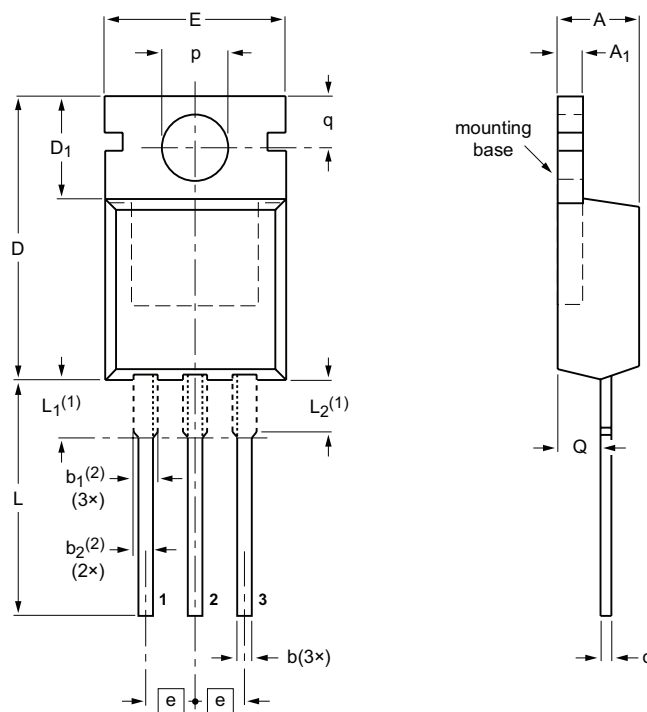
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MECHANICAL DATA

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

SOT78



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub> (2)	b <sub>2</sub> (2)	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub> (1)	L <sub>2</sub> (1) max.	p	q	Q
mm	4.7	1.40	0.9	1.6	1.3	0.7	16.0	6.6	10.3	2.54	15.0	3.30	3.0	3.8	3.0	2.6
	4.1	1.25	0.6	1.0	1.0	0.4	15.2	5.9	9.7		12.8	2.79		3.5	2.7	2.2

Notes

- Lead shoulder designs may vary.
- Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT78		3-lead TO-220AB	SC-46		08-04-23 08-06-13

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### Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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