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

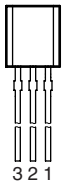
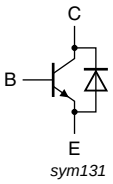
1.4 Quick reference data

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	$T_{lead} \leq 25$ °C; see Figure 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; $T_j = 25$ °C	8	17	25	

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base		
2	C	collector		
3	E	emitter		

SOT54 (TO-92)

3. Ordering information

Table 3. Ordering information

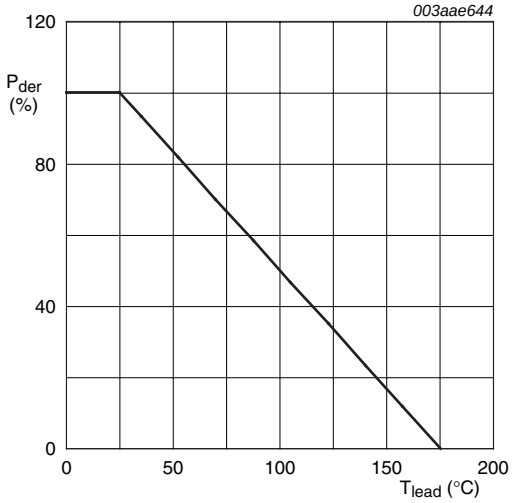
Type number	Package		
	Name	Description	Version
PHD13003C	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

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 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	$T_{lead} \leq 25$ ℃; see Figure 1	-	2.1	W
T_{stg}	storage temperature		-65	150	℃
T_j	junction temperature		-	150	℃
V_{EBO}	emitter-base voltage	I_C = 0 A; I(Emitter) = 10 mA	-	9	V



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

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
$R_{th(j\text{-}lead)}$	thermal resistance from junction to lead	see Figure 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

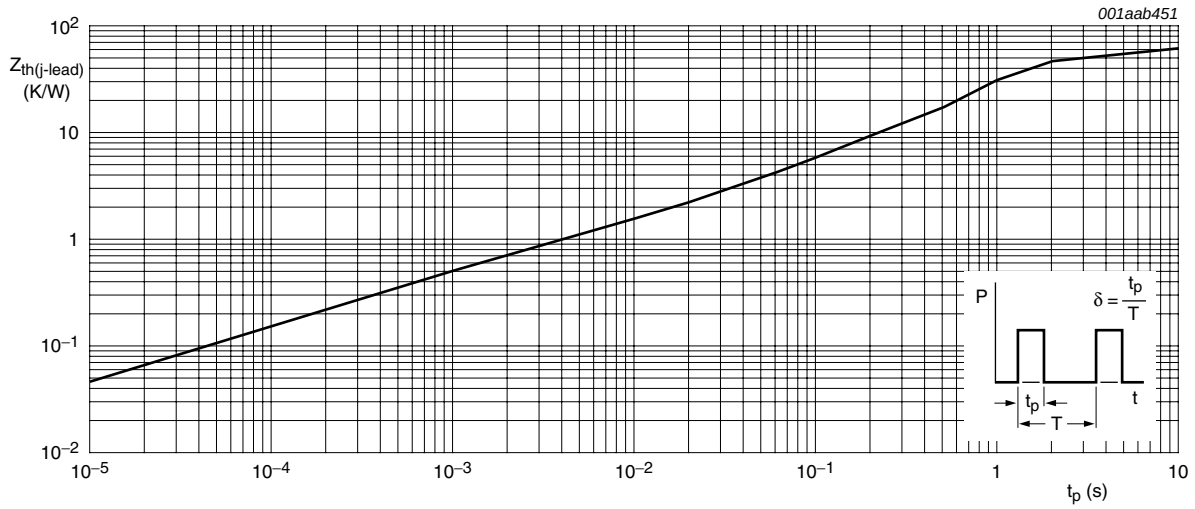


Fig 2. Transient thermal impedance from junction to lead as a function of pulse width

6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V; V_{CE} = 700 V	-	-	1	mA
		V_{BE} = 0 V; V_{CE} = 700 V; T_j = 100 °C	-	-	5	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 ℃; see Figure 3; see Figure 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
V_F	forward voltage	I_F = 0.5 A; T_j = 25 °C	-	-	1.5	V
h_{FE}	DC current gain	I_C = 0.5 A; V_{CE} = 2 V; T_j = 25 ℃	8	17	25	
		I_C = 1 A; V_{CE} = 2 V; T_j = 25 °C	5	9	15	
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 ℃; resistive load; see Figure 5; see Figure 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 ℃; inductive load; see Figure 7; see Figure 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 ℃; resistive load; see Figure 5; see Figure 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 ℃; inductive load; see Figure 7; see Figure 8	-	0.1	-	µs

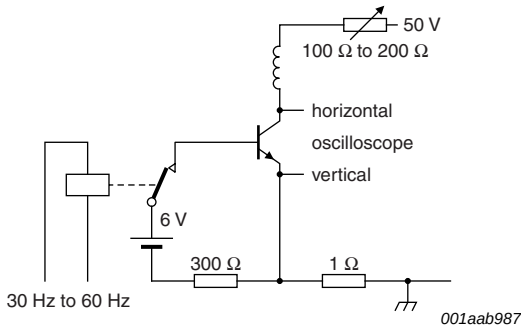


Fig 3. Test circuit for collector-emitter sustaining voltage

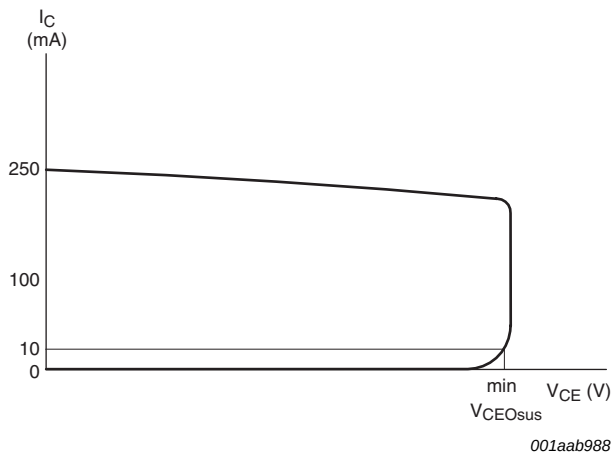
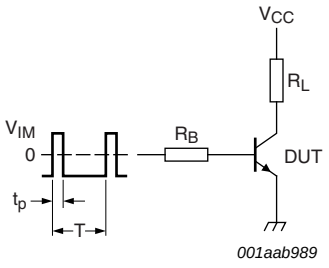


Fig 4. Oscilloscope display for collector-emitter sustaining voltage test waveform



$V_{IM} = -6$ 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 5. Test circuit for resistive load switching

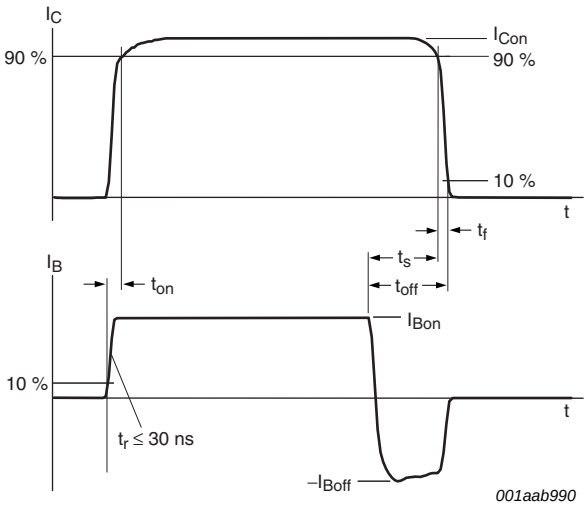
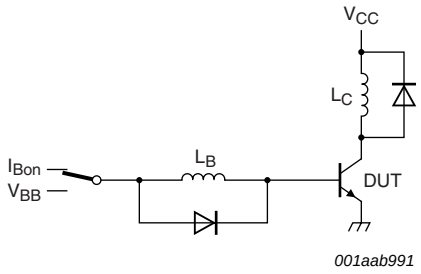


Fig 6. Switching times waveforms for resistive load



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

Fig 7. Test circuit for inductive load switching

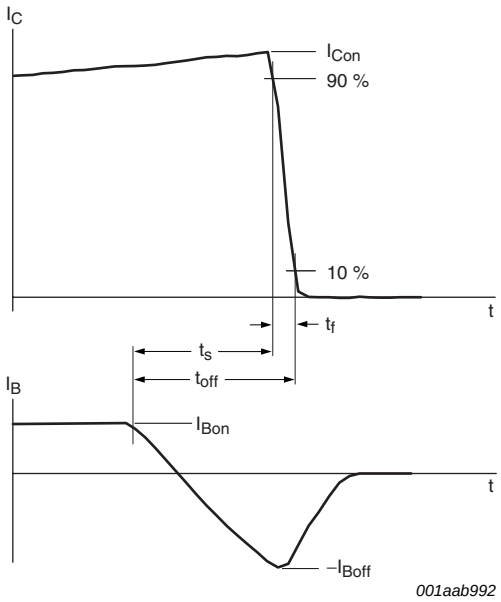
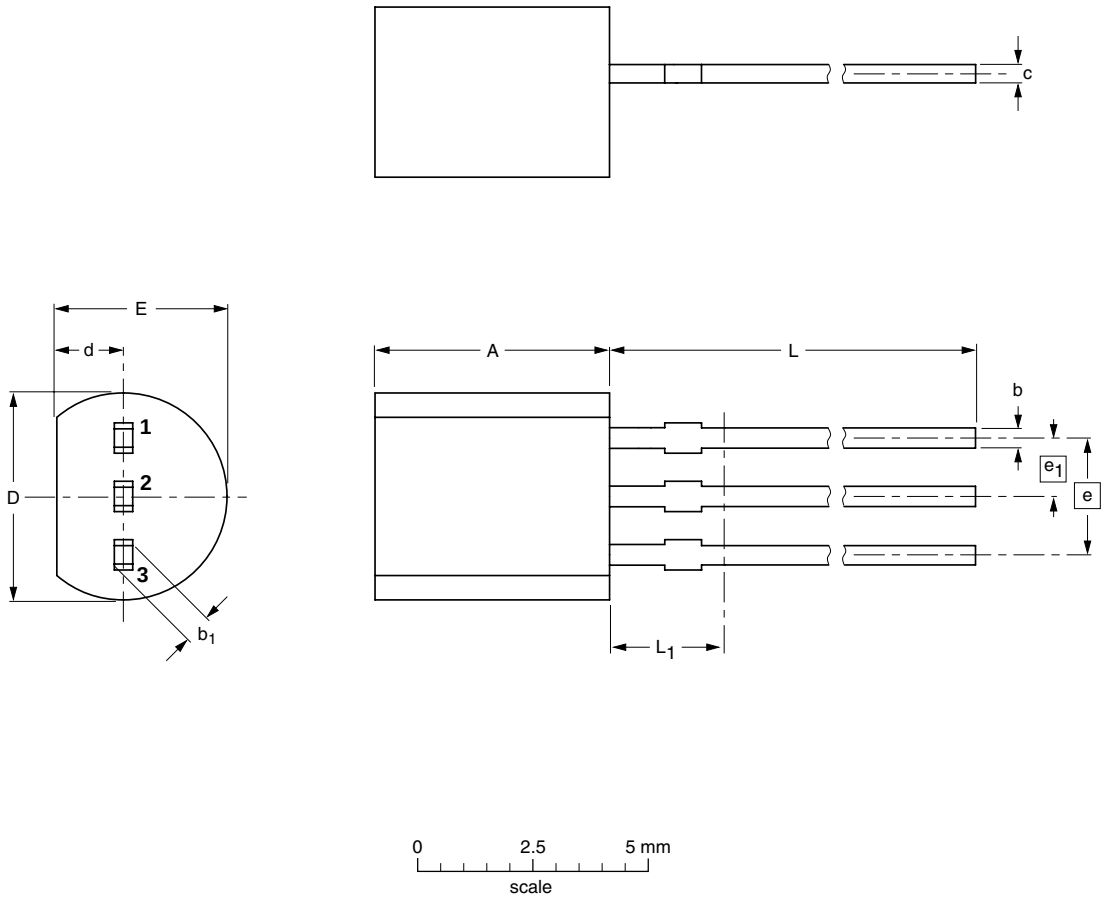


Fig 8. Switching times waveforms for inductive load

7. Package outline

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



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 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[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.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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11. Contents

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