



**THE DATASHEET OF  
PHE13003C,412**



## 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

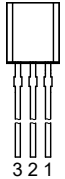
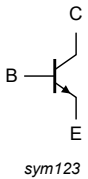
## 4. Quick reference data

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	$T_{lead} \leq 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	-	2.1	W
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	700	V
<b>Static characteristics</b>						
$h_{FE}$	DC current gain	$I_C = 0.5\text{ A}$ ; $V_{CE} = 2\text{ V}$ ; $T_{lead} = 25\text{ °C}$	8	17	25	
		$I_C = 1\text{ A}$ ; $V_{CE} = 2\text{ V}$ ; $T_{lead} = 25\text{ °C}$	5	9	15	

## 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

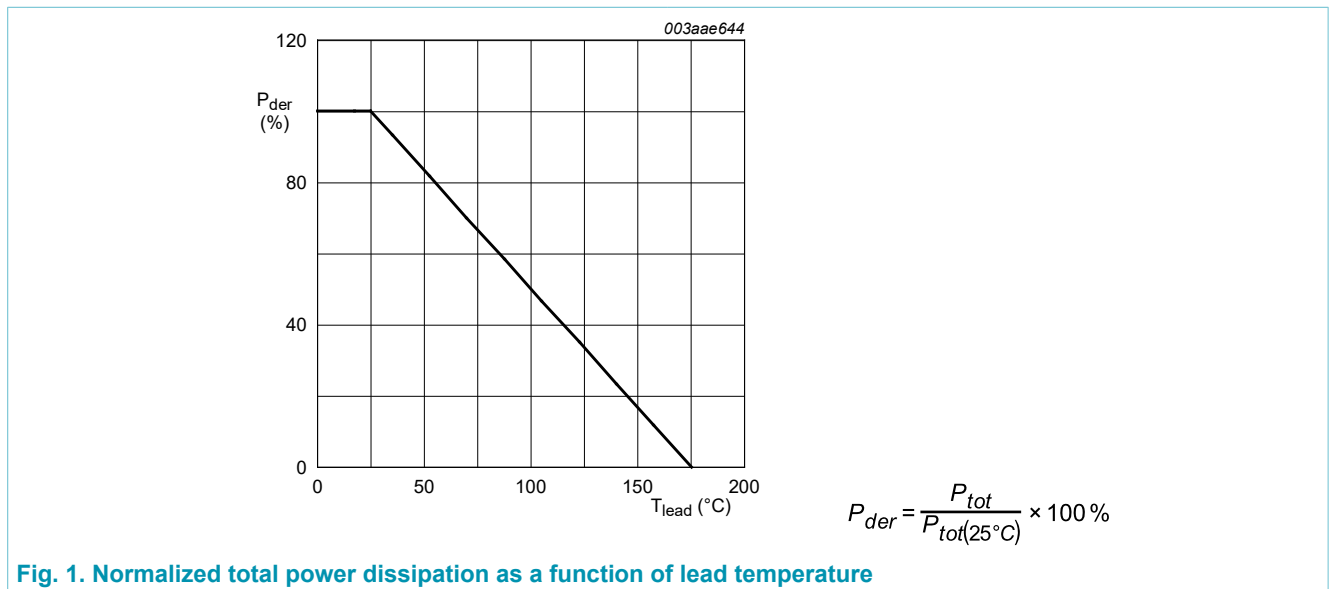
Type number	Package		
	Name	Description	Version
PHE13003C	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

## 7. Limiting values

**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CESM</sub>	collector-emitter peak voltage	V <sub>BE</sub> = 0 V	-	700	V
V <sub>CBO</sub>	collector-base voltage	I <sub>E</sub> = 0 A	-	700	V
V <sub>CEO</sub>	collector-emitter voltage	I <sub>B</sub> = 0 A	-	400	V
V <sub>EBO</sub>	emitter-base voltage	I <sub>C</sub> = 0 A; I(Emitter) = 10 mA	-	9	V
I <sub>C</sub>	collector current	DC	-	1.5	A
I <sub>CM</sub>	peak collector current		-	3	A
I <sub>B</sub>	base current	DC	-	0.75	A
I <sub>BM</sub>	peak base current		-	1.5	A
P <sub>tot</sub>	total power dissipation	T <sub>lead</sub> ≤ 25 °C; <a href="#">Fig. 1</a>	-	2.1	W
T <sub>stg</sub>	storage temperature		-65	150	°C
T <sub>j</sub>	junction temperature		-	150	°C



## 8. Thermal characteristics

Table 5. Thermal characteristics

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

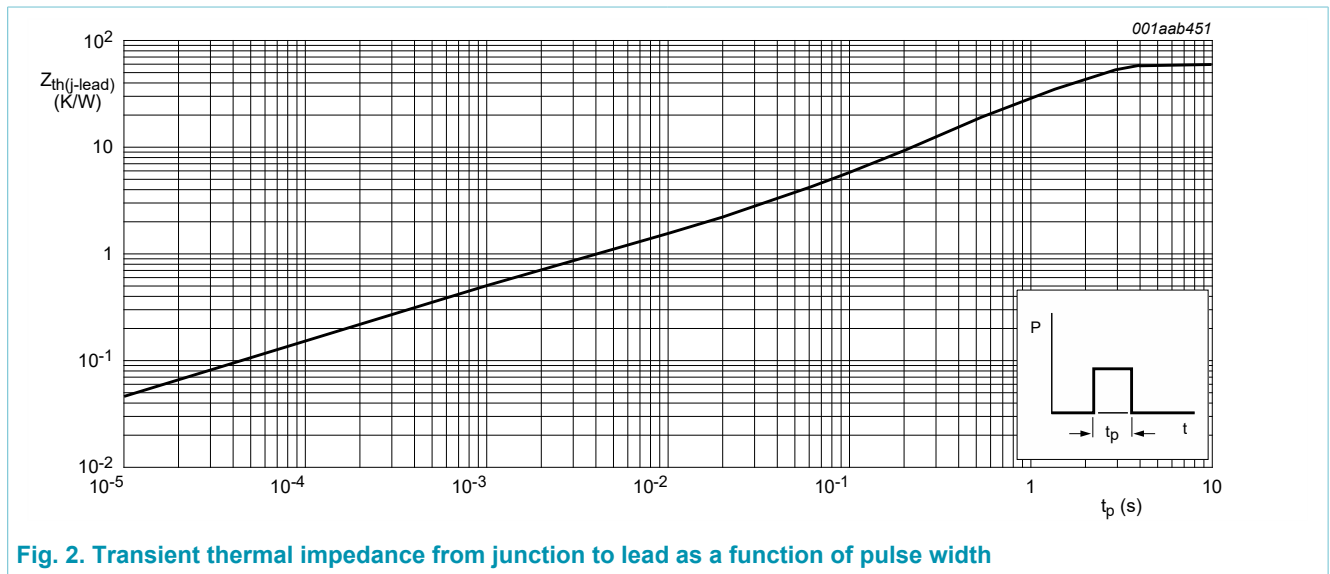


Fig. 2. Transient thermal impedance from junction to lead as a function of pulse width

## 9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{CES}$	collector-emitter cut-off current (base shorted)	$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}; T_j = 125\text{ }^\circ\text{C}$	-	-	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 (base open)	$V_{CE} = 400\text{ V}; I_B = 0\text{ A}; T_{lead} = 25\text{ }^\circ\text{C}$	-	-	0.1	mA
$I_{EBO}$	emitter-base cut-off current (collector open)	$V_{EB} = 9\text{ V}; I_C = 0\text{ A}; T_{lead} = 25\text{ }^\circ\text{C}$	-	-	1	mA
$V_{CEOsus}$	collector-emitter sustaining voltage (base open)	$I_B = 0\text{ A}; I_C = 1\text{ mA}; L_C = 25\text{ mH}; T_{lead} = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 3</a> ; <a href="#">Fig. 4</a>	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	
<b>Dynamic characteristics</b>						
$t_{on}$	turn-on time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\text{ }\Omega; T_{lead} = 25\text{ }^\circ\text{C};$ resistive load; <a href="#">Fig. 5</a> ; <a href="#">Fig. 6</a>	-	-	1	$\mu\text{s}$
$t_s$	storage time		$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_{lead} = 25\text{ }^\circ\text{C};$ inductive load; <a href="#">Fig. 7</a> ; <a href="#">Fig. 8</a>	-	0.8	-
		$t_f$	fall time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\text{ }\Omega; T_{lead} = 25\text{ }^\circ\text{C};$ resistive load; <a href="#">Fig. 5</a> ; <a href="#">Fig. 6</a>	-	-
$I_C = 0.5\text{ A}; I_{Bon} = 0.1\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_{lead} = 25\text{ }^\circ\text{C};$ inductive load; <a href="#">Fig. 7</a> ; <a href="#">Fig. 8</a>	-			0.1	-	$\mu\text{s}$

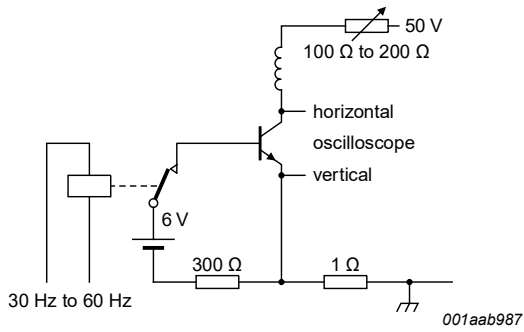


Fig. 3. Test circuit for collector-emitter sustaining voltage

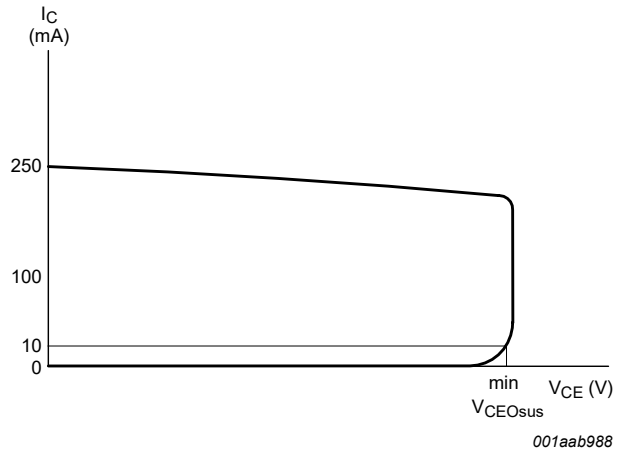
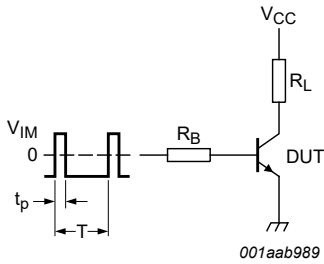


Fig. 4. Oscilloscope display for collector-emitter sustaining voltage test waveform



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

Fig. 5. Test circuit for resistive load switching

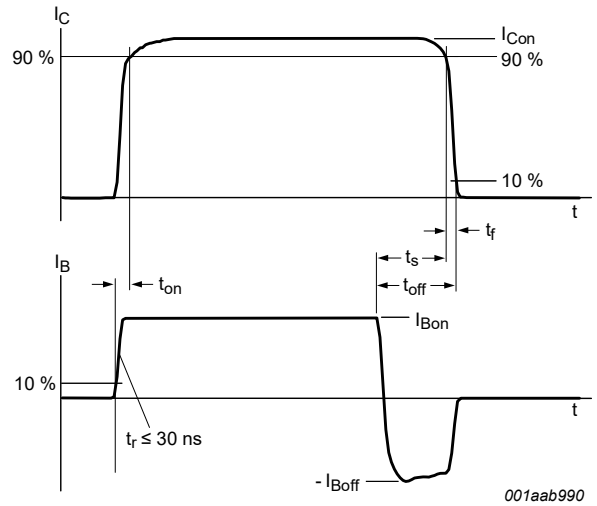


Fig. 6. Switching times waveforms for resistive load

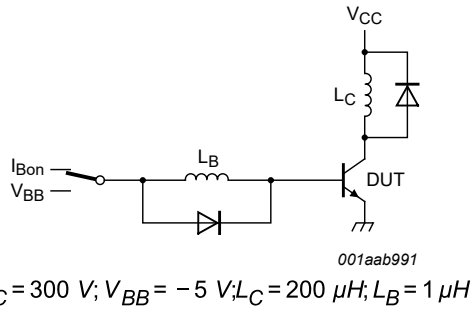


Fig. 7. Test circuit for inductive load switching

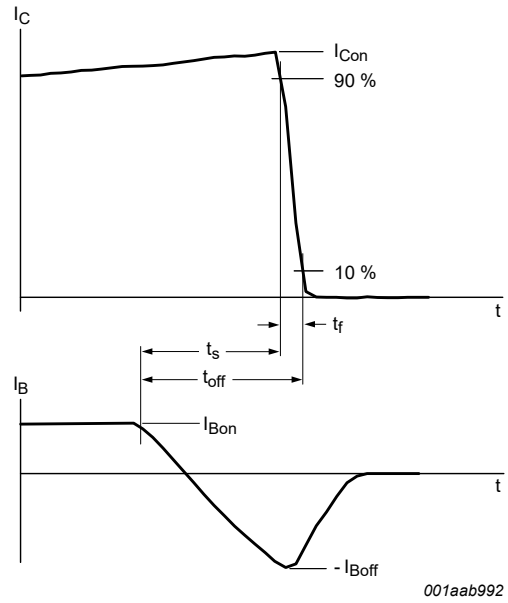
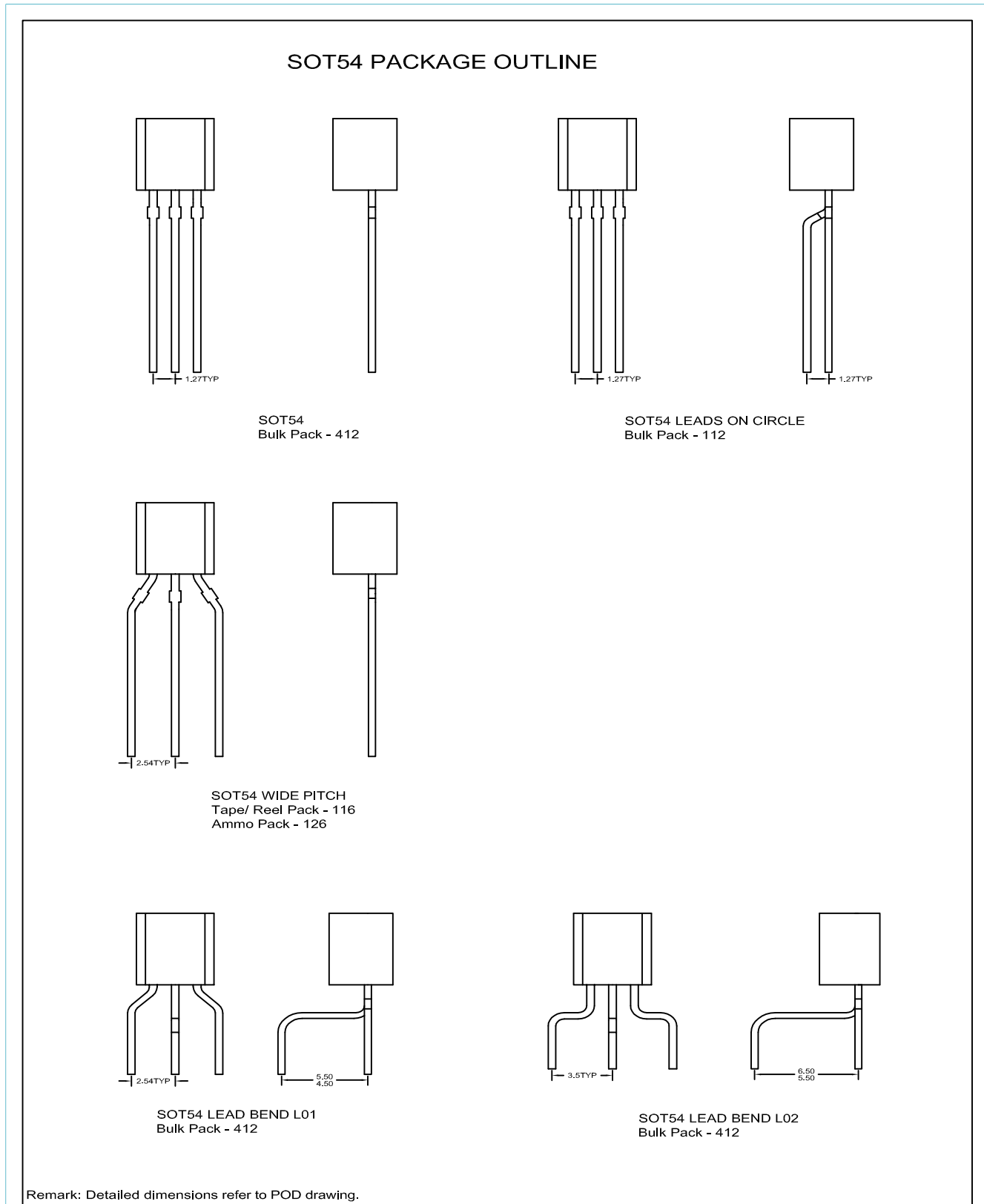


Fig. 8. Switching times waveforms for inductive load

### 10. Package outline



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

## 11. Legal information

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