

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.

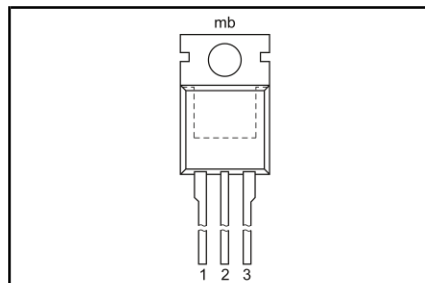
QUICK REFERENCE DATA

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	μs

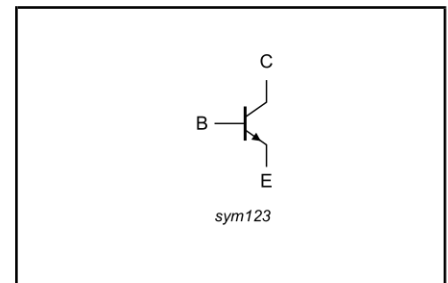
PINNING - TO220AB

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

 $T_{mb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}, I_{CBO} I_{CES}	Collector cut-off current ¹	$V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ $V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ $T_j = 125\text{ }^{\circ}\text{C}$	-	-	1.0 5.0	mA mA
I_{CEO} I_{EBO} $V_{CEOsust}$	Collector cut-off current Emitter cut-off current Collector-emitter sustaining voltage	$V_{CEO} = V_{CEOMmax} (400\text{V})$ $V_{EB} = 9\text{ V}; I_C = 0\text{ A}$ $I_B = 0\text{ A}; I_C = 10\text{ mA};$ $L = 25\text{ mH}$	- - 400	- - -	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

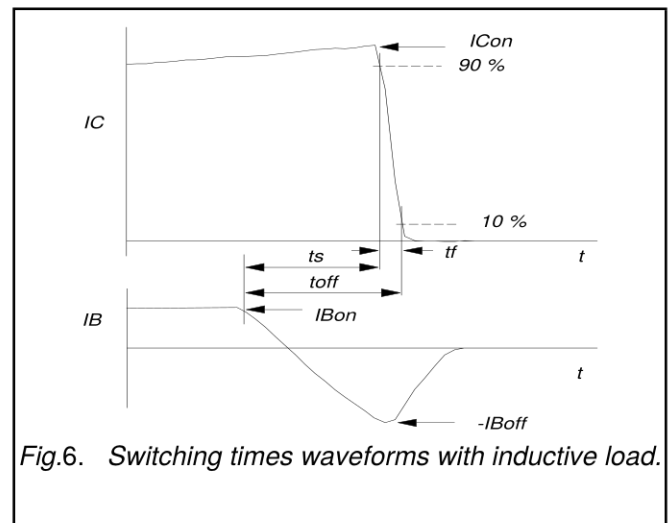
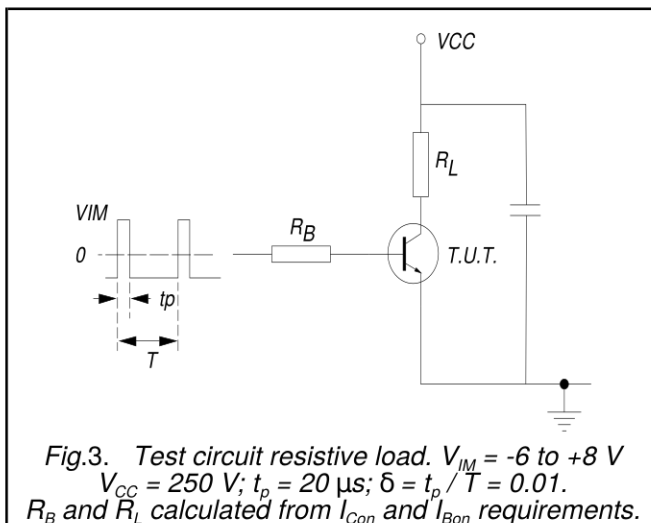
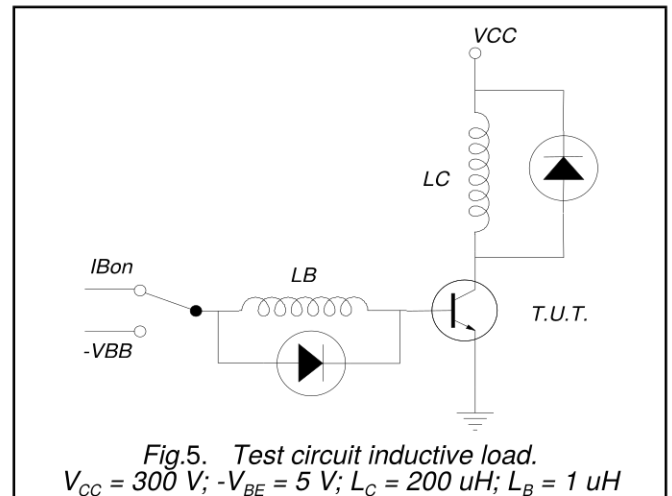
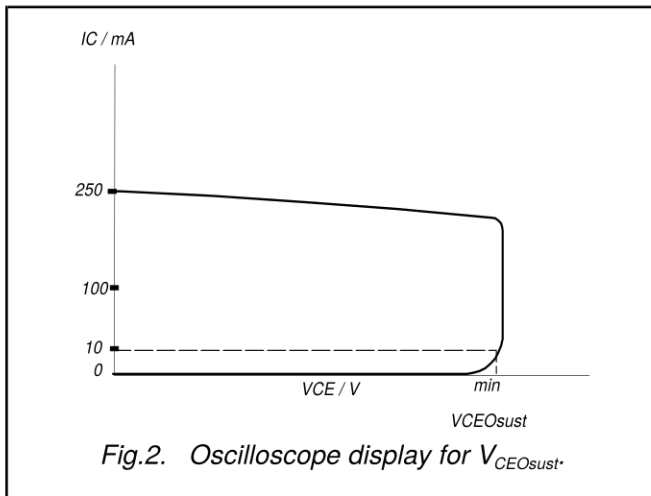
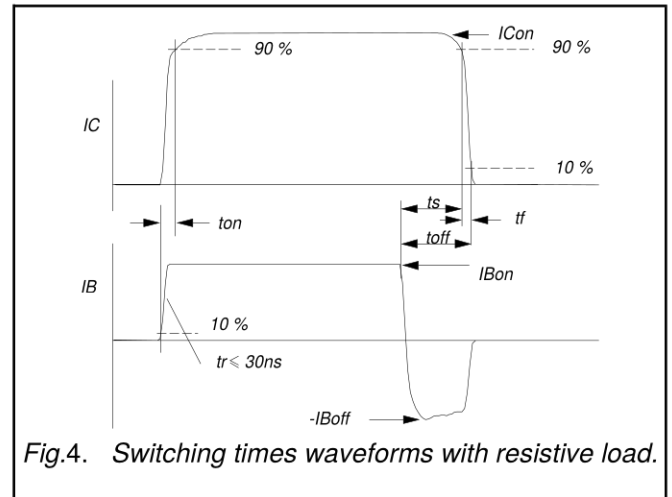
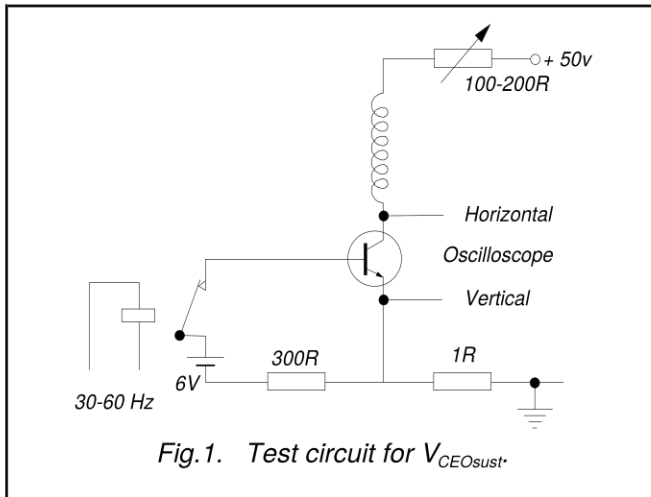
 $T_{mb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

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	μs μs
	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	μs μs
	Switching times (inductive load)	$I_{Con} = 5\text{ A}; I_{Bon} = 1\text{ A}; L_B = 1\text{ }\mu\text{H};$ $-V_{BB} = 5\text{ V}; T_j = 100\text{ }^{\circ}\text{C}$			
t_s t_f	Turn-off storage time Turn-off fall time		- -	3.2 0.9	μs μs

¹ Measured with half sine-wave voltage (curve tracer).

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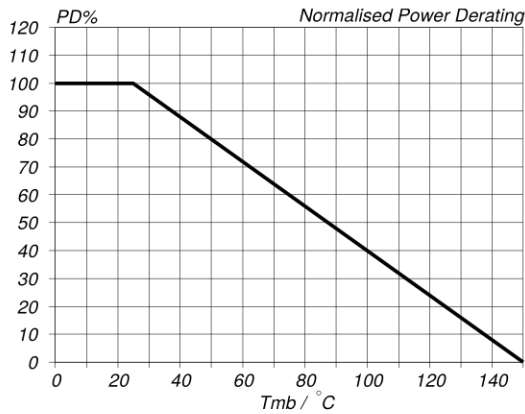


Fig.7. Normalised power dissipation.
 $PD\% = 100 \cdot PD / PD_{25^\circ C} = f(T_{mb})$

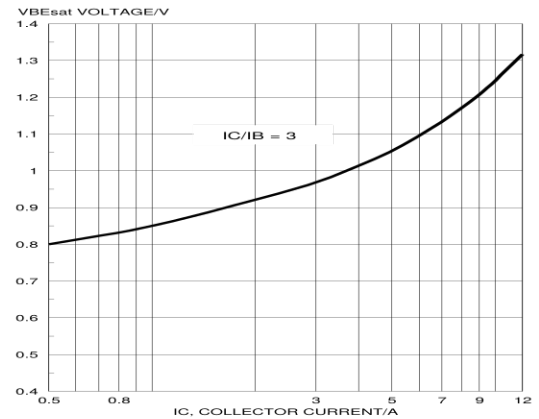


Fig.10. Base-Emitter saturation voltage.
 Solid lines = typ values, $V_{BEsat} = f(I_C)$; at $I_C/I_B = 5$.

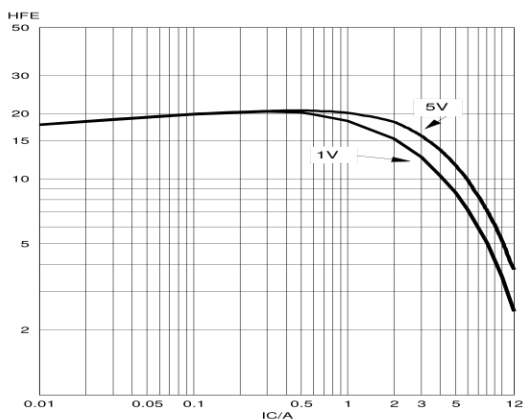


Fig.8. Typical DC current gain. $h_{FE} = f(I_C)$
 parameter V_{CE}

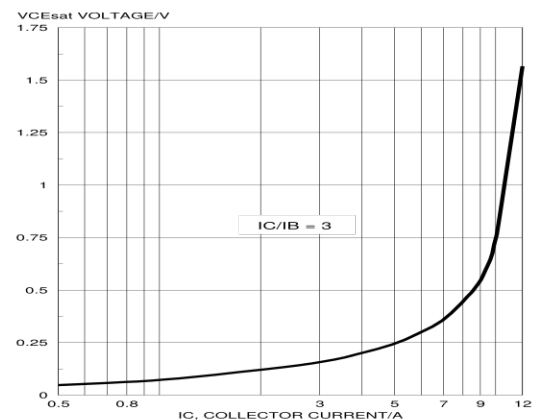


Fig.11. Collector-Emitter saturation voltage.
 Solid lines = typ values, $V_{CEsat} = f(I_C)$; at $I_C/I_B = 5$.

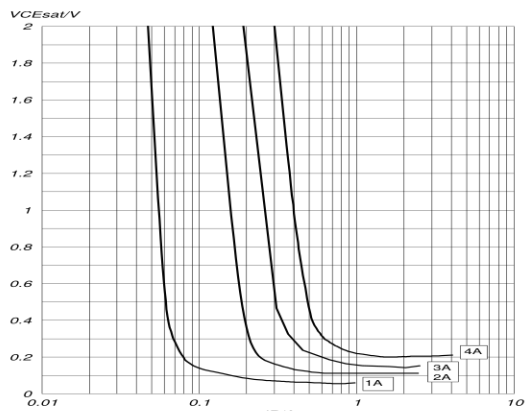


Fig.9. Collector-Emitter saturation voltage.
 Solid lines = typ values, $V_{CEsat} = f(I_B)$; $T_J = 25^\circ C$.

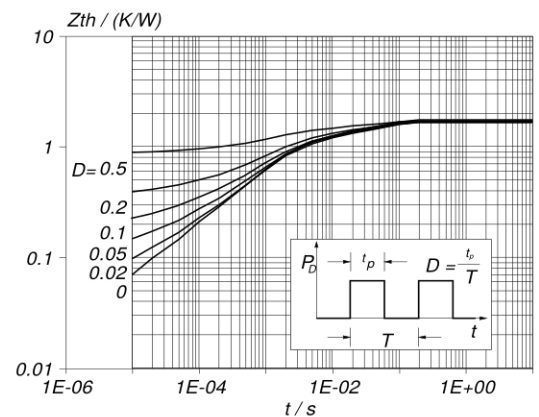


Fig.12. Transient thermal impedance.
 $Z_{th j-mb} = f(t)$; parameter $D = t_p / T$

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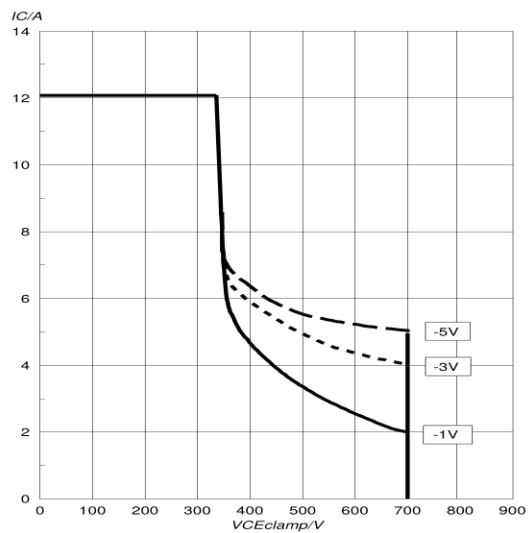


Fig.13. Reverse bias safe operating area ($T_j < T_{jmax}$) for $-V_{be} = 5V, 3V$ and $1V$.

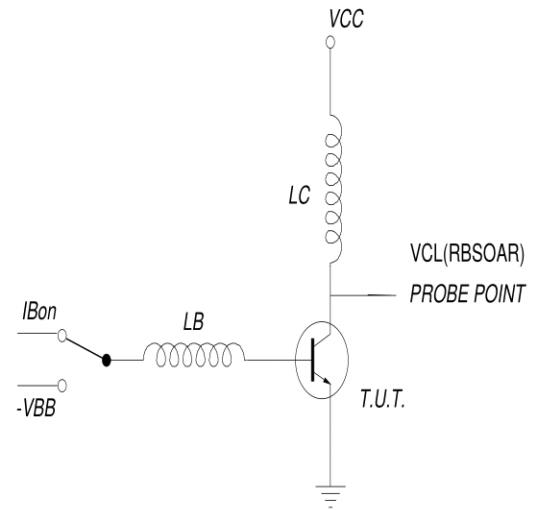


Fig.14. Test circuit for reverse bias safe operating area.

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

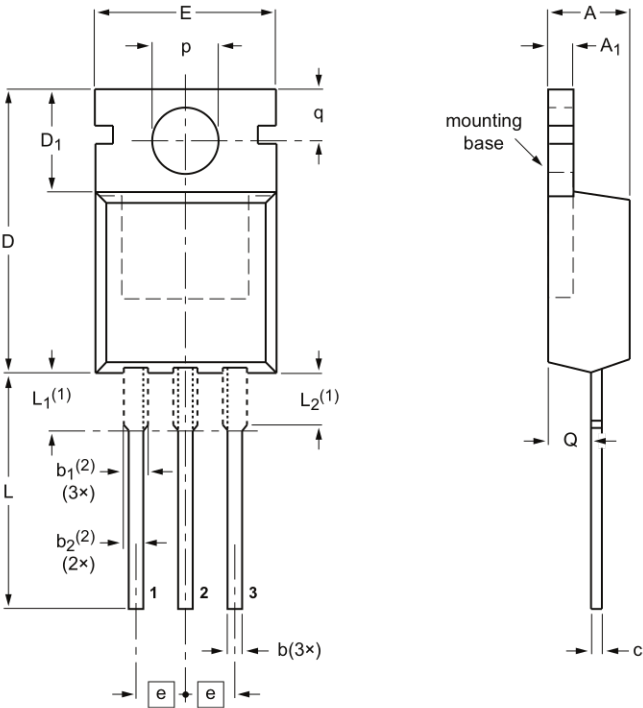
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MECHANICAL DATA

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

SOT78



DIMENSIONS (mm are the original dimensions)

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

- Notes
- 1. Lead shoulder designs may vary.
 - 2. 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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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.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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