



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	$T_{lead} \leq 25\text{ °C}$; Fig. 1	-	-	2.1	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	700	V
Static characteristics						
h_{FE}	DC current gain	$I_C = 0.5\text{ A}$; $V_{CE} = 2\text{ V}$; $T_{lead} = 25\text{ °C}$	8	17	25	

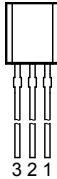
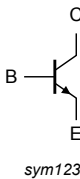


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5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>TO-92 (SOT54)</p>	
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	$V_{BE} = 0\text{ V}$	-	700	V
V_{CBO}	collector-base voltage	$I_E = 0\text{ A}$	-	700	V
V_{CEO}	collector-emitter voltage	$I_B = 0\text{ A}$	-	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	$T_{lead} \leq 25\text{ °C}$; Fig. 1	-	2.1	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C
V_{EBO}	emitter-base voltage	$I_C = 0\text{ A}$; $I(\text{Emitter}) = 10\text{ mA}$	-	9	V

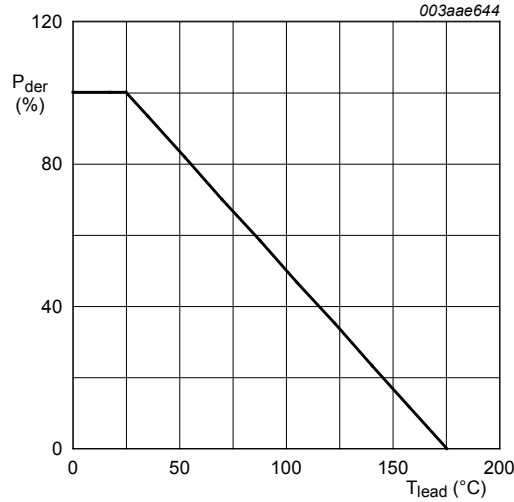


Fig. 1. Normalized total power dissipation as a function of lead temperature

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

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

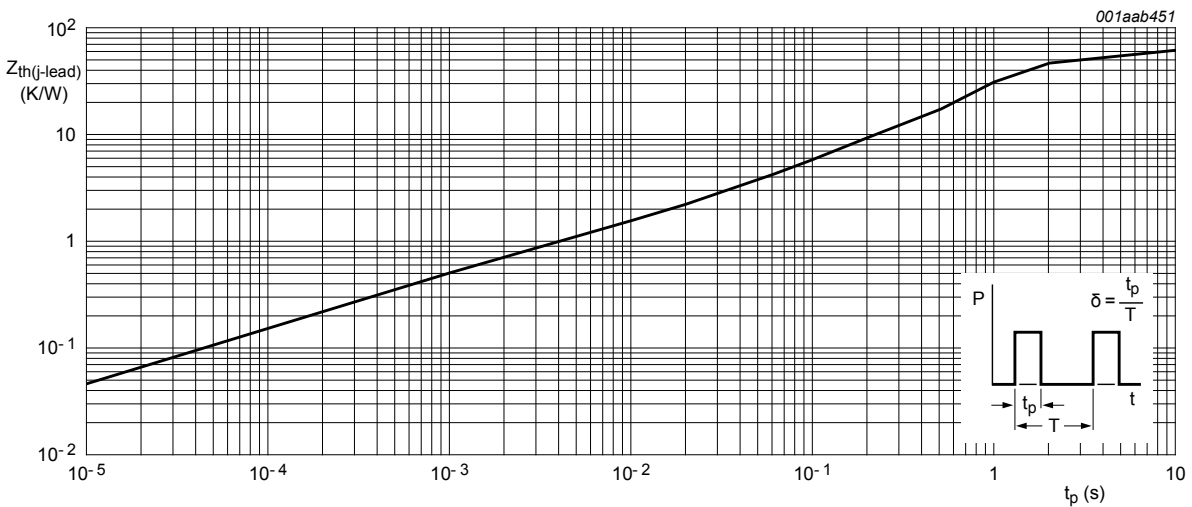


Fig. 2. Transient thermal impedance from junction to lead as a function of pulse width

9. Characteristics

Table 6. Characteristics

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

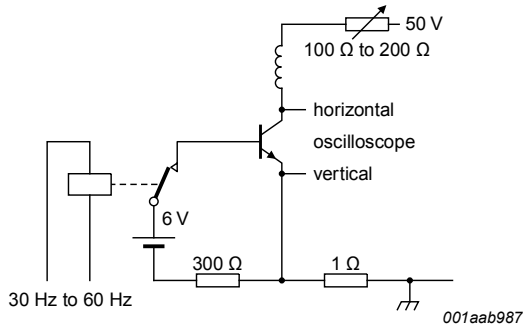


Fig. 3. Test circuit for collector-emitter sustaining voltage

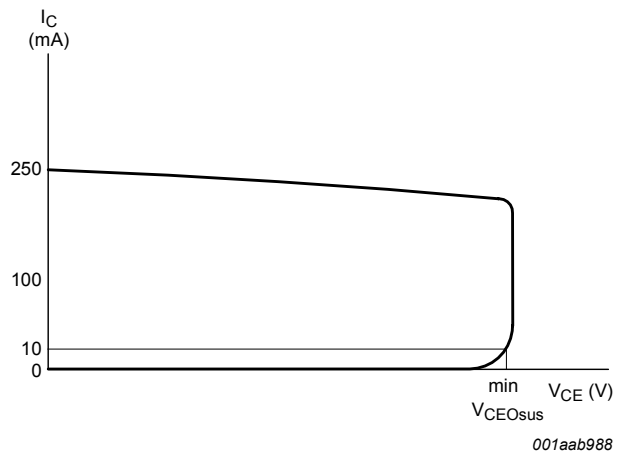


Fig. 4. Oscilloscope display for collector-emitter sustaining voltage test waveform

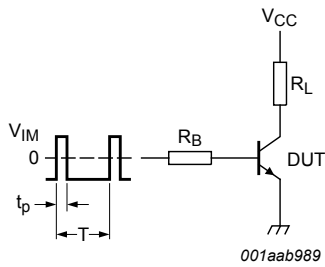


Fig. 5. Test circuit for resistive load switching

$V_{IM} = -6 \text{ to } +8 \text{ V}$; $V_{CC} = 250 \text{ V}$; $t_p = 20 \mu\text{s}$; $\delta = \frac{t_p}{T} = 0.01$
 R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

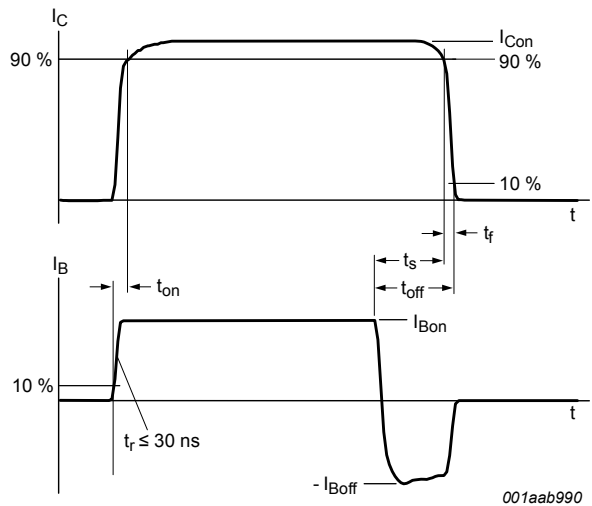


Fig. 6. Switching times waveforms for resistive load

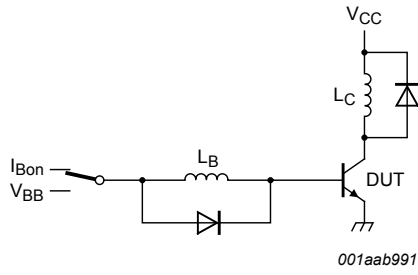


Fig. 7. Test circuit for inductive load switching

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

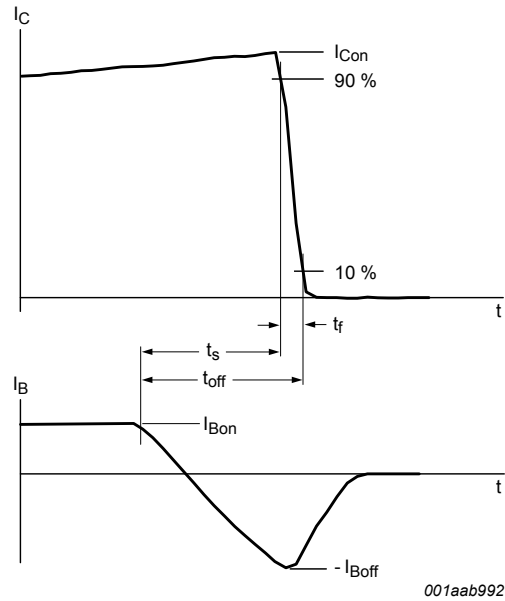
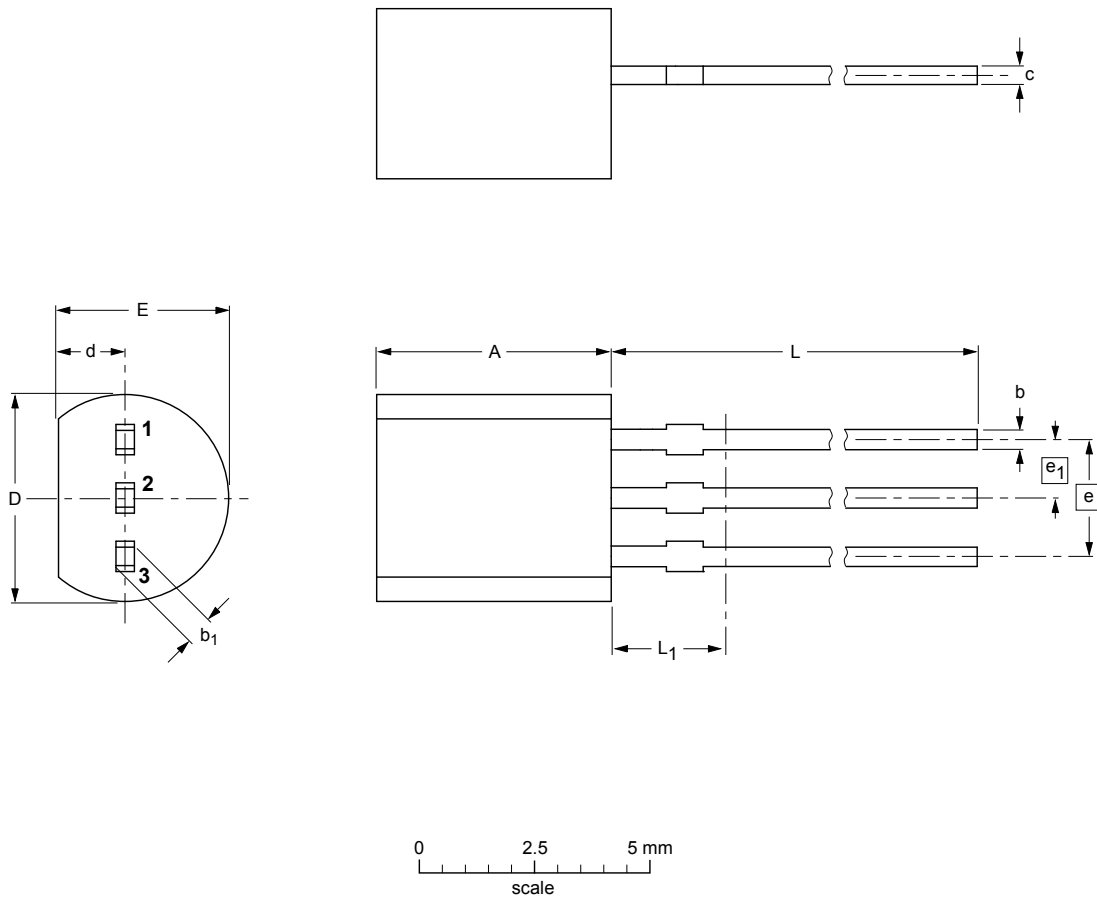


Fig. 8. Switching times waveforms for inductive load

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)

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Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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