

# PHD13003C

NPN power transistor with integrated diode

Rev. 01 — 29 July 2010

Product data sheet

## 1. Product profile

### 1.1 General description

High voltage, high speed, planar passivated NPN power switching transistor with integrated anti-parallel emitter-collector diode in a SOT54 plastic package

### 1.2 Features and benefits

- Fast switching
- High typical DC current gain
- High voltage capability
- Integrated anti-parallel E-C diode

### 1.3 Applications

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

### 1.4 Quick reference data

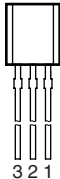
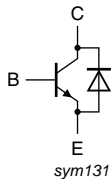
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_C$	collector current	DC	-	-	1.5	A
$P_{tot}$	total power dissipation	$T_{lead} \leq 25\text{ °C}$ ; see <a href="#">Figure 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	$I_C = 0.5\text{ A}$ ; $V_{CE} = 2\text{ V}$ ; $T_j = 25\text{ °C}$	8	17	25	



## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>SOT54 (TO-92)</p>	 <p>sym131</p>
2	C	collector		
3	E	emitter		

## 3. Ordering information

Table 3. Ordering information

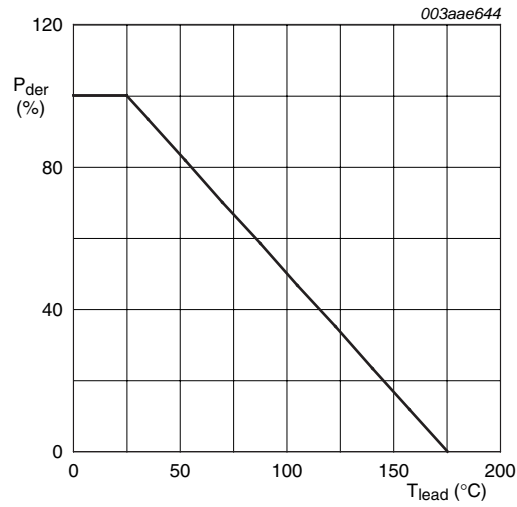
Type number	Package		
	Name	Description	Version
PHD13003C	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

## 4. 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	$T_{lead} \leq 25\text{ °C}$ ; see <a href="#">Figure 1</a>	-	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



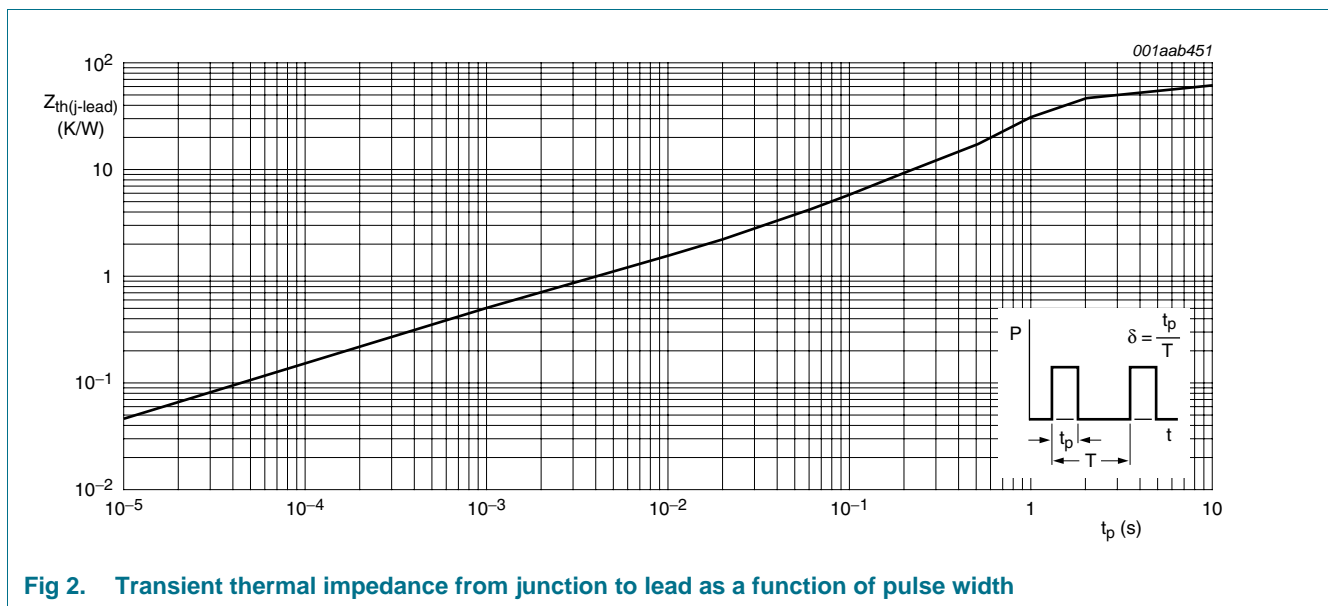
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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

## 5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-lead)}$	thermal resistance from junction to lead	see <a href="#">Figure 2</a>	-	-	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



## 6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{CES}$	collector-emitter cut-off current	$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}$	-	-	1	mA
		$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}; T_j = 100\text{ °C}$	-	-	5	mA
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = 400\text{ V}; I_B = 0\text{ A}; T_{lead} = 25\text{ °C}$	-	-	0.1	mA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 9\text{ V}; I_C = 0\text{ A}; T_{lead} = 25\text{ °C}$	-	-	1	mA
$V_{CEOsus}$	collector-emitter sustaining voltage	$I_B = 0\text{ A}; I_C = 1\text{ mA}; L_C = 25\text{ mH}; T_{lead} = 25\text{ °C};$ see <a href="#">Figure 3</a> ; see <a href="#">Figure 4</a>	400	-	-	V
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 0.1\text{ A}; T_{lead} = 25\text{ °C}$	-	-	0.5	V
		$I_C = 1\text{ A}; I_B = 0.25\text{ A}; T_{lead} = 25\text{ °C}$	-	-	1	V
		$I_C = 1.5\text{ A}; I_B = 0.5\text{ A}; T_{lead} = 25\text{ °C}$	-	-	1.5	V
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 0.1\text{ A}; T_{lead} = 25\text{ °C}$	-	-	1	V
		$I_C = 1\text{ A}; I_B = 0.25\text{ A}; T_{lead} = 25\text{ °C}$	-	-	1.2	V
$V_F$	forward voltage	$I_F = 0.5\text{ A}; T_j = 25\text{ °C}$	-	-	1.5	V
$h_{FE}$	DC current gain	$I_C = 0.5\text{ A}; V_{CE} = 2\text{ V}; T_j = 25\text{ °C}$	8	17	25	
		$I_C = 1\text{ A}; V_{CE} = 2\text{ V}; T_j = 25\text{ °C}$	5	9	15	
<b>Dynamic characteristics</b>						
$t_{on}$	turn-on time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\text{ }\Omega; T_{lead} = 25\text{ °C};$ resistive load; see <a href="#">Figure 5</a> ; see <a href="#">Figure 6</a>	-	-	1	$\mu\text{s}$
$t_s$	storage time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_{lead} = 25\text{ °C};$ inductive load; see <a href="#">Figure 7</a> ; see <a href="#">Figure 8</a>	-	0.8	-	$\mu\text{s}$
		$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\text{ }\Omega; T_{lead} = 25\text{ °C};$ resistive load; see <a href="#">Figure 5</a> ; see <a href="#">Figure 6</a>	-	-	0.7	$\mu\text{s}$
$t_f$	fall time	$I_C = 0.5\text{ A}; I_{Bon} = 0.1\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_{lead} = 25\text{ °C};$ inductive load; see <a href="#">Figure 7</a> ; see <a href="#">Figure 8</a>	-	0.1	-	$\mu\text{s}$
		$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\text{ }\Omega; T_{lead} = 25\text{ °C};$ resistive load; see <a href="#">Figure 5</a> ; see <a href="#">Figure 6</a>	-	-	0.7	$\mu\text{s}$

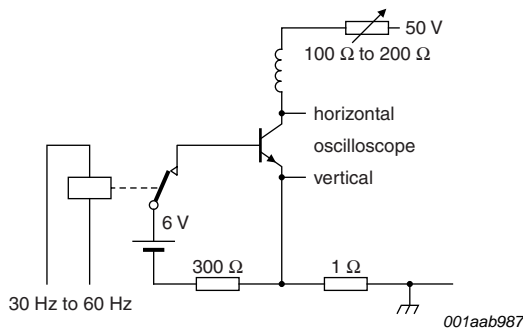


Fig 3. Test circuit for collector-emitter sustaining voltage

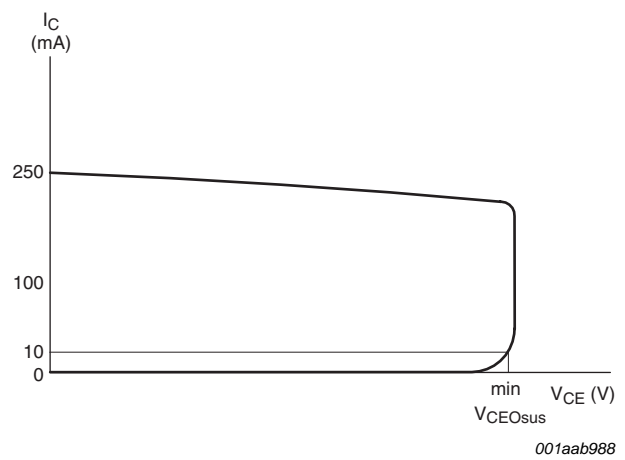
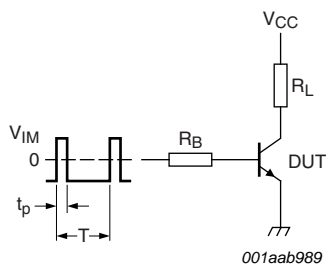


Fig 4. Oscilloscope display for collector-emitter sustaining voltage test waveform



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

Fig 5. Test circuit for resistive load switching

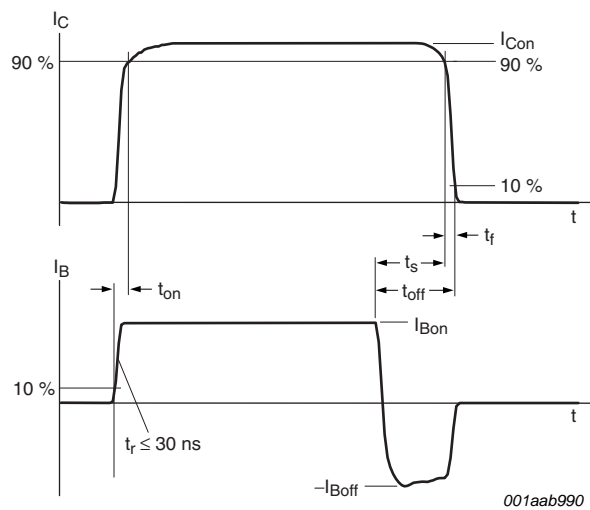
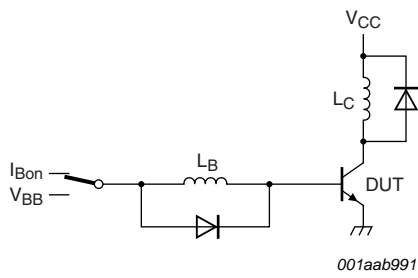


Fig 6. Switching times waveforms for resistive load



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

Fig 7. Test circuit for inductive load switching

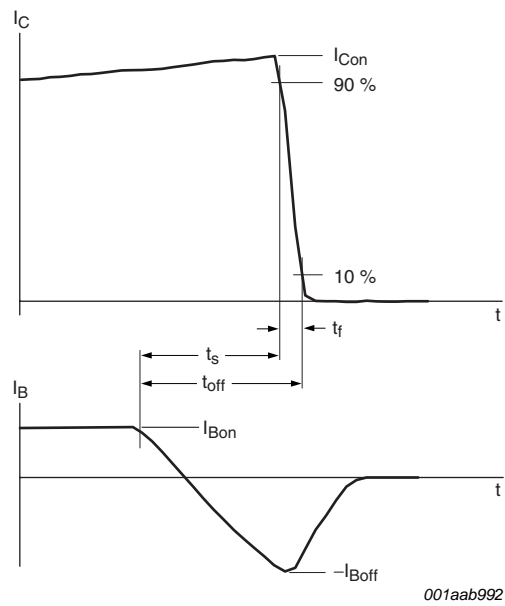


Fig 8. Switching times waveforms for inductive load

7. Package outline

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

SOT54

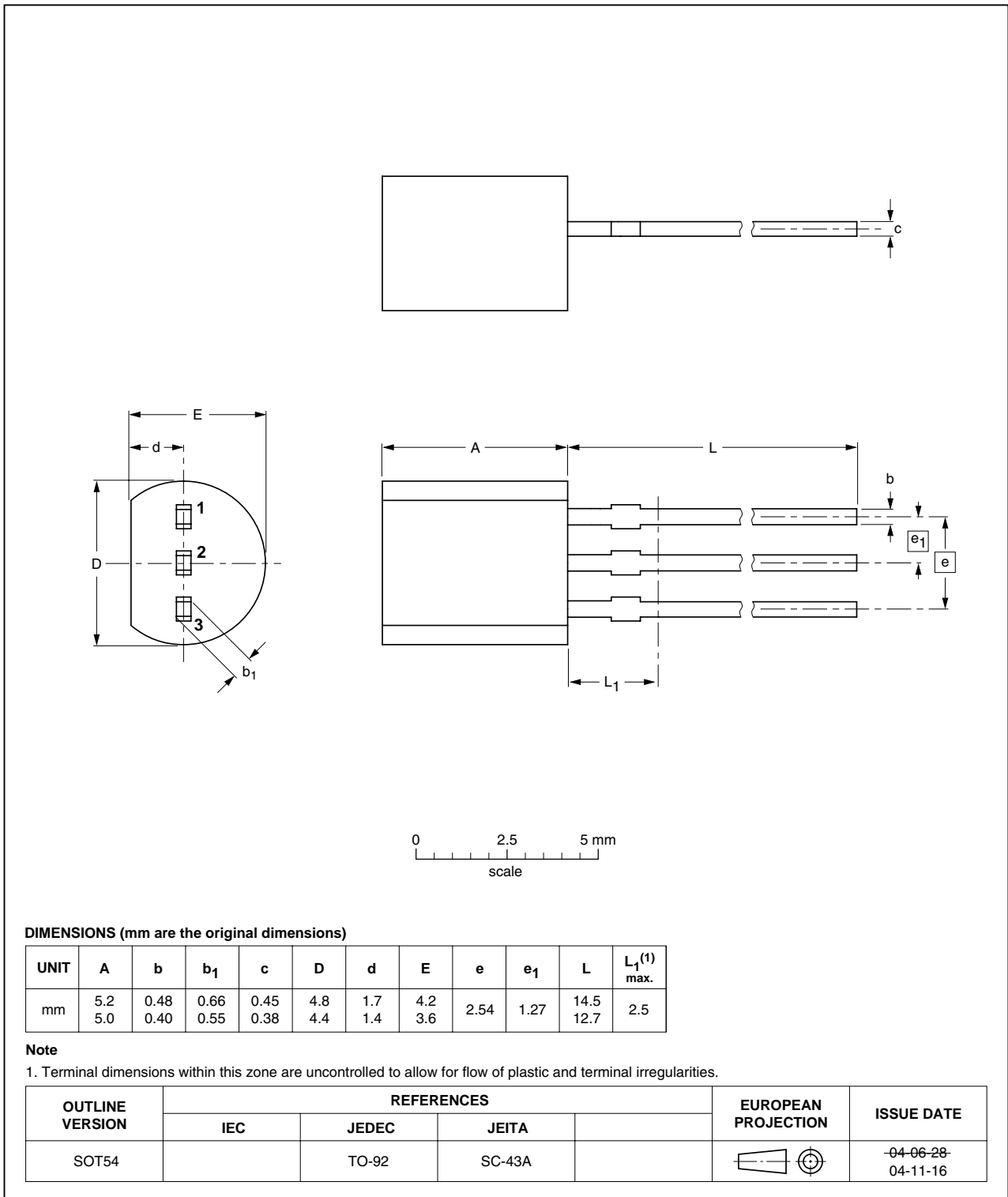


Fig 9. Package outline SOT54 (TO-92)



## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHD13003C v.1	20100729	Product data sheet	-	-

## 9. Legal information

### 9.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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