

PHE13003C

NPN power transistor

7 October 2013 **Product data sheet**

1. General description

High voltage, high speed, planar passivated NPN power switching transistor in a SOT54 (TO-92) plastic package.

2. Features and benefits

- Fast switching
- High typical DC current gain
- High voltage capability of 700 V
- Very low switching and conduction losses

3. Applications

- Compact fluorescent lamps (CFL)
- Low power electronic lighting ballasts
- Off-line self-oscillating power supplies (SOPS) for battery charging

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_C	collector current	DC		-	-	1.5	A
P_{tot}	total power dissipation	$T_{lead} \leq 25$ °C; Fig. 1		-	-	2.1	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$ V		-	-	700	V
Static characteristics							
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 2$ V; $T_{lead} = 25$ °C		8	17	25	

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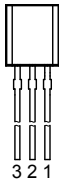
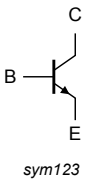
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 TO-92 (SOT54)	 sym123
2	C	collector		
3	E	emitter		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PHE13003C	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CESM}	collector-emitter peak voltage	V_{BE} = 0 V		-	700	V
V_{CBO}	collector-base voltage	I_E = 0 A		-	700	V
V_{CEO}	collector-emitter voltage	I_B = 0 A		-	400	V
I_C	collector current	DC		-	1.5	A
I_{CM}	peak collector current			-	3	A
I_B	base current	DC		-	0.75	A
I_{BM}	peak base current			-	1.5	A
P_{tot}	total power dissipation	T_{lead} ≤ 25 °C; Fig. 1		-	2.1	W
T_{stg}	storage temperature			-65	150	°C
T_j	junction temperature			-	150	°C
V_{EBO}	emitter-base voltage	I_C = 0 A; I(Emitter) = 10 mA		-	9	V

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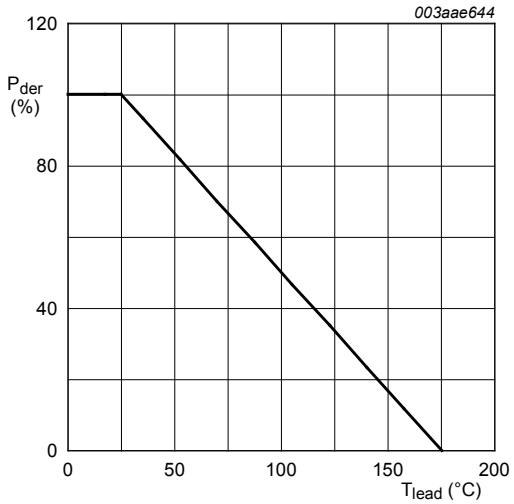

Fig. 1. Normalized total power dissipation as a function of lead temperature

$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j\text{-}lead)}$	thermal resistance from junction to lead	Fig. 2		-	-	60	K/W
$R_{th(j\text{-}a)}$	thermal resistance from junction to ambient	in free air; printed circuit board mounted; lead length = 4 mm		-	150	-	K/W

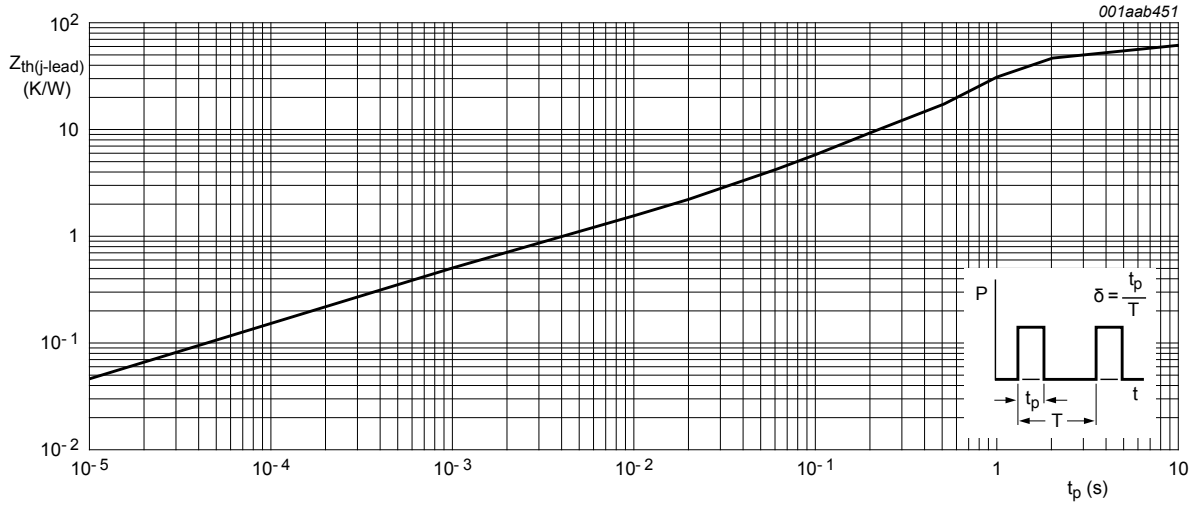

Fig. 2. Transient thermal impedance from junction to lead as a function of pulse width

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9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
t_{on}	turn-on time	I_C = 1 A; I_{Bon} = 0.2 A; I_{Boff} = -0.2 A; R_L = 75 Ω; T_{lead} = 25 °C; resistive load; Fig. 5; Fig. 6		-	-	1	µs
t_s	storage time			-	-	4	µs
		I_C = 1 A; I_{Bon} = 0.2 A; V_{BB} = -5 V; L_B = 1 µH; T_{lead} = 25 °C; inductive load; Fig. 7; Fig. 8		-	0.8	-	µs
t_f	fall time	I_C = 1 A; I_{Bon} = 0.2 A; I_{Boff} = -0.2 A; R_L = 75 Ω; T_{lead} = 25 °C; resistive load; Fig. 5; Fig. 6		-	-	0.7	µs
		I_C = 0.5 A; I_{Bon} = 0.1 A; V_{BB} = -5 V; L_B = 1 µH; T_{lead} = 25 °C; inductive load; Fig. 7; Fig. 8		-	0.1	-	µs
Static characteristics							
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V; V_{CE} = 700 V; T_j = 125 °C		-	-	5	mA
		V_{BE} = 0 V; V_{CE} = 700 V; T_j = 25 °C		-	-	1	mA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 400 V; I_B = 0 A; T_{lead} = 25 °C		-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0 A; T_{lead} = 25 °C		-	-	1	mA
V_{CEOsus}	collector-emitter sustaining voltage	I_B = 0 A; I_C = 1 mA; L_C = 25 mH; T_{lead} = 25 °C; Fig. 3; Fig. 4		400	-	-	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 0.5 A; I_B = 0.1 A; T_{lead} = 25 °C		-	-	0.5	V
		I_C = 1 A; I_B = 0.25 A; T_{lead} = 25 °C		-	-	1	V
		I_C = 1.5 A; I_B = 0.5 A; T_{lead} = 25 °C		-	-	1.5	V
V_{BEsat}	base-emitter saturation voltage	I_C = 0.5 A; I_B = 0.1 A; T_{lead} = 25 °C		-	-	1	V
		I_C = 1 A; I_B = 0.25 A; T_{lead} = 25 °C		-	-	1.2	V
h_{FE}	DC current gain	I_C = 0.5 A; V_{CE} = 2 V; T_{lead} = 25 °C		8	17	25	
		I_C = 1 A; V_{CE} = 2 V; T_{lead} = 25 °C		5	9	15	

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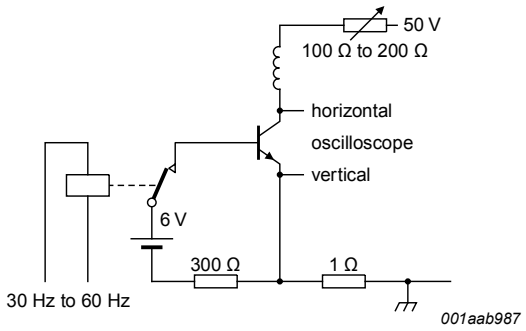

Fig. 3. Test circuit for collector-emitter sustaining voltage

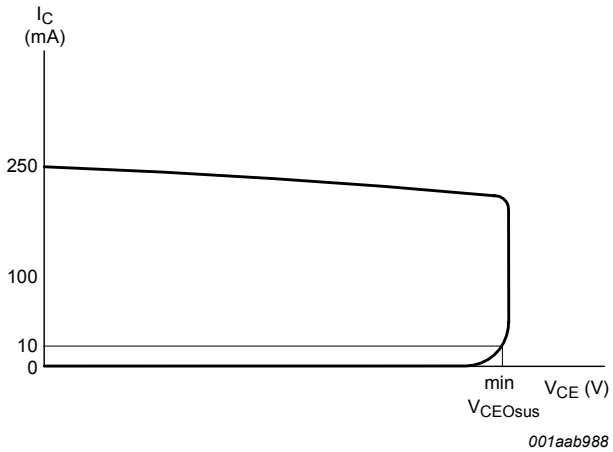

Fig. 4. Oscilloscope display for collector-emitter sustaining voltage test waveform

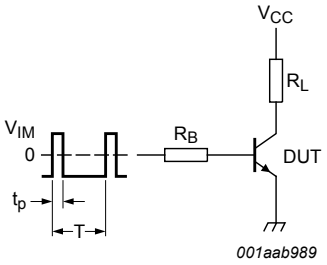

Fig. 5. Test circuit for resistive load switching

$V_{IM} = -6$ to $+8\ V$; $V_{CC} = 250\ V$; $t_p = 20\ \mu s$; $\delta = \frac{t_p}{T} = 0.01$

R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

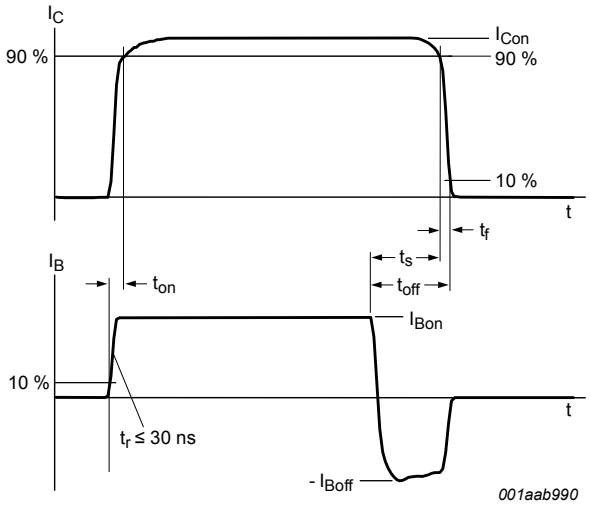

Fig. 6. Switching times waveforms for resistive load

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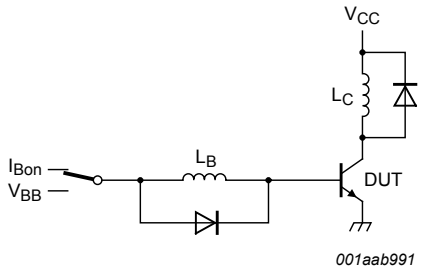

Fig. 7. Test circuit for inductive load switching

$$V_{CC} = 300\ V; V_{BB} = -5\ V; L_C = 200\ \mu H; L_B = 1\ \mu H$$

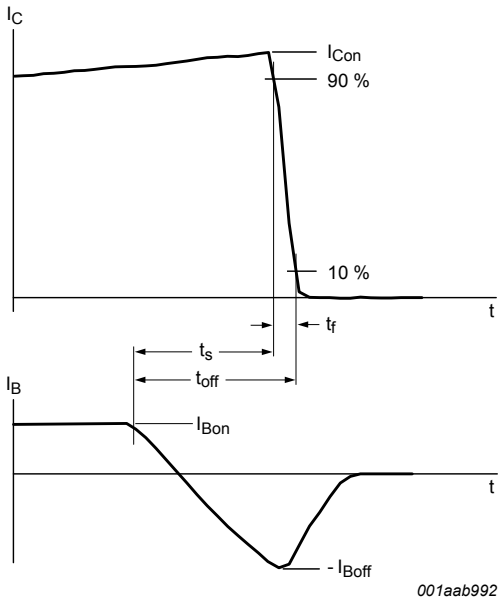

Fig. 8. Switching times waveforms for inductive load

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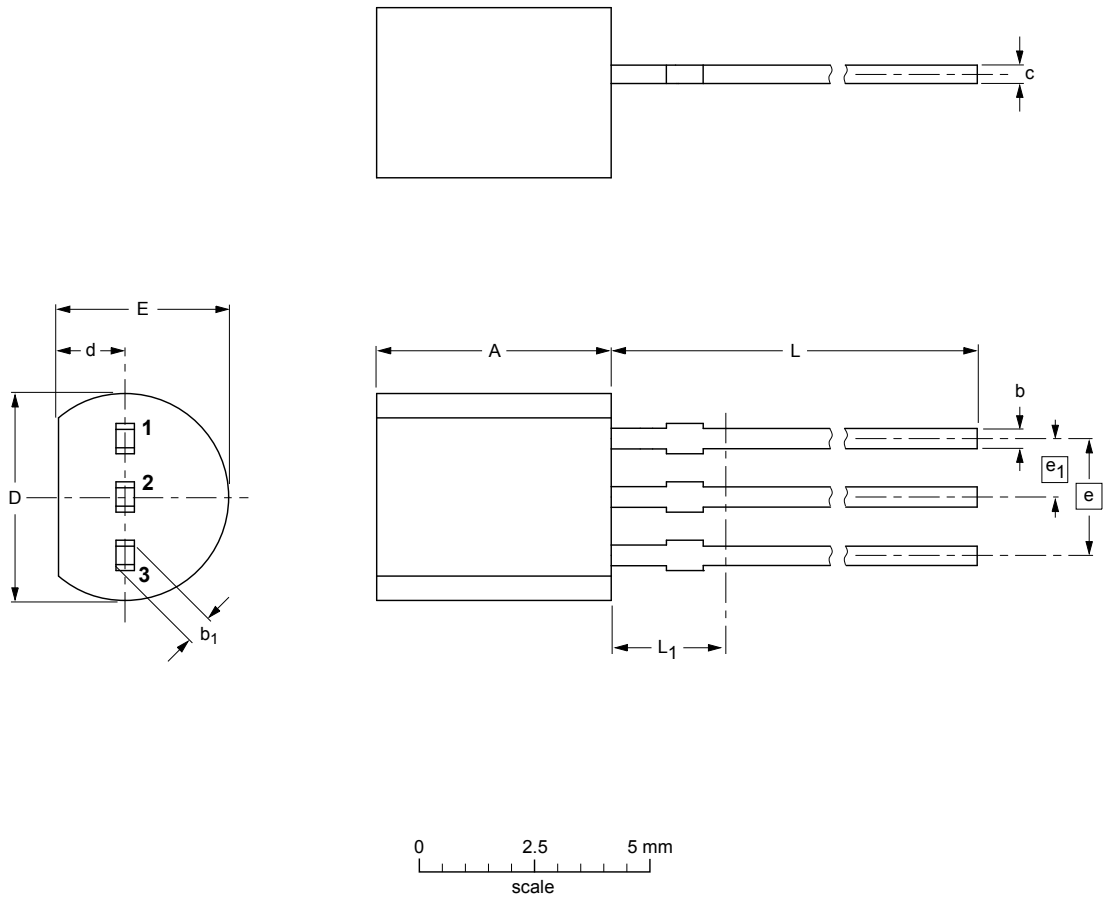
10. Package outline

Plastic single-ended leaded (through hole) package; 3 leads **SOT54**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b	b_1	c	D	d	E	e	e_1	L	L_1 (1) max.
mm	5.2 5.0	0.48 0.40	0.66 0.55	0.45 0.38	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

Note

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT54		TO-92	SC-43A			~~04-06-28~~ 04-11-16

Fig. 9. Package outline TO-92 (SOT54)

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