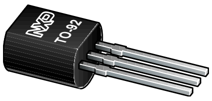

PHE13003C

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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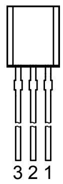
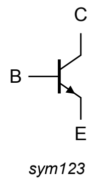
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 TO-92 (SOT54)	
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

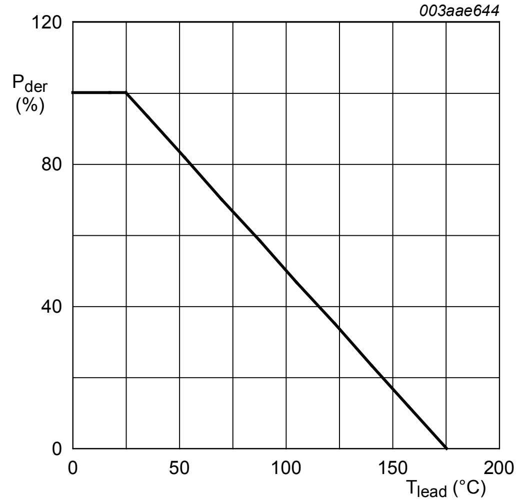


Fig. 1. Normalized total power dissipation as a function of lead temperature

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

8. Thermal characteristics

Table 5. Thermal characteristics

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

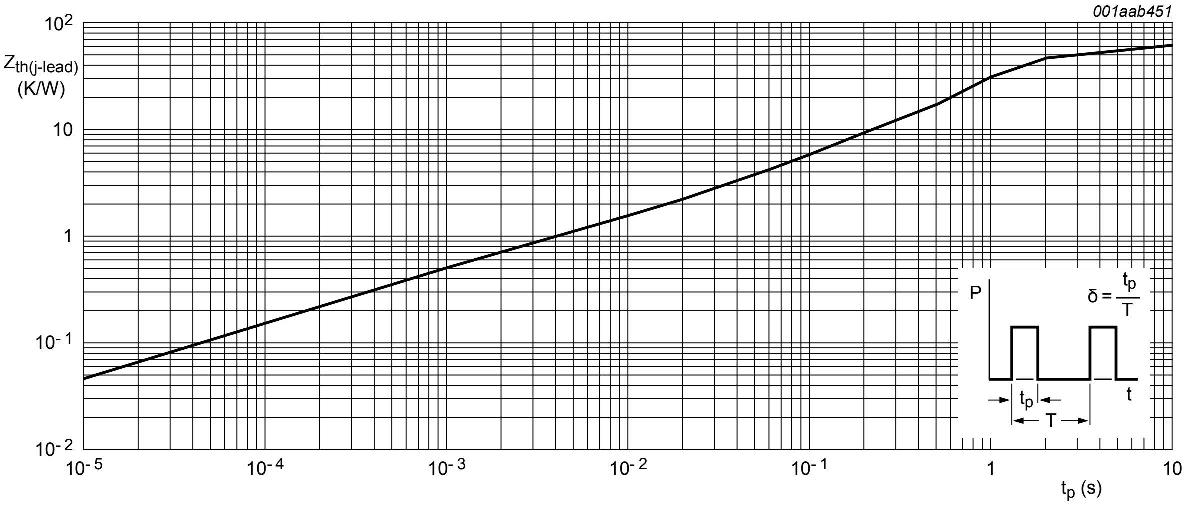


Fig. 2. Transient thermal impedance from junction to lead as a function of pulse width

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	

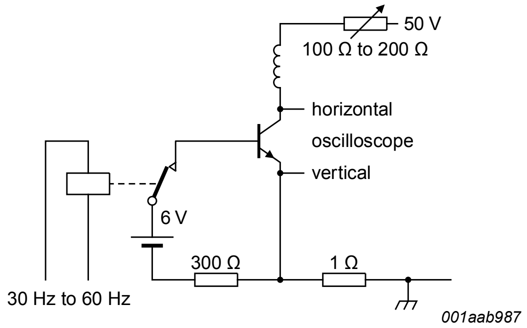


Fig. 3. Test circuit for collector-emitter sustaining voltage

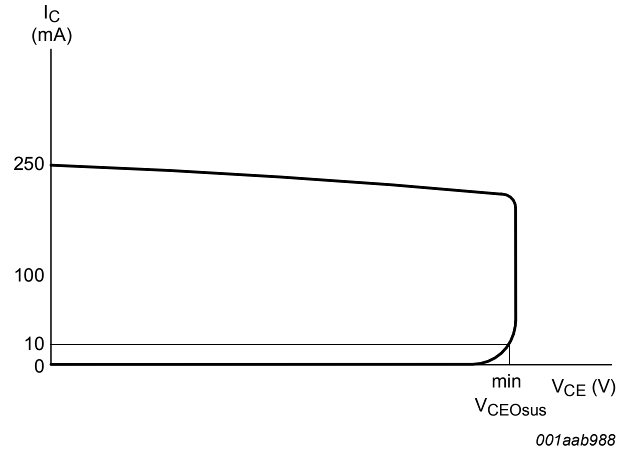


Fig. 4. Oscilloscope display for collector-emitter sustaining voltage test waveform

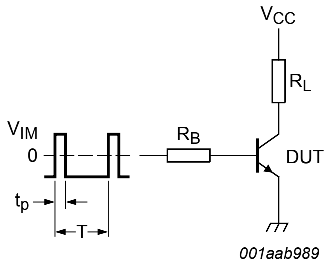


Fig. 5. Test circuit for resistive load switching

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

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

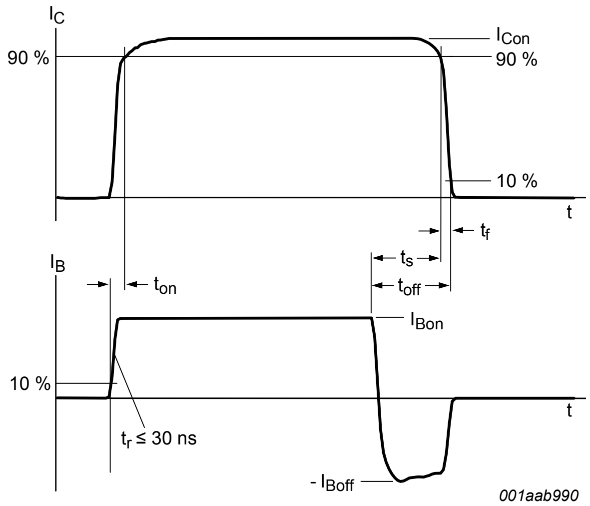


Fig. 6. Switching times waveforms for resistive load

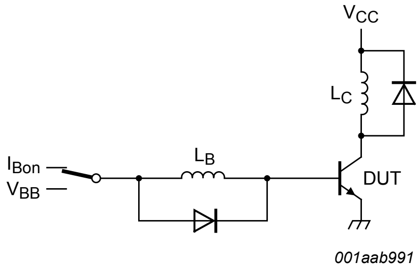


Fig. 7. Test circuit for inductive load switching

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

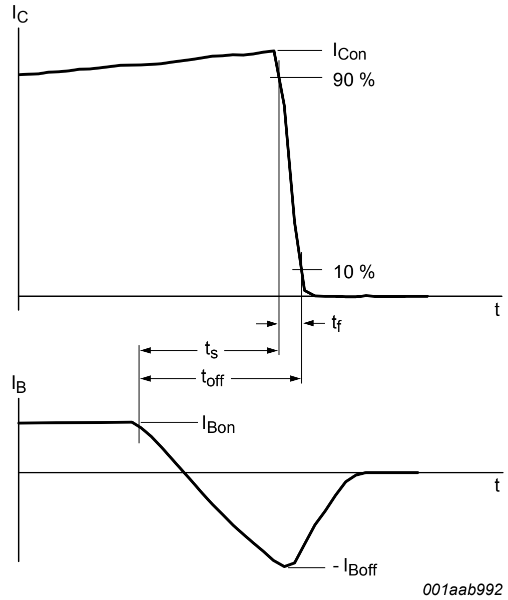
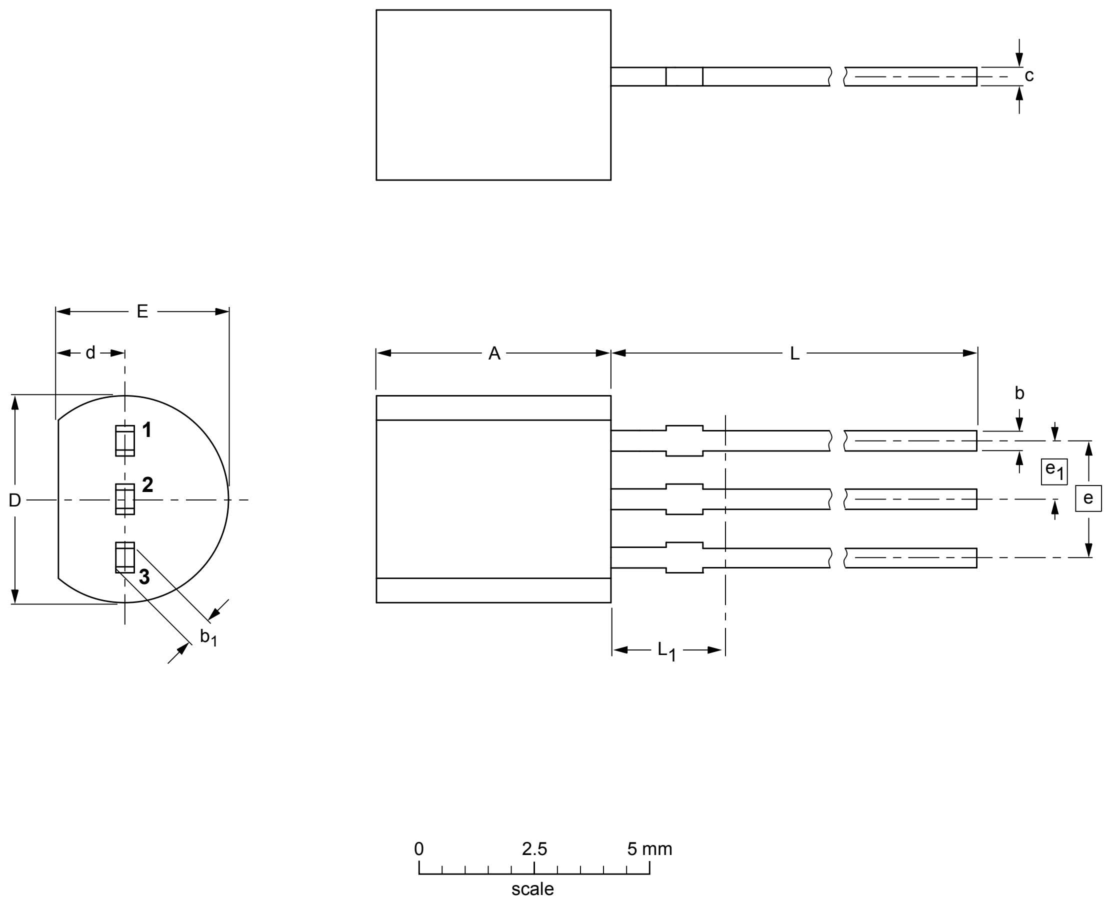


Fig. 8. Switching times waveforms for inductive load

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)

11. Legal information

11.1 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.
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