



**THE DATASHEET OF  
PHD13005,127**



## 1. General description

High voltage, high speed, planar passivated NPN power switching transistor with integrated anti-parallel E-C diode in a SOT78 (TO-220AB) plastic package.

## 2. Features and benefits

- Low thermal resistance
- Fast switching
- High voltage capability
- Integrated anti-parallel E-C diode

## 3. Applications

- Integrated fluorescent lamp ballasts e.g. high power cluster lamps
- Low Voltage Tungsten Halogen transformers
- Remote fluorescent lamp ballasts
- Self Oscillating Power Supplies

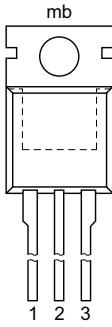
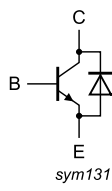
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Values			Unit
<b>Absolute maximum rating</b>						
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	700			V
$I_C$	collector current	DC; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 4</a>	4			A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ °C}$ ; <a href="#">Fig. 3</a>	75			W
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$h_{FE}$	DC current gain	$I_C = 1.0\text{ A}$ ; $V_{CE} = 5\text{ V}$ ; <a href="#">Fig. 10</a>	12	20	40	
		$I_C = 2.0\text{ A}$ ; $V_{CE} = 5\text{ V}$ ; <a href="#">Fig. 10</a>	10	17	28	

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base		
2	C	collector		
3	E	emitter		
mb	C	mounting base; connected to collector		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PHD13005	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 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; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 4</a>	4	A
$I_{CM}$	peak collector current	<a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 4</a>	8	A
$I_B$	base current	DC	2	A
$I_{BM}$	peak base current		4	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ °C}$ ; <a href="#">Fig. 3</a>	75	W
$T_{stg}$	storage temperature		-65 to 150	°C
$T_j$	junction temperature		150	°C

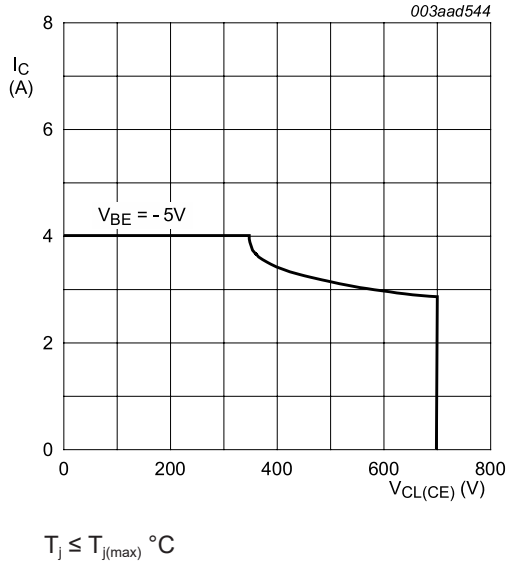
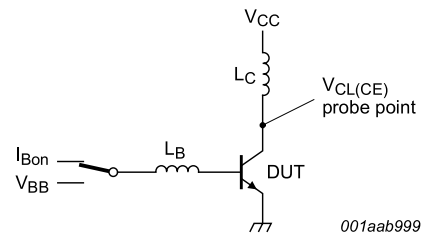
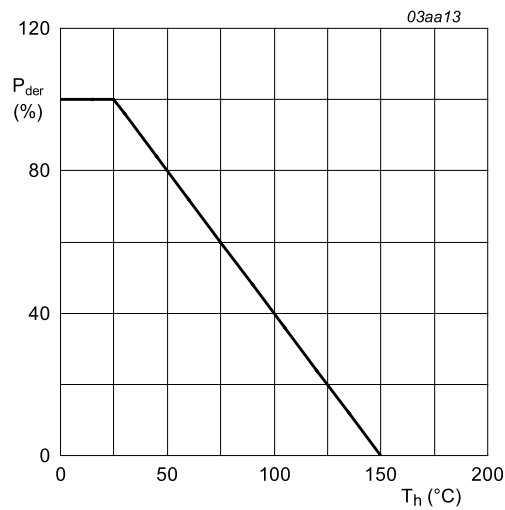


Fig. 1. Reverse bias safe operating area



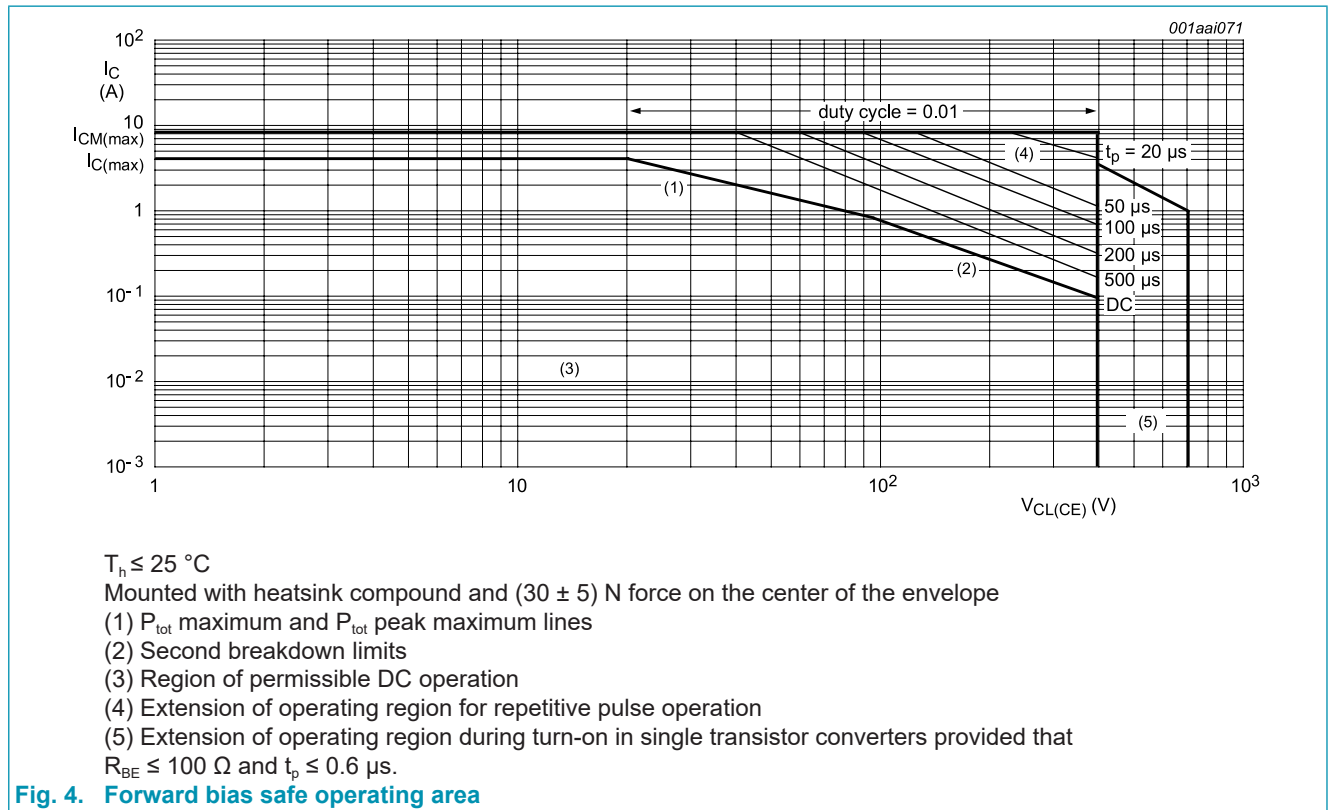
$V_{CL(CE)} \leq 1000 \text{ V}; V_{CC} = 150 \text{ V}; V_{BB} = -5 \text{ V};$   
 $L_B = 1 \text{ } \mu\text{H}; L_C = 200 \text{ } \mu\text{H}.$

Fig. 2. Test circuit for reverse bias safe operating area



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

Fig. 3. Normalized total power dissipation as a function of heatsink temperature



### 8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	<a href="#">Fig. 5</a>	-	-	1.67	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

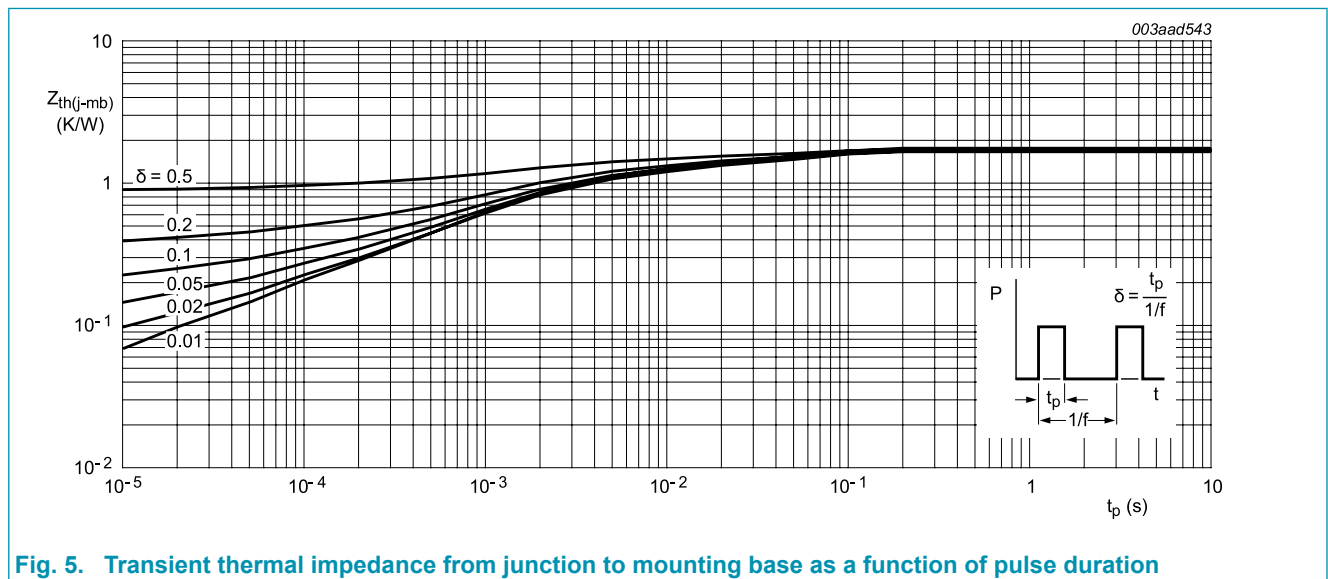


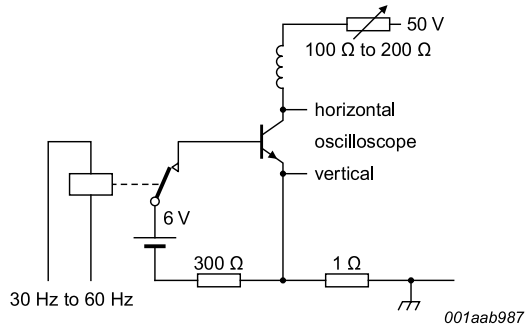
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 9. Characteristics

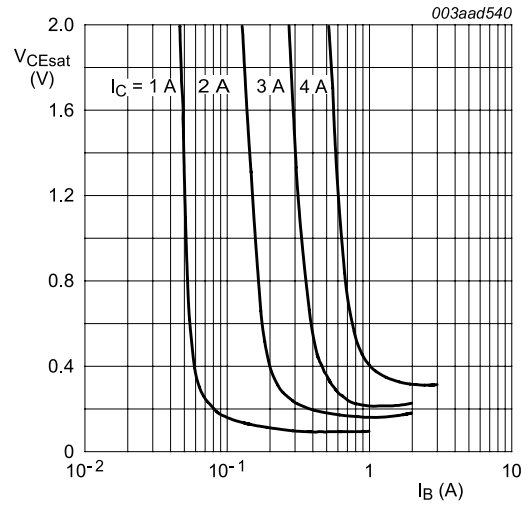
Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{CES}$	collector-emitter cut-off current	$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}; T_j = 100\text{ }^\circ\text{C}; [1]$	-	-	5	mA
		$V_{BE} = 0\text{ V}; V_{CE} = 700\text{ V}; [1]$	-	-	1	mA
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 700\text{ V}; I_E = 0\text{ A}; [1]$	-	-	1	mA
$I_{CEO}$	collector-emitter cut-off current	$V_{CE} = 400\text{ V}; I_B = 0\text{ A}; [1]$	-	-	0.1	mA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 9\text{ V}; I_C = 0\text{ A}$	-	-	10	mA
$V_{CEOsus}$	collector-emitter sustaining voltage	$I_B = 0\text{ A}; I_C = 10\text{ mA}; L_C = 25\text{ mH};$ <a href="#">Fig. 6; Fig. 15</a>	400	-	-	V
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 1.0\text{ A}; I_B = 0.2\text{ A};$ <a href="#">Fig. 7; Fig. 8</a>	-	0.1	0.5	V
		$I_C = 2.0\text{ A}; I_B = 0.5\text{ A};$ <a href="#">Fig. 7; Fig. 8</a>	-	0.2	0.6	V
		$I_C = 4.0\text{ A}; I_B = 1.0\text{ A};$ <a href="#">Fig. 7; Fig. 8</a>	-	0.3	1	V
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 2.0\text{ A}; I_B = 0.5\text{ A};$ <a href="#">Fig. 9</a>	-	0.92	1.6	V
		$I_C = 1.0\text{ A}; I_B = 0.2\text{ A};$ <a href="#">Fig. 9</a>	-	0.85	1.2	V
$V_F$	forward voltage	$I_F = 2.0\text{ A}$	-	1.04	1.5	V
$h_{FE}$	DC current gain	$I_C = 1.0\text{ A}; V_{CE} = 5\text{ V};$ <a href="#">Fig. 10</a>	12	20	40	
		$I_C = 2.0\text{ A}; V_{CE} = 5\text{ V};$ <a href="#">Fig. 10</a>	10	17	28	
<b>Dynamic characteristics</b>						
$t_s$	storage time	$I_C = 2.0\text{ A}; I_{B(on)} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ } \mu\text{H};$ inductive load; <a href="#">Fig. 11;</a> <a href="#">Fig. 12</a>	-	1.2	2	$\mu\text{s}$
		$I_C = 2.0\text{ A}; I_{B(on)} = 0.4\text{ A}; I_{B(off)} = -0.4\text{ A};$ $R_L = 75\text{ } \Omega;$ resistive load; <a href="#">Fig. 13;</a> <a href="#">Fig. 14</a>	-	2.7	4	$\mu\text{s}$
		$I_C = 2.0\text{ A}; I_{B(on)} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ } \mu\text{H}; T_j = 100\text{ }^\circ\text{C};$ inductive load; <a href="#">Fig. 11; Fig. 12</a>	-	1.4	4	$\mu\text{s}$
$t_f$	fall time	$I_C = 2.0\text{ A}; I_{B(on)} = 0.4\text{ A}; I_{B(off)} = -0.4\text{ A};$ $R_L = 75\text{ } \Omega;$ resistive load; <a href="#">Fig. 13;</a> <a href="#">Fig. 14</a>	-	0.3	0.9	$\mu\text{s}$
		$I_C = 2.0\text{ A}; I_{B(on)} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ } \mu\text{H}; T_j = 100\text{ }^\circ\text{C};$ inductive load; <a href="#">Fig. 11; Fig. 12</a>	-	0.16	0.9	$\mu\text{s}$
		$I_C = 2.0\text{ A}; I_{B(on)} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ } \mu\text{H};$ inductive load; <a href="#">Fig. 11;</a> <a href="#">Fig. 12</a>	-	0.1	0.5	$\mu\text{s}$

[1] Measured with half-sine wave voltage (curve tracer).

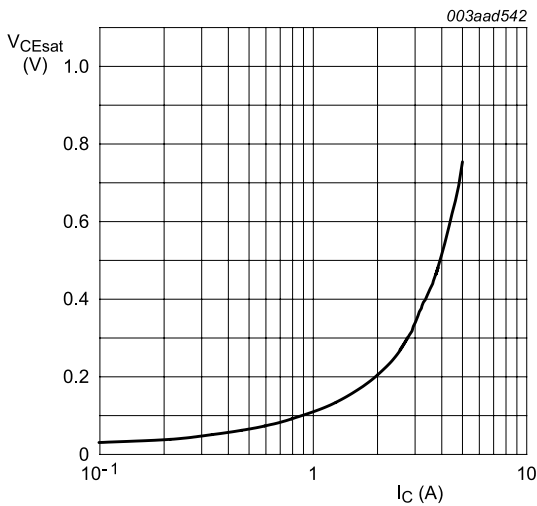


**Fig. 6. Test circuit for collector-emitter sustaining voltage**



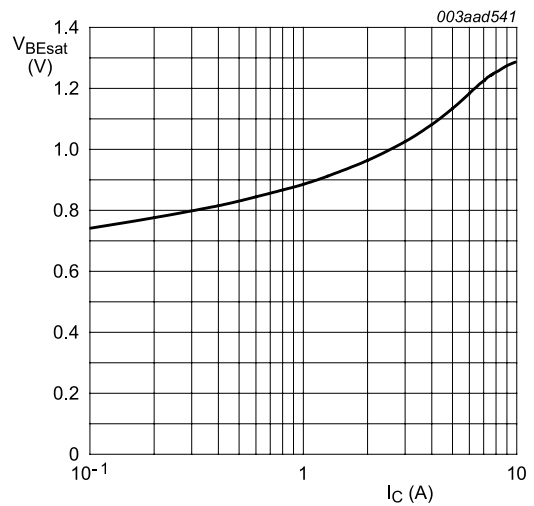
$T_j = 25\text{ }^\circ\text{C}$

**Fig. 7. Collector-emitter saturation voltage; typical values**



$I_C / I_B = 4$

**Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values**



$I_C / I_B = 4$

**Fig. 9. Base-emitter saturation voltage; typical values**

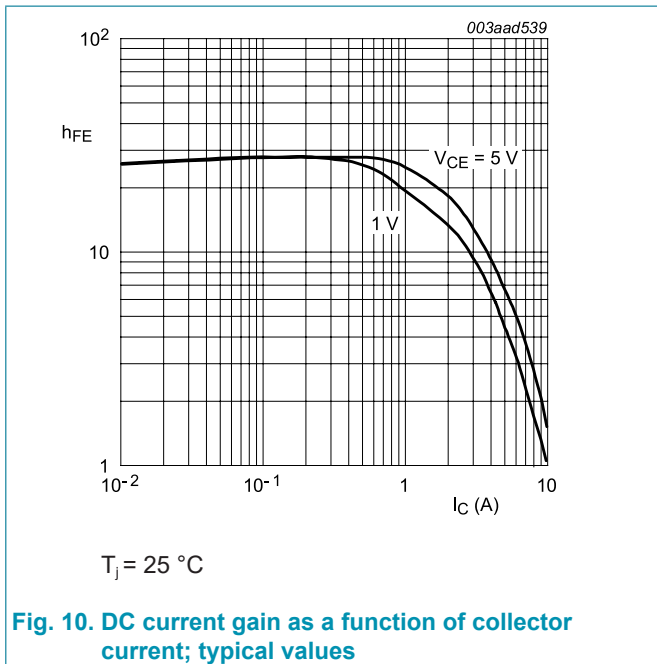


Fig. 10. DC current gain as a function of collector current; typical values

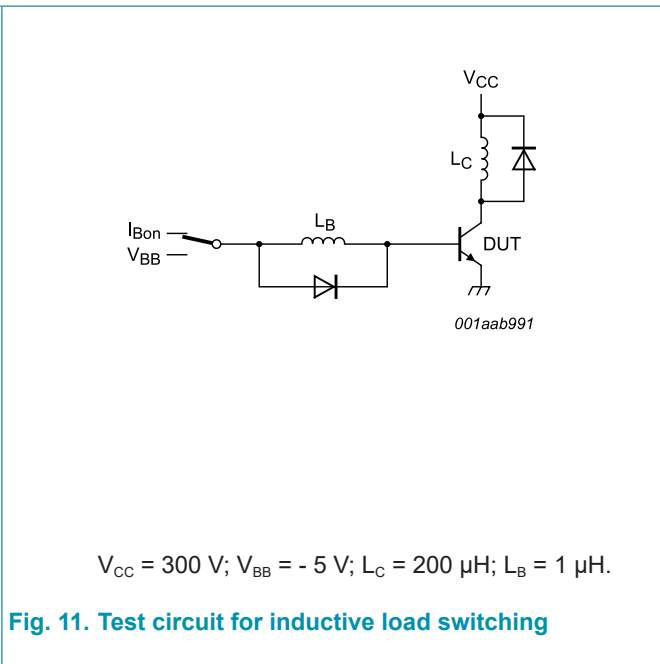


Fig. 11. Test circuit for inductive load switching

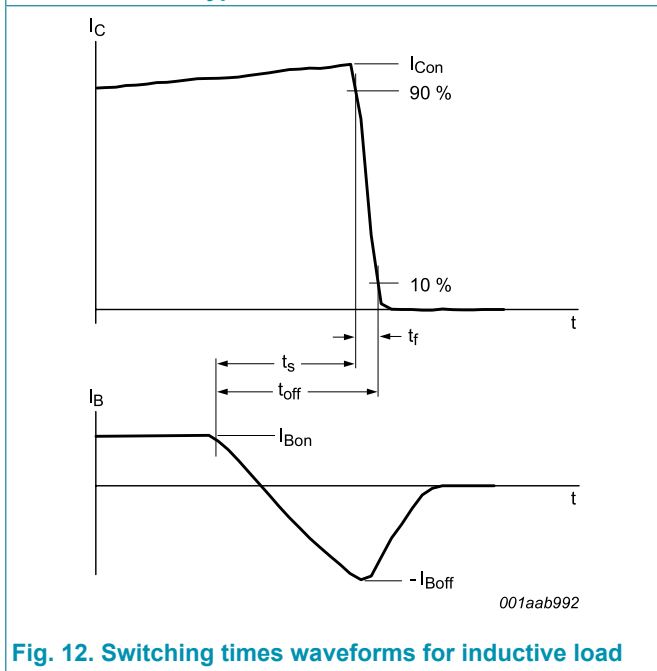


Fig. 12. Switching times waveforms for inductive load

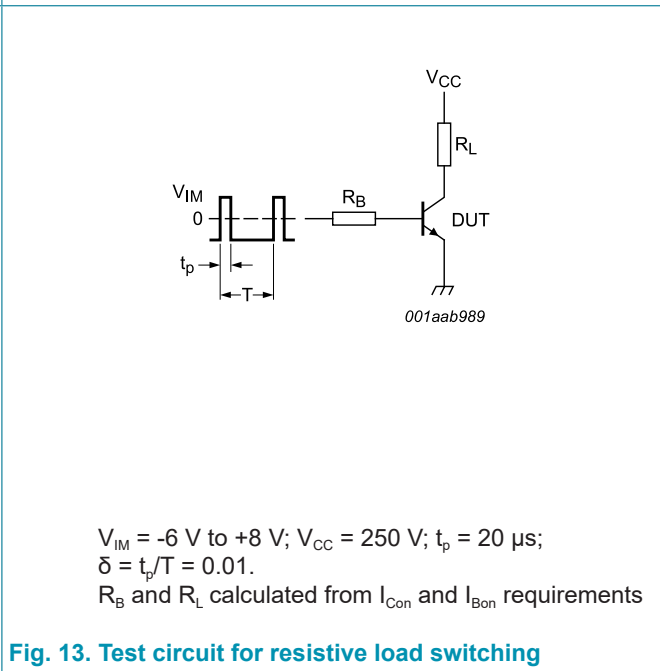


Fig. 13. Test circuit for resistive load switching

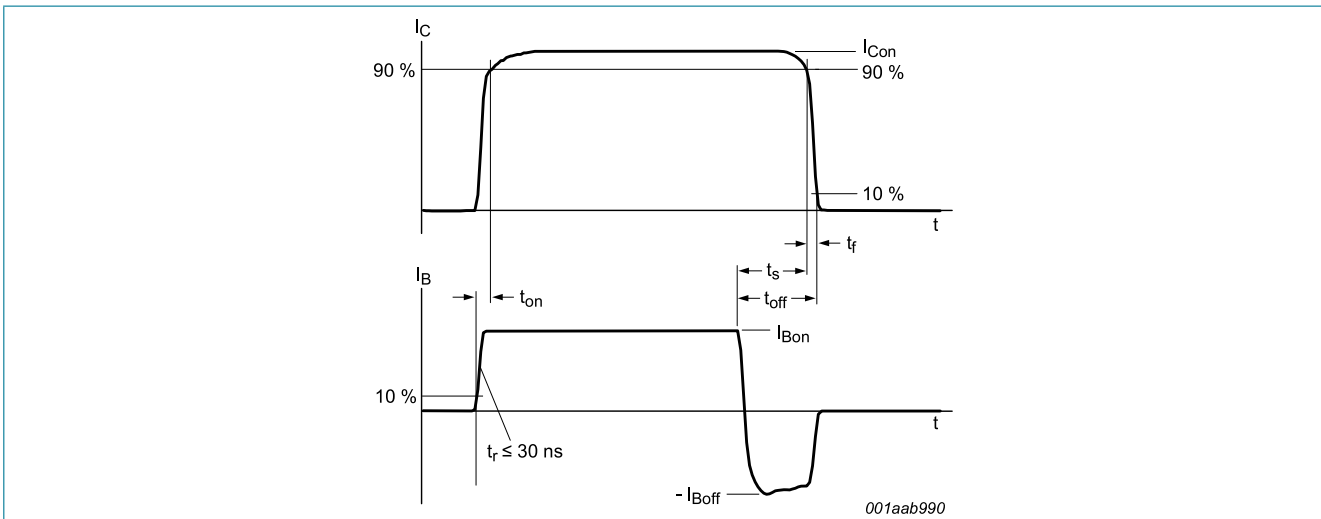


Fig. 14. Switching times waveforms for resistive load

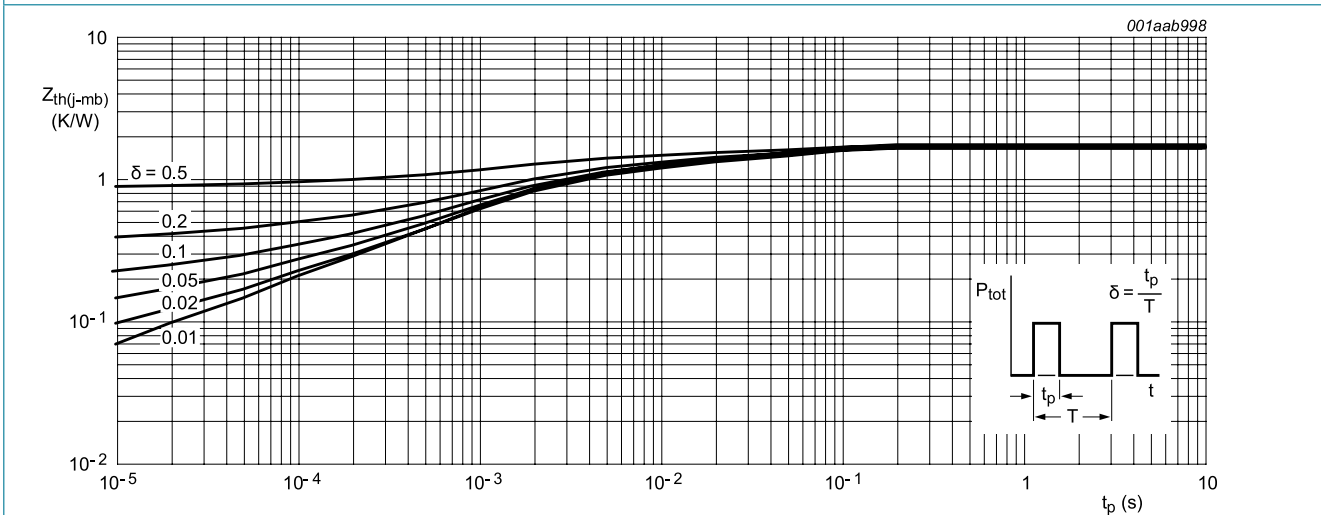
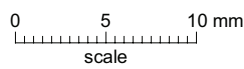
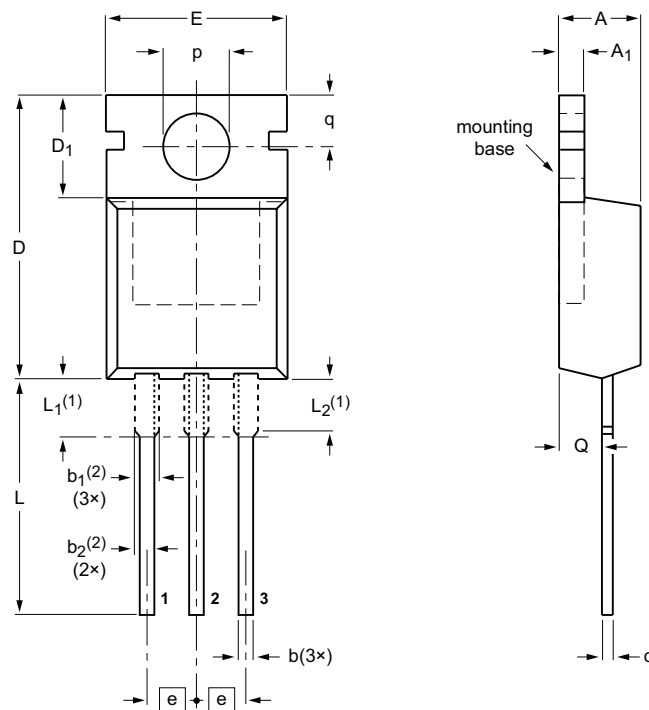


Fig. 15. Transient thermal impedance from junction to mounting base as a function of pulse width

### 10. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78



**DIMENSIONS** (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub> (2)	b <sub>2</sub> (2)	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub> (1)	L <sub>2</sub> (1) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

**Notes**

- 1. Lead shoulder designs may vary.
- 2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT78		3-lead TO-220AB	SC-46		08-04-23 08-06-13

## 11. Revision history

**Table 7. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHD13005 v.3	20180330	Product data sheet	-	PHD13005 v.2
Modifications:	Change from NXP version to WeEn version			
PHD13005 v.2	20100729	Product data sheet	-	PHD13005 v.1
Modifications:	Various changes to content.			
PHD13005 v.1	20100520	Product data sheet	-	-

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### 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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