GENERAL DESCRIPTION

The PHE13005 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.

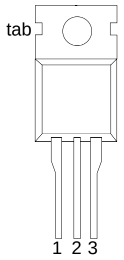
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0V	-	700	V
V_{CBO}	Collector-Base voltage (open emitter)		-	700	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	V
V_{EBO}	Emitter-Base voltage (I_B = 0)		-	9	V
I_C	Collector current (DC)		-	4	A
I_{CM}	Collector current peak value		-	8	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25^{\circ}C$	-	75	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 2A; I_B = 0.5A	0.2	0.6	V
t_f	Fall time	I_C = 2A; I_{B1} = 0.4A; $V_{BE(OFF)}$ = 5V	0.1	0.5	µs

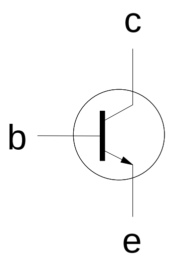
PINNING - TO220AB

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} = 0V	-	700	V
V_{CEO}	Collector to emitter voltage (open base)		-	400	V
V_{CBO}	Collector to base voltage (open emitter)		-	700	V
V_{EBO}	Emitter-Base voltage (I_B = 0)		-	9	V
I_C	Collector current (DC)		-	4	A
I_{CM}	Collector current peak value		-	8	A
I_B	Base current (DC)		-	2	A
I_{BM}	Base current peak value		-	4	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25^{\circ}C$	-	75	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES8

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base		-	1.67	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_{CEV}	Collector cut-off current[1]	$V_{BE(off)}$ = -1.5V; V_{CE} = $V_{CESMmax}$	-	-	1.0	mA
I_{CEV}		$V_{BE(off)}$ = -1.5V; V_{CE} = $V_{CESMmax}$; T_j = 100˚C	-	-	5.0	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 9V; I_C = 0A	-	-	1	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0A; I_C = 10mA	400	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1.0A; I_B = 0.2A	-	0.1	0.5	V
V_{CEsat}		I_C = 2.0A; I_B = 0.5A	-	0.2	0.6	V
V_{CEsat}		I_C = 4.0A; I_B = 1.0A	-	0.3	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 1.0A; I_B = 0.2A	-	0.85	1.2	V
V_{BEsat}		I_C = 2.0A; I_B = 0.5A	-	0.92	1.6	V
h_{FE}	DC current gain	I_C = 1.0A; V_{CE} = 5V	10	20	60	
h_{FEsat}		I_C = 2.0A; V_{CE} = 5V	8	17	40	

DYNAMIC CHARACTERISTICS

T_{mb} = 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 2.0A; I_{Bon} = $-I_{Boff}$ = 0.4A; R_L = 75Ω; V_{CC} = 250V			
t_s	Turn-off storage time		2.7	4	µs
t_f	Turn-off fall time		0.3	0.9	µs
	Switching times (inductive load)	I_{Con} = 2.0A; I_{Bon} = 0.4A; L_B = 1µH; $-V_{BE(off)}$ = 5V			
t_s	Turn-off storage time		1.2	2	µs
t_f	Turn-off fall time		0.1	0.5	µs
	Switching times (inductive load)	I_{Con} = 2.0A; I_{Bon} = 0.4A; L_B = 1µH; $-V_{BE(off)}$ = 5V; T_j = 100˚C			
t_s	Turn-off storage time		1.4	4	µs
t_f	Turn-off fall time		0.16	0.9	µs

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

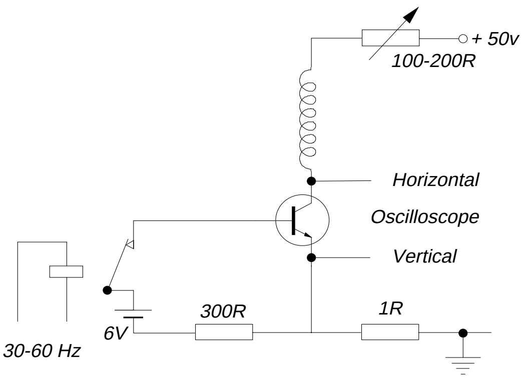


Fig.1. Test circuit for $V_{CEOsust}$.

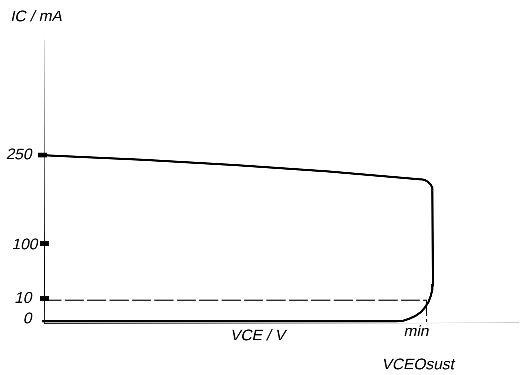


Fig.2. Oscilloscope display for $V_{CEOsust}$.

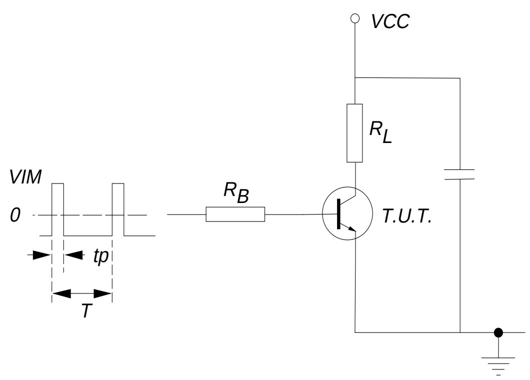


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; $\delta = t_p / T = 0.01$.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

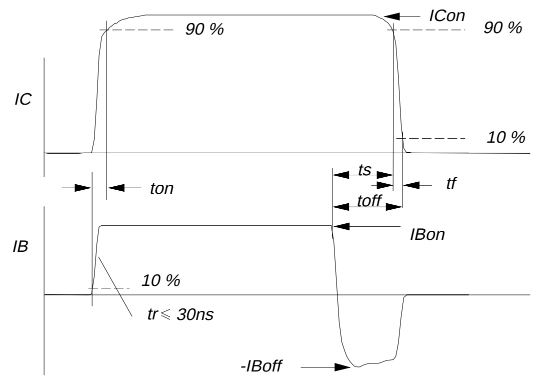


Fig.4. Switching times waveforms with resistive load.

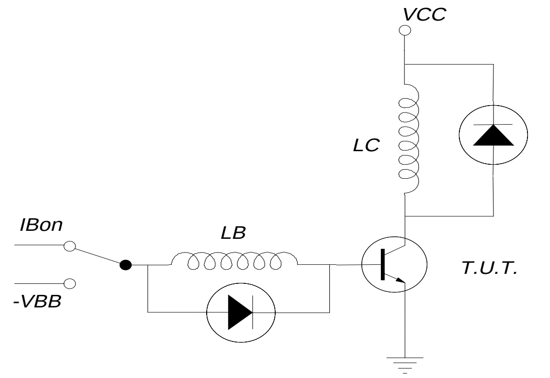


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V, L_C = 200 uH; L_B = 1 uH

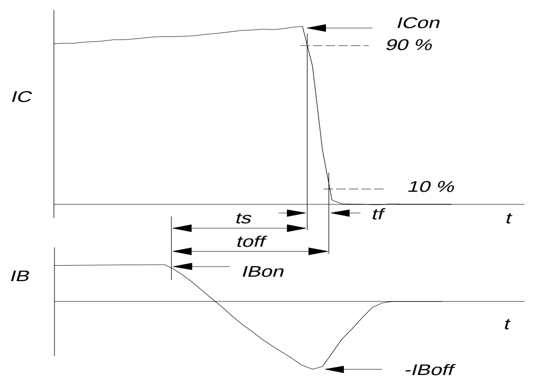


Fig.6. Switching times waveforms with inductive load.

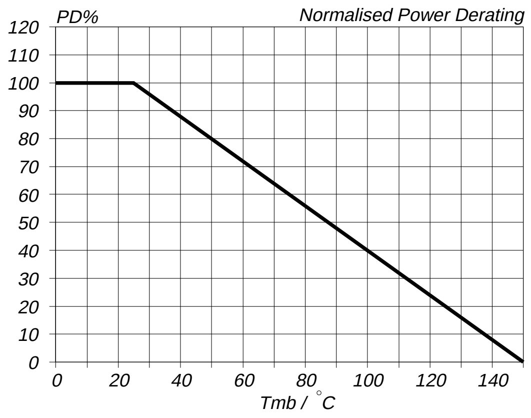


Fig.7. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{mb})$

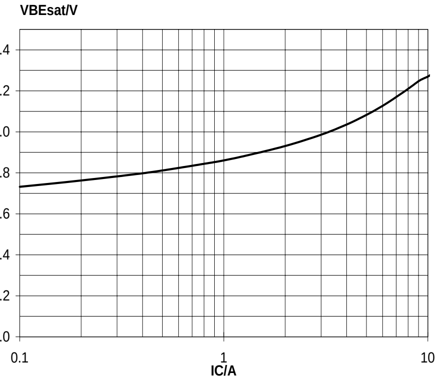


Fig.10. Base-Emitter saturation voltage.
Solid lines = typ values, $V_{BEsat} = f(IC)$; at IC/IB =4.

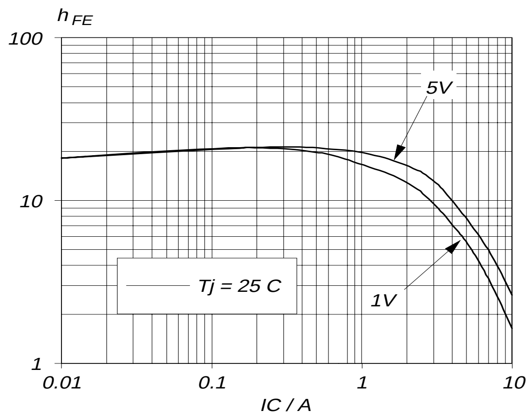


Fig.8. Typical DC current gain. $h_{FE} = f(I_C)$
parameter V_{CE}

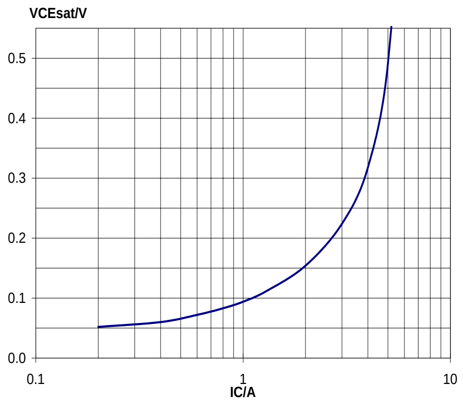


Fig.11. Collector-Emitter saturation voltage.
Solid lines = typ values, $V_{CEsat} = f(IC)$; at IC/IB =4.

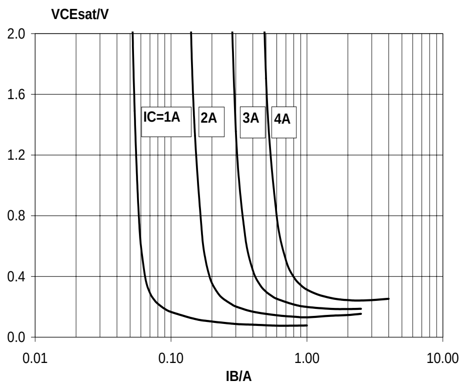


Fig.9. Collector-Emitter saturation voltage.
Solid lines = typ values, VCEsat = f(IB); Tj=25˚C

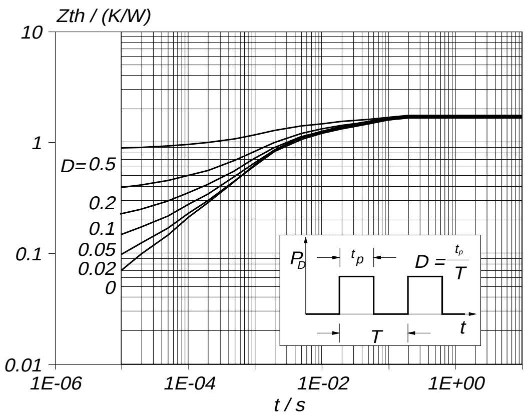


Fig.12. Transient thermal impedance.
$Z_{th\ j-mb} = f(t)$; parameter $D = t_p/T$

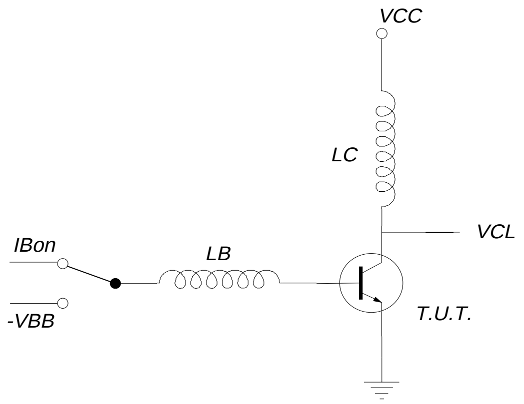


Fig.13. Test Circuit for reverse bias safe operating area.

$V_{cl} \leq 1000V$; $V_{cc} = 150V$; $V_{BE} = -5V$; $L_B = 1\mu H$; $L_c = 200\mu H$

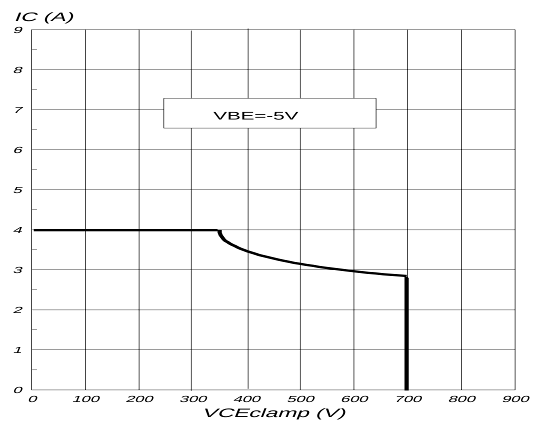


Fig.14. Reverse bias safe operating area $T_j \leq T_{jmax}$

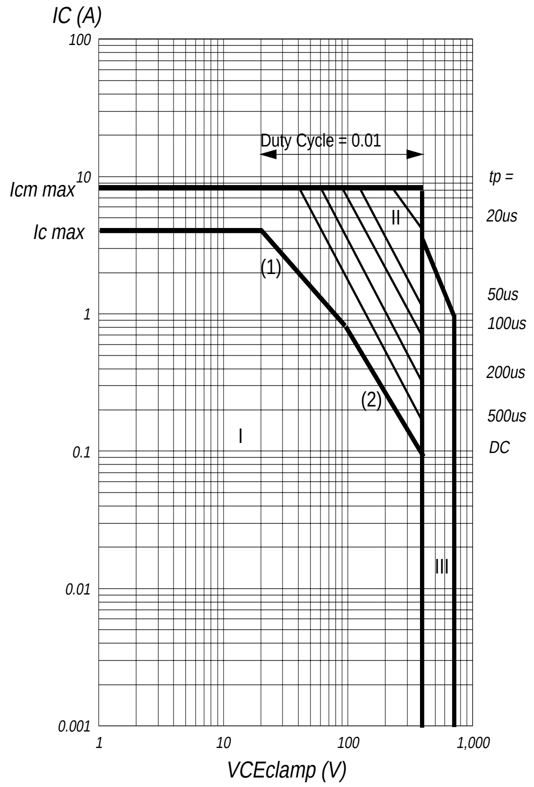


Fig.15. Forward bias safe operating area. $T_{hs} \leq 25$ ˚C

(1)	P_{tot} max and P_{tot} peak max lines.
(2)	Second breakdown limits.
I	Region of permissible DC operation.
II	Extension for repetitive pulse operation.
III	Extension during turn-on in single transistor converters provided that $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6\ \mu s$.
NB:	Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

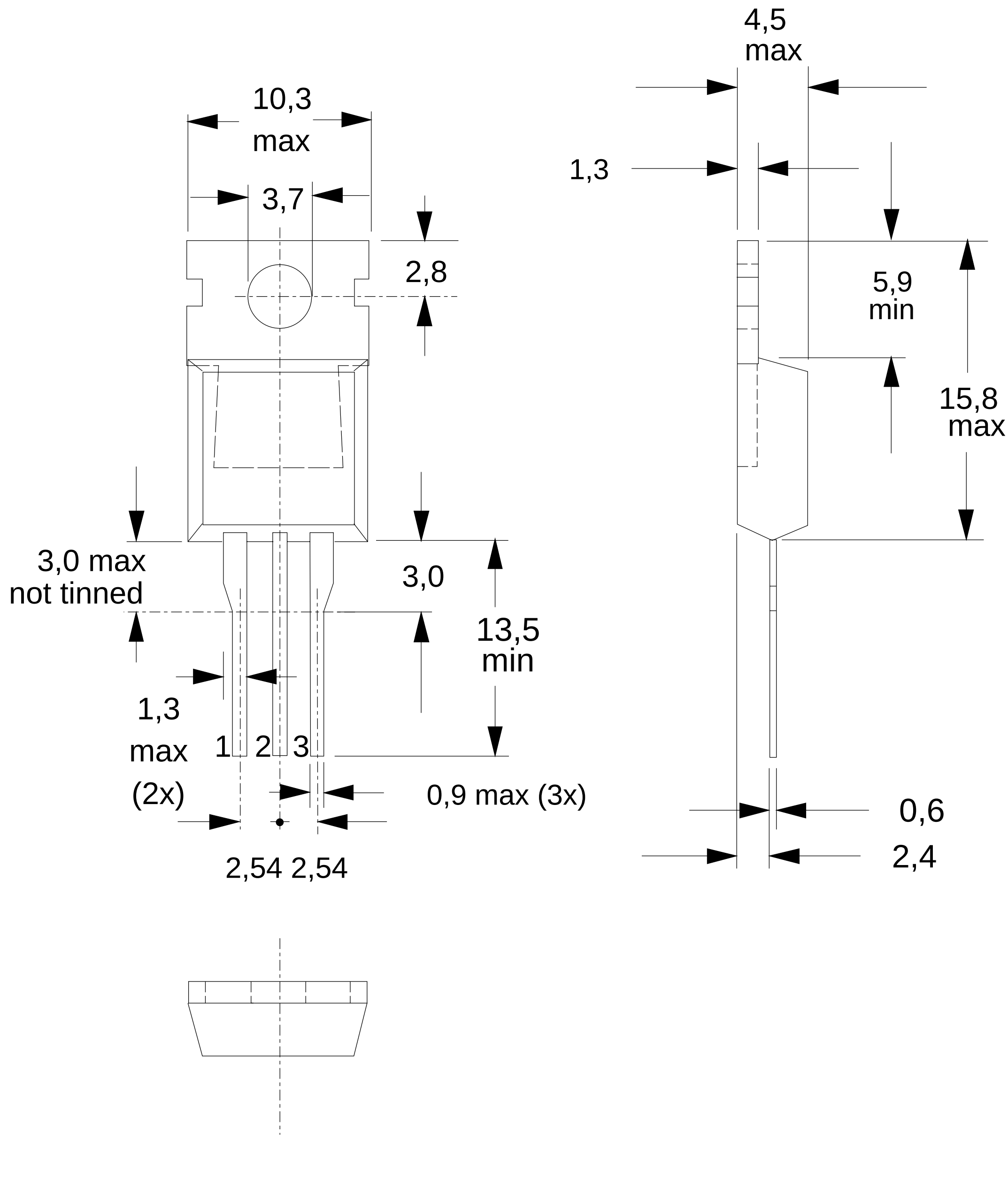


Fig.16. TO220AB; pin 2 connected to mounting base.

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.	
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