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IMPORTANT NOTICE

10 December 2015

1. Global joint venture starts operations as WeEn Semiconductors

Dear customer,

As from November 9th, 2015 NXP Semiconductors N.V. and Beijing JianGuang Asset Management Co. Ltd established Bipolar Power joint venture (JV), **WeEn Semiconductors**, which will be used in future Bipolar Power documents together with new contact details.

In this document where the previous NXP references remain, please use the new links as shown below.

WWW - For www.nxp.com use www.ween-semi.com
Email - For salesaddresses@nxp.com use salesaddresses@ween-semi.com

For the copyright notice at the bottom of each page (or elsewhere in the document, depending on the version) "© **NXP Semiconductors N.V. *{year}*. All rights reserved**" becomes "© **WeEn Semiconductors Co., Ltd. *{year}*. All rights reserved**"

If you have any questions related to this document, please contact our nearest sales office via e-mail or phone (details via salesaddresses@ween-semi.com).

Thank you for your cooperation and understanding,

WeEn Semiconductors

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.

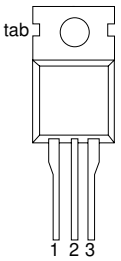
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 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	$T_{mb} \leq 25$ ˚C	-	80	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.0 A;I_B = 1.0 A	0.32	1.0	V
h_{FEsat}		I_C = 5.0 A; V_{CE} = 5 V	-	40	
t_f	Fall time	I_C = 5.0 A; I_{B1} = 1.0 A	0.1	0.5	µs

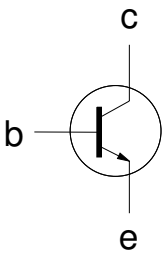
PINNING - TO220AB

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 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	$T_{mb} \leq 25$ ˚C	-	80	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

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

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

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

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

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

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

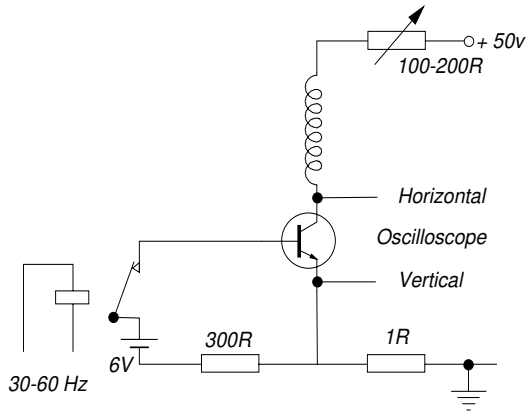


Fig.1. Test circuit for $V_{CEOsust}$.

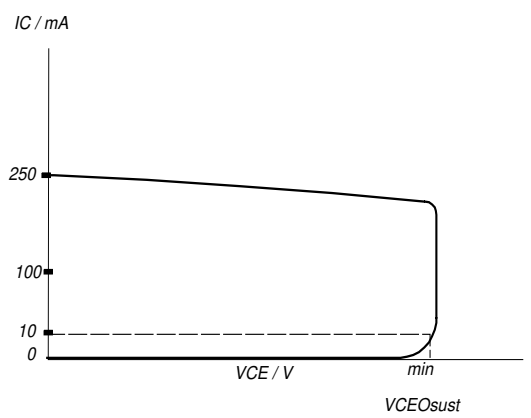


Fig.2. Oscilloscope display for $V_{CEOsust}$.

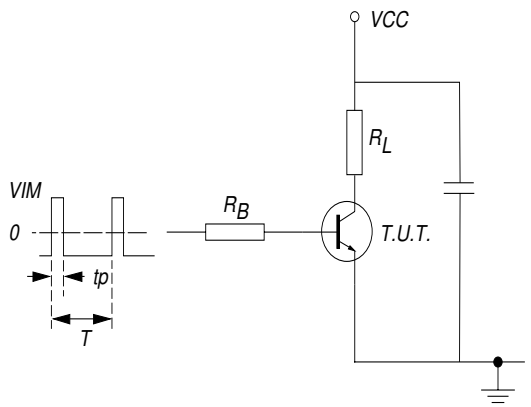


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 μs; δ = t_p / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

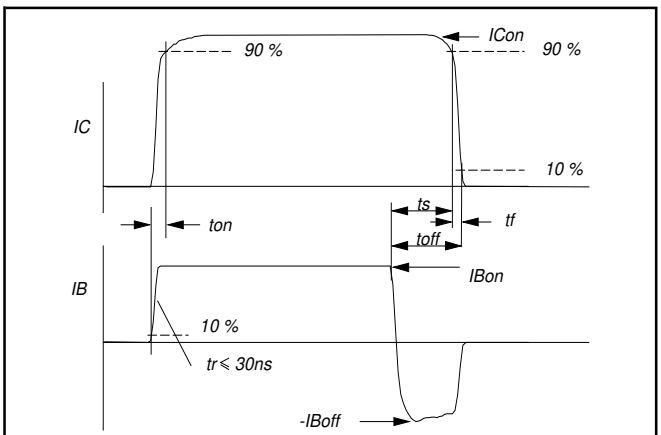


Fig.4. Switching times waveforms with resistive load.

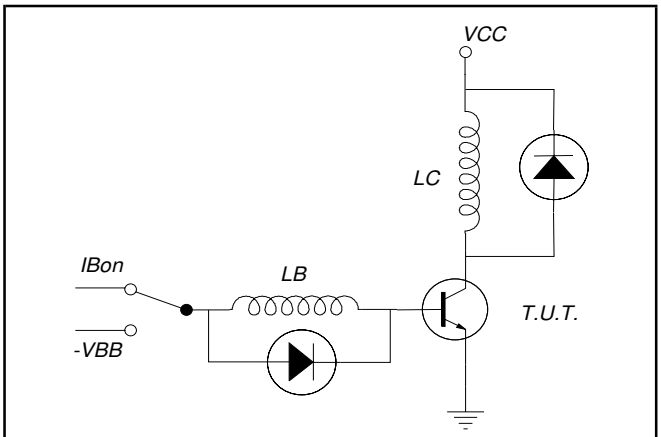


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V; L_C = 200 uH; L_B = 1 uH

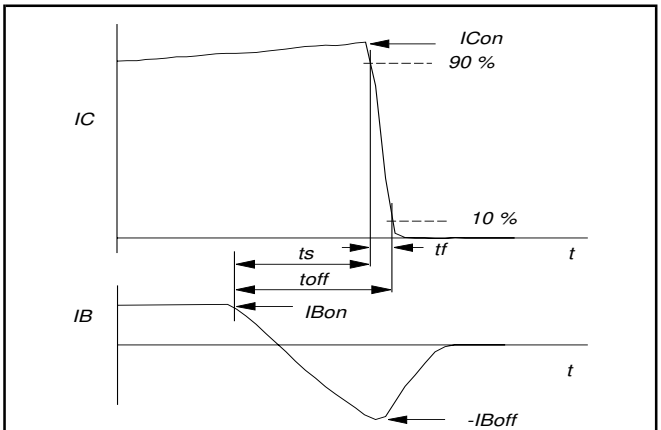


Fig.6. Switching times waveforms with inductive load.

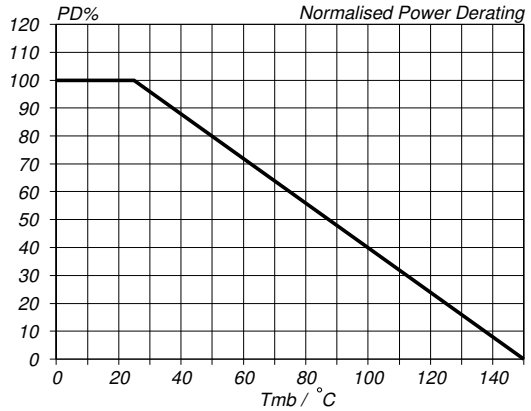


Fig.7. Normalised power dissipation. PD% = 100·PD/PD $_{25°C}$ = f (T_{mb})

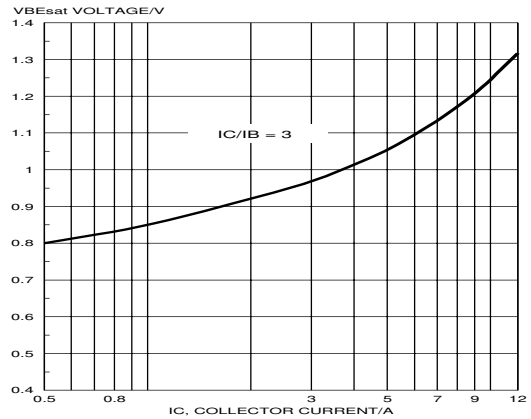


Fig.10. Base-Emitter saturation voltage. Solid lines = typ values, V_{BEsat} = f(IC); at IC/IB =5.

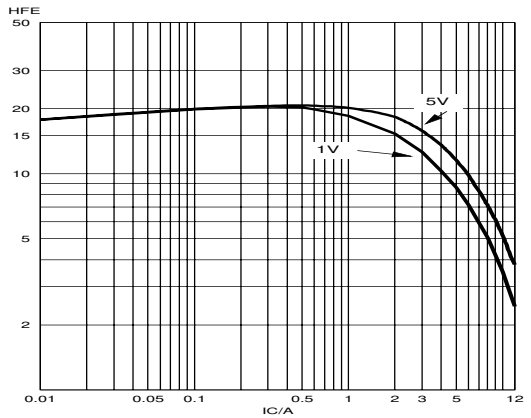


Fig.8. Typical DC current gain. h_{FE} = f(I_C) parameter V_{CE}

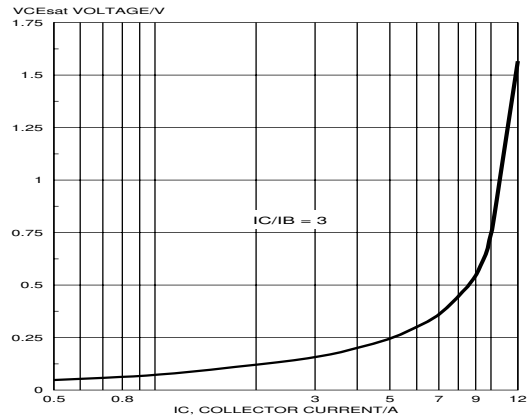


Fig.11. Collector-Emitter saturation voltage. Solid lines = typ values, V_{CEsat} = f(IC); at IC/IB =5.

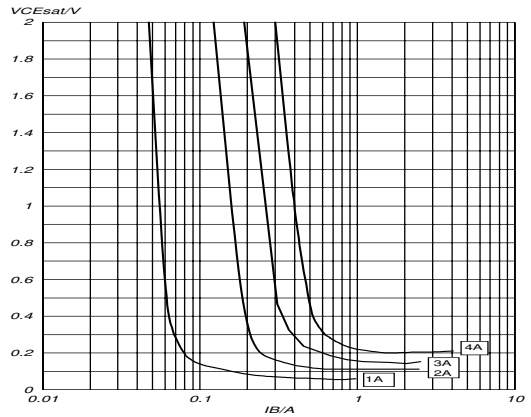


Fig.9. Collector-Emitter saturation voltage. Solid lines = typ values, V_{CEsat} = f(IB); T_j=25˚C.

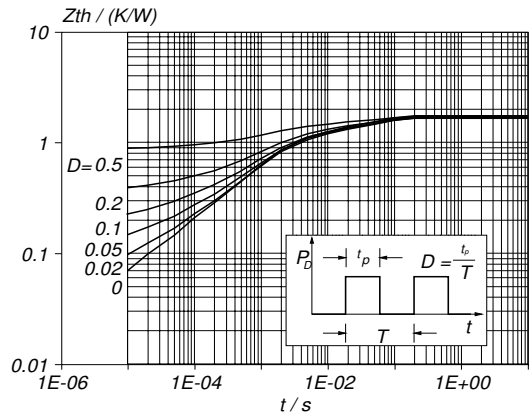


Fig.12. Transient thermal impedance. $Z_{th\ j\text{-}mb}$ = f(t); parameter D = t_p/T

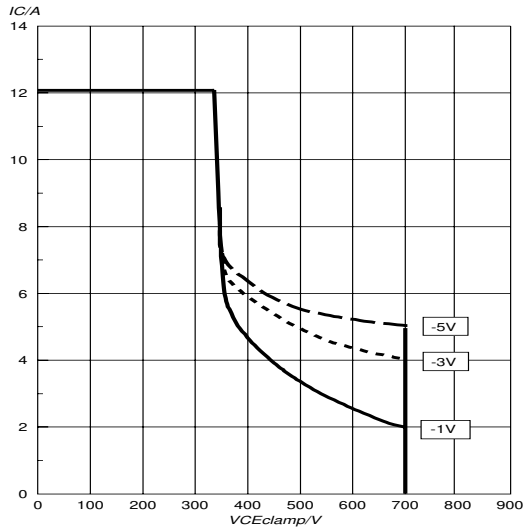


Fig.13. Reverse bias safe operating area ($T_j < T_{jmax}$) for $-V_{be}$ = 5V,3V and 1V.

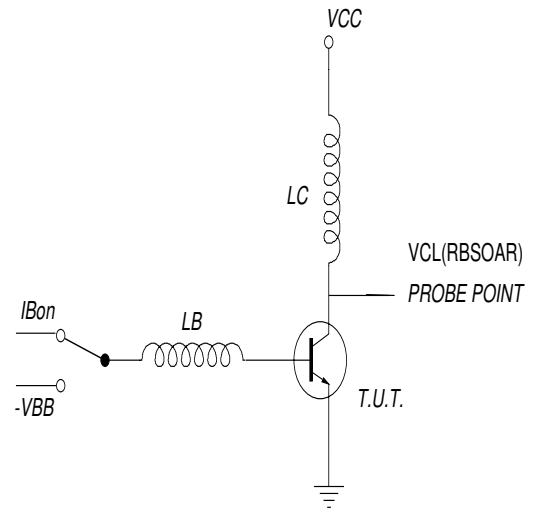


Fig.14. Test circuit for reverse bias safe operating area.

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

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

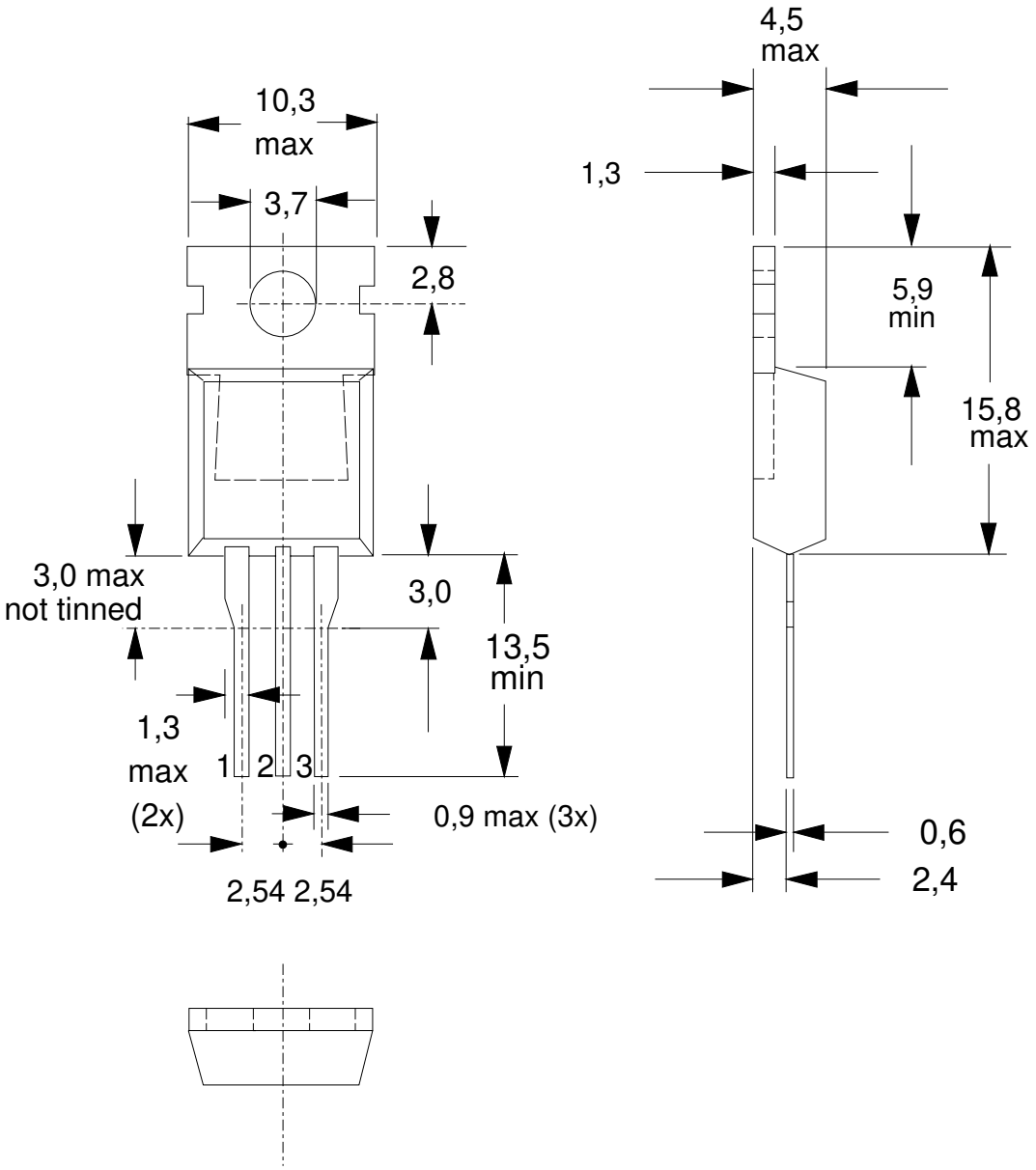


Fig.15. TO220AB; pin 2 connected to mounting base.

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

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

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