



**THE DATASHEET OF
PHD13003C,412**



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

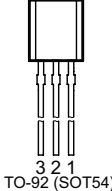
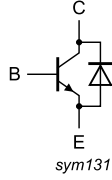
4. Quick reference data

Table 1. Quick reference data

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

5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

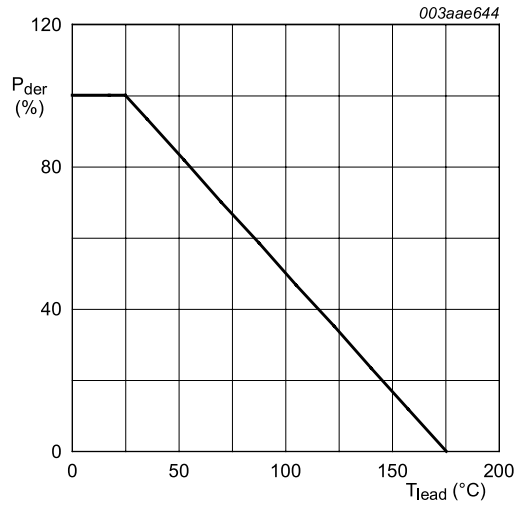
Type number	Package		
	Name	Description	Version
PHD13003C	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

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	$V_{BE} = 0\text{ V}$	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 to 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

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

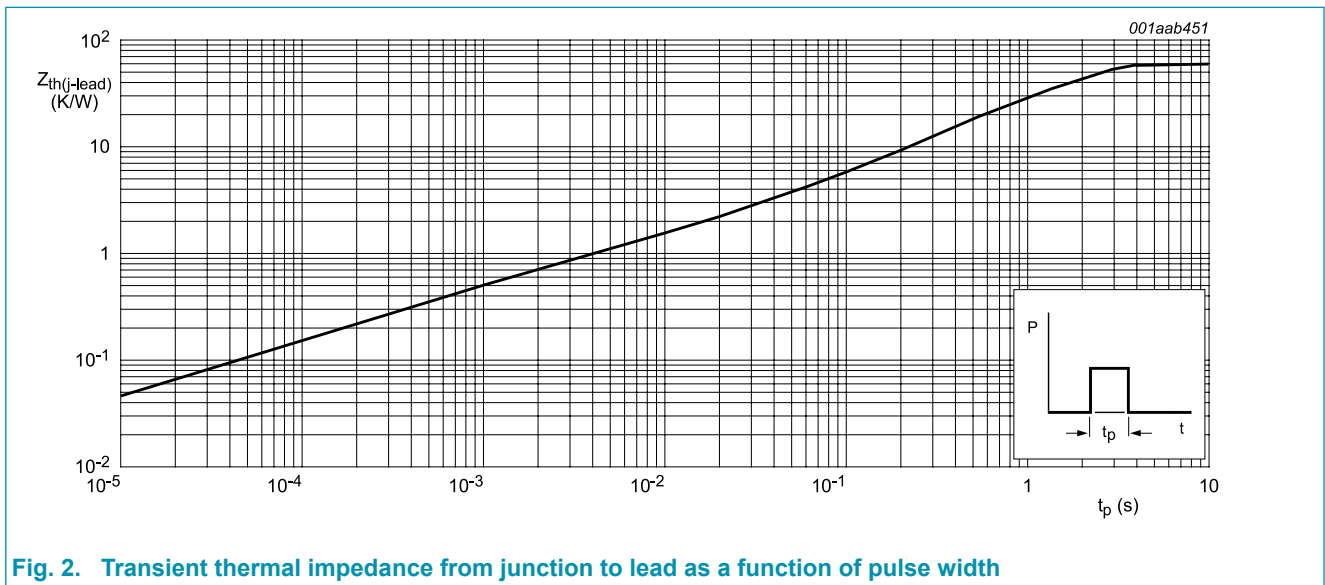


Fig. 2. Transient thermal impedance from junction to lead as a function of pulse width

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{CES}	collector-emitter cut-off current	$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}$	-	-	1	mA
		$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}; T_j = 100^\circ\text{C}$	-	-	5	mA
I_{CEO}	collector-emitter cut-off current	$V_{CE} = 400\text{ V}; I_B = 0\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9\text{ V}; I_C = 0\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	1	mA
V_{CE0sus}	collector-emitter sustaining voltage	$I_B = 0\text{ A}; I_C = 1\text{ mA}; L_C = 25\text{ mH}; T_{lead} = 25^\circ\text{C}$; Fig. 3 ; Fig. 4	400	-	-	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 0.1\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	0.5	V
		$I_C = 1\text{ A}; I_B = 0.25\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	1	V
		$I_C = 1.5\text{ A}; I_B = 0.5\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 0.5\text{ A}; I_B = 0.1\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	1	V
		$I_C = 1\text{ A}; I_B = 0.25\text{ A}; T_{lead} = 25^\circ\text{C}$	-	-	1.2	V
V_F	forward voltage	$I_F = 0.5\text{ A}; T_j = 25^\circ\text{C}$	-	-	1.5	V
h_{FE}	DC current gain	$I_C = 0.5\text{ A}; V_{CE} = 2\text{ V}; T_j = 25^\circ\text{C}$	8	17	25	
		$I_C = 1\text{ A}; V_{CE} = 2\text{ V}; T_j = 25^\circ\text{C}$	5	9	15	
Dynamic characteristics						
t_{on}	turn-on time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\ \Omega; T_{lead} = 25^\circ\text{C}$; resistive load; Fig. 5 ; Fig. 6	-	-	1	μs
t_s	storage time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\ \Omega; T_{lead} = 25^\circ\text{C}$; resistive load; Fig. 5 ; Fig. 6	-	-	4	μs
		$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\ \mu\text{H}; T_{lead} = 25^\circ\text{C}$; inductive load; Fig. 7 ; Fig. 8	-	0.8	-	μs
t_f	fall time	$I_C = 1\text{ A}; I_{Bon} = 0.2\text{ A}; I_{Boff} = -0.2\text{ A}; R_L = 75\ \Omega; T_{lead} = 25^\circ\text{C}$; resistive load; Fig. 5 ; Fig. 6	-	-	0.7	μs
		$I_C = 0.5\text{ A}; I_{Bon} = 0.1\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\ \mu\text{H}; T_{lead} = 25^\circ\text{C}$; inductive load; Fig. 7 ; Fig. 8	-	0.1	-	μs

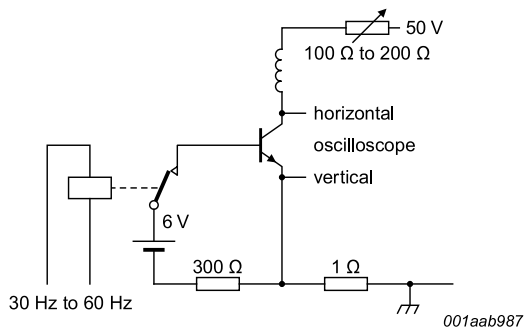


Fig. 3. Test circuit for collector-emitter sustaining voltage

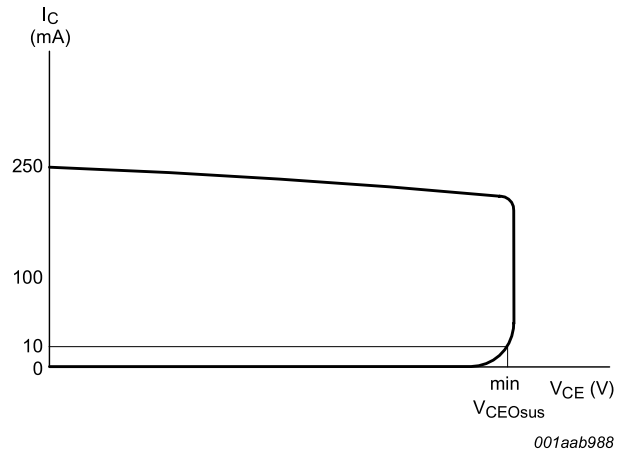
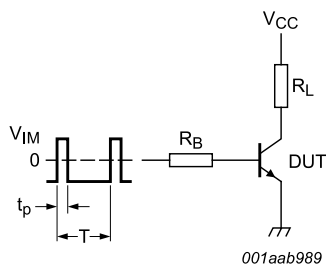


Fig. 4. Oscilloscope display for collector-emitter sustaining voltage test waveform



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

Fig. 5. Test circuit for resistive load switching

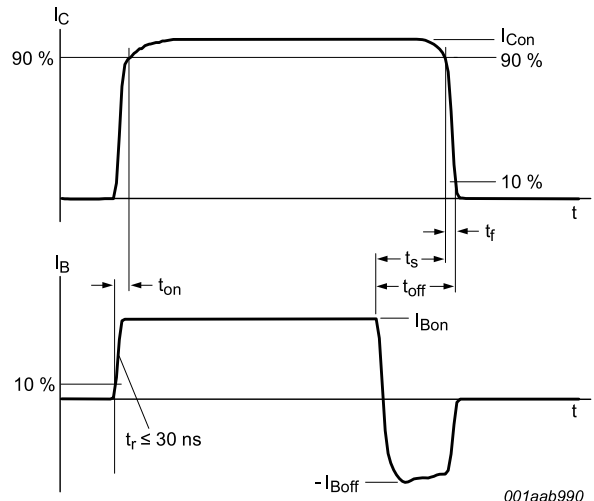
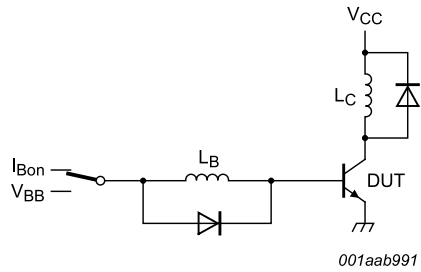


Fig. 6. Switching times waveforms for resistive load



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

Fig. 7. Test circuit for inductive load switching

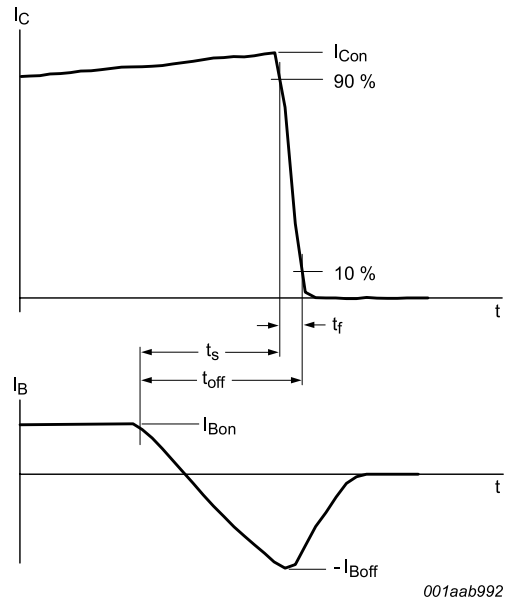
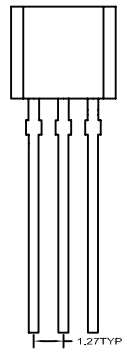


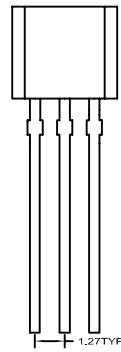
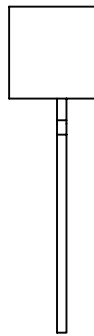
Fig. 8. Switching times waveforms for inductive load

10. Package outline

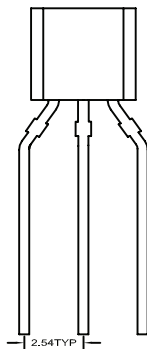
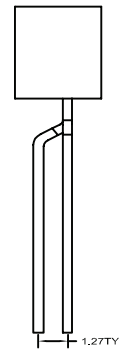
SOT54 PACKAGE OUTLINE



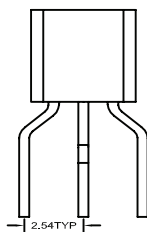
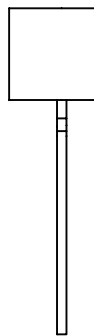
SOT54
Bulk Pack - 412



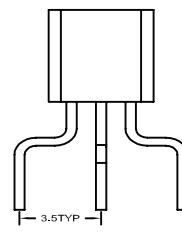
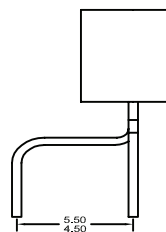
SOT54 LEADS ON CIRCLE
Bulk Pack - 112



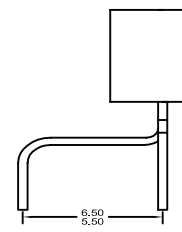
SOT54 WIDE PITCH
Tape/ Reel Pack - 116
Ammo Pack - 126



SOT54 LEAD BEND L01
Bulk Pack - 412



SOT54 LEAD BEND L02
Bulk Pack - 412



Remark: Detailed dimensions refer to POD drawing.

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	-	-

12. Legal information

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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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Date of release: 29 May 2018

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