PHD13003C

NPN power transistor with integrated diode

Rev.02 - 29 May 2018 Product data sheet

1. General description

High voltage, high speed, planar passivated NPN power switching transistor with integrated anti-parallel emitter-collector diode in a SOT54 (TO-92) plastic package.

2. Features and benefits

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

3. Applications

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

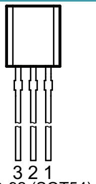
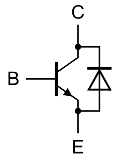
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Values		Unit
Absolute maximum rating						
V_{CESM}	collector-emitter peak voltage	V_{BE} = 0 V		700		V
I_C	collector current	DC		1.5		A
P_{tot}	total power dissipation	$T_{lead} \leq 25$ °C; Fig. 1		2.1		W
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Static characteristics						
h_{FE}	DC current gain	I_C = 0.5 A; V_{CE} = 2 V; T_j = 25 °C	8	17	25	

5. Pinning information

Table 2. Pinning information

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

6. 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

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7. Limiting values

Table 4. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Values	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	$T_{lead} \leq 25$ °C; Fig. 1	2.1	W
T_{stg}	storage temperature		-65 to 150	°C
T_j	junction temperature		150	°C
V_{EBO}	emitter-base voltage	I_C = 0 A; I(Emitter) = 10 mA	9	V

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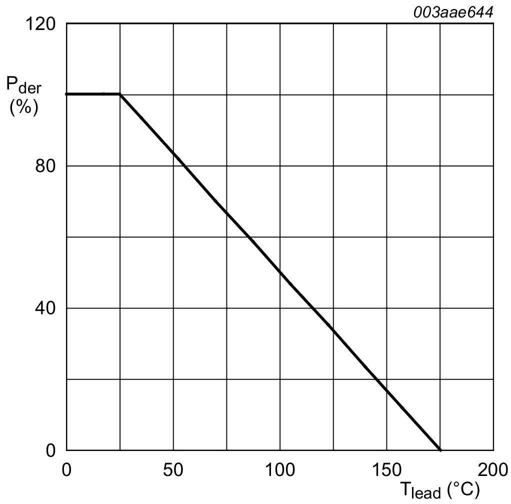

$$P_{der}(\%) = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\%$$

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

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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

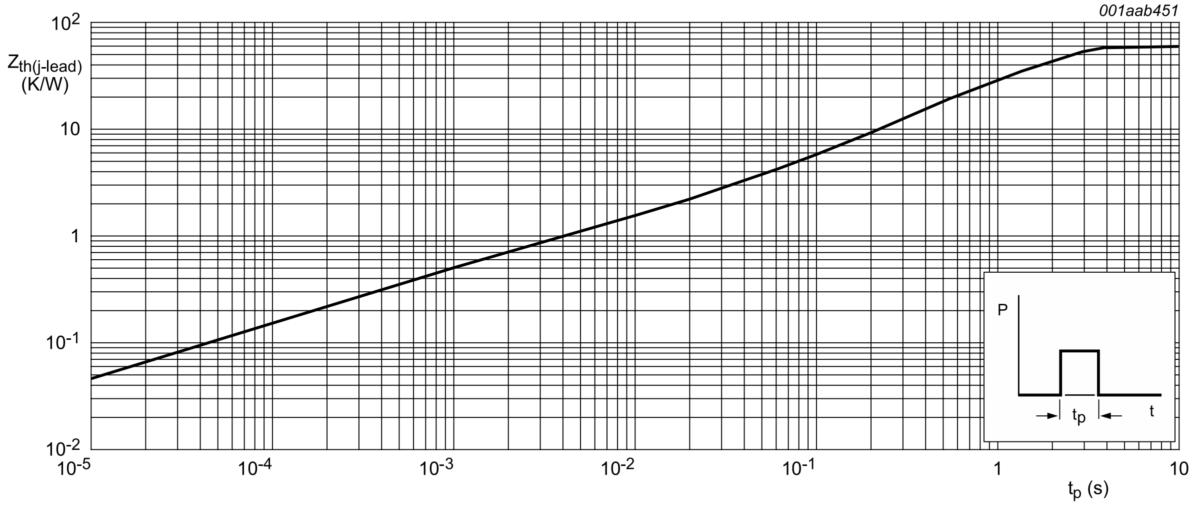

Fig. 2. Transient thermal impedance from junction to lead as a function of pulse width

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9. 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°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
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°C		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 °C; resistive load; Fig. 5; Fig. 6		-	-	1	µs
t_s	storage 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		-	-	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

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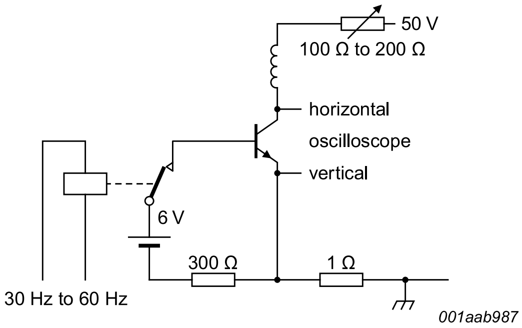


Fig. 3. Test circuit for collector-emitter sustaining voltage

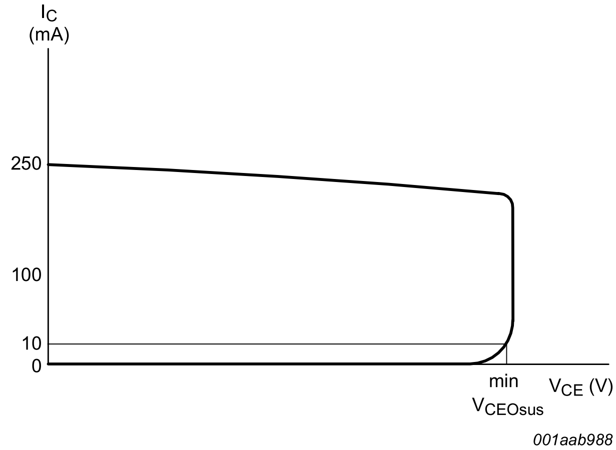
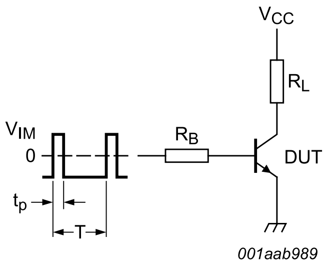


Fig. 4. Oscilloscope display for collector-emitter sustaining voltage test waveform



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

Fig. 5. Test circuit for resistive load switching

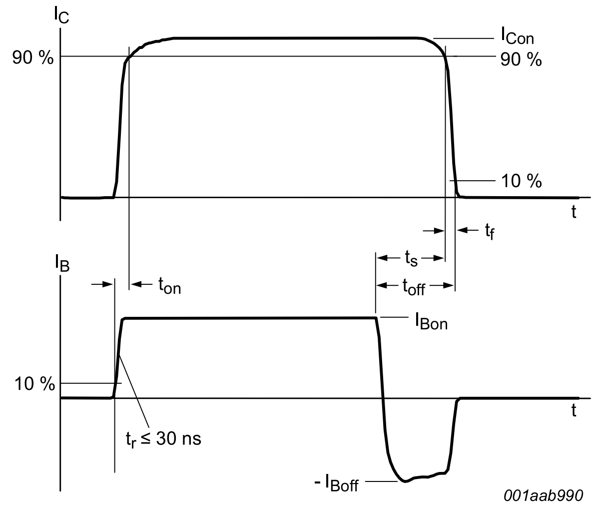


Fig. 6. Switching times waveforms for resistive load

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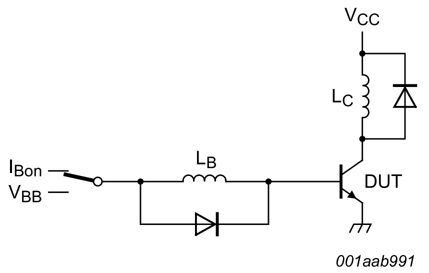

V_{CC} = 300 V; V_{BB} = - 5 V; L_C = 200 µH; L_B = 1 µH.

Fig. 7. Test circuit for inductive load switching

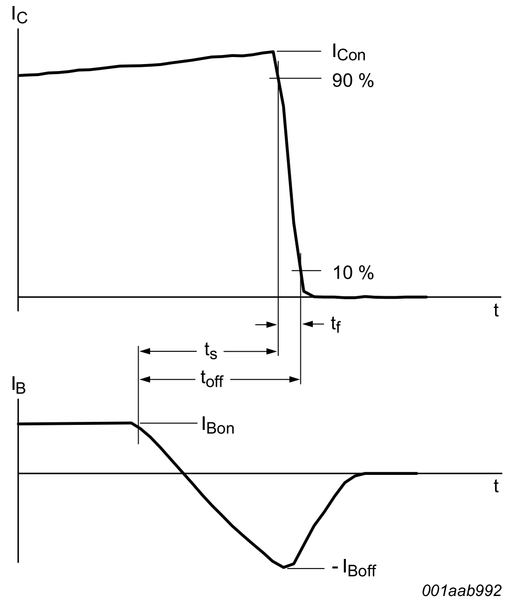

Fig. 8. Switching times waveforms for inductive load

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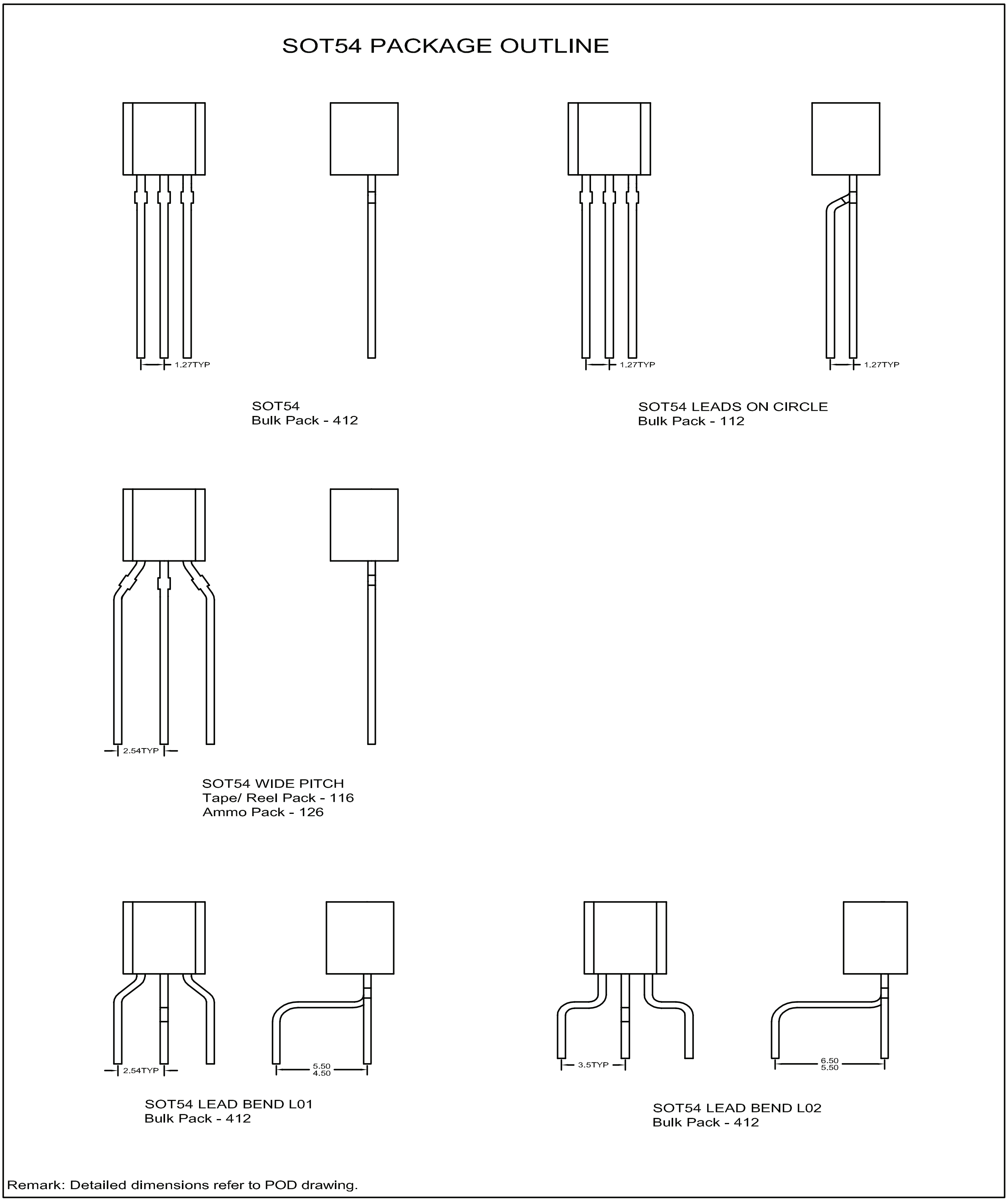
10. Package outline



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11. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHD13003C v.2	20180224	Product data sheet	-	PHD13003C v.1
Modifications:	Change from NXP version to WeEn version			
PHD13003C v.1	20100729	Product data sheet	-	-

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12. Legal information

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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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