PHE13003A

NPN power transistor

Rev.02 - 19 October 2021 Product data sheet

1. General description

High voltage, high speed, planar passivated NPN power switching transistor in a TO92 plastic package.

2. Features and benefits

- Fast switching
- High voltage capability
- Very low switching and conduction losses

3. Applications

- Compact fluorescent lamps (CFL)
- Electronic lighting ballasts
- Inverters
- Off-line self-oscillating power supplies

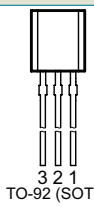
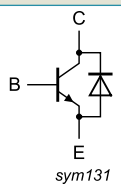
4. Quick reference data

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; Fig. 1	1				A
P_{tot}	total power dissipation	T_{lead} ≤ 25 °C; Fig. 2	2.1				W
Symbol	**Parameter**	**Conditions**		**Min**	**Typ**	**Max**	**Unit**
Static characteristics							
h_{FE}	DC current gain	I_C = 0.8 A; V_{CE} = 5 V; T_{lead} = 25 °C; Fig. 8; Fig. 9		5	7.5	20	

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	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
PHE13003A	TO92	PHE13003A,412	Bulk	1000	SOT54	14-Nov-2013
PHE13003A	TO92	PHE13003A,126	Reel	2000	SOT54 wide pitch	14-Nov-2013

7. Marking

Table 4. Marking codes

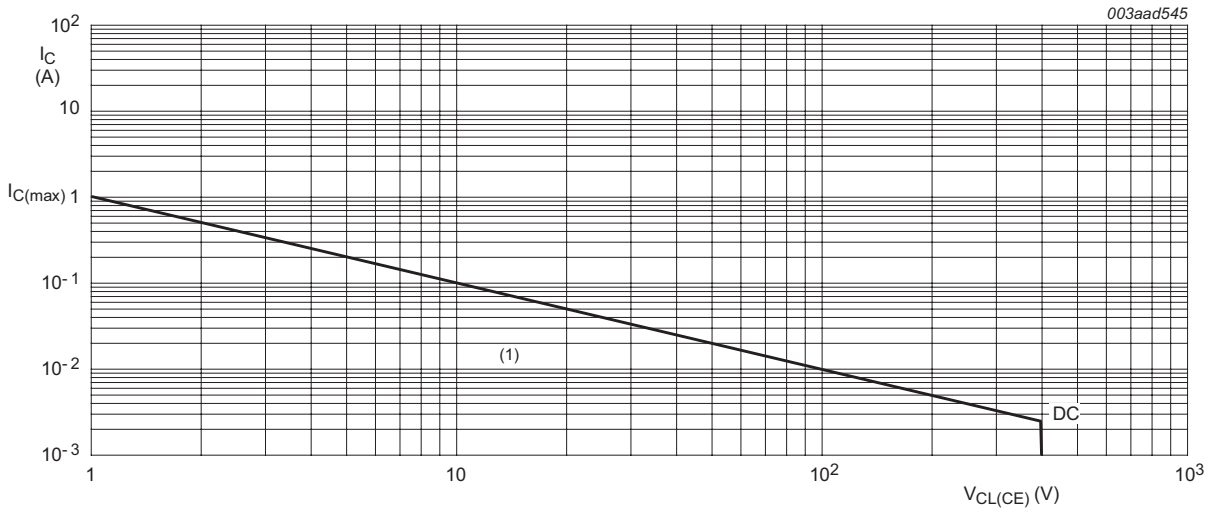
Type number	Marking codes
PHE13003A	13003A

8. Limiting values

Table 5. Limiting values

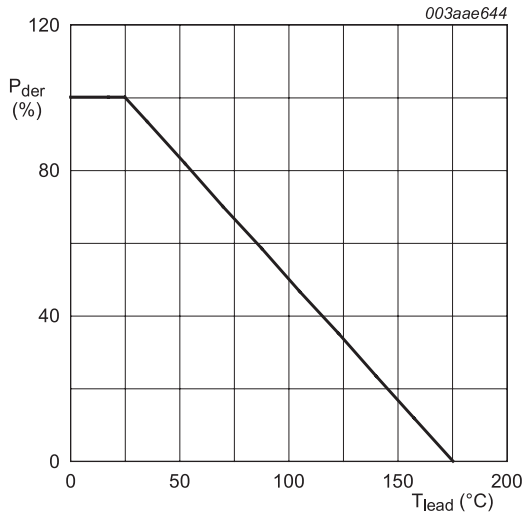
In accordance with the Absolute Maximum Rating System (IEC 60134).

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
V_{EBO}	emitter-base voltage	I_C = 0 A; I(Emitter) = 10 mA		-	9	V
I_C	collector current	DC; Fig. 1		-	1	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} ≤ 25 °C; Fig. 2		-	2.1	W
T_{stg}	storage temperature			-65	150	°C
T_j	junction temperature			-	150	°C



T_{lead} ≤ 25 °C; (1) Region of permissible DC operation

Fig. 1. Forward bias safe operating area



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

Fig. 2. Normalized total power dissipation as a function of lead temperature

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j\text{-}lead)}$	thermal resistance from junction to lead	Fig. 3		-	-	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

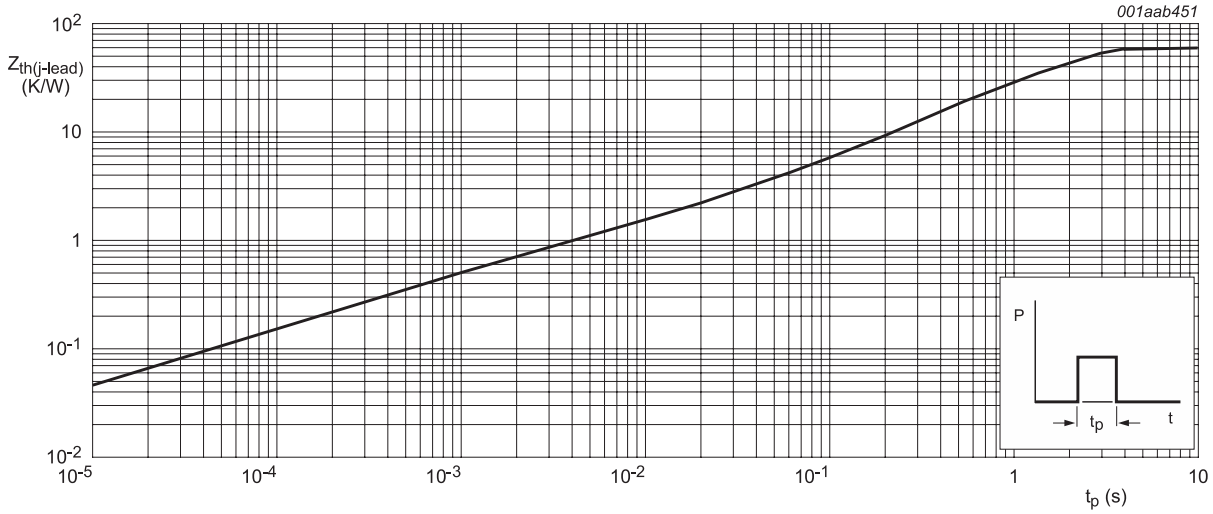


Fig. 3. Transient thermal impedance from junction to lead as a function of pulse width

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I_{CES}	collector-emitter cut-off current (base shorted)	V_{BE} = 0 V; V_{CE} = 700 V; T_j =125°C		-	-	5	mA
I_{EBO}	emitter-base cut-off current (collector open)	V_{EB} = 9 V; I_C = 0 A; T_{lead} = 25°C		-	-	1	mA
V_{CEOsus}	collector-emitter sustaining voltage (base open)	I_B = 0 A; I_C = 1 mA; L_C = 25 mH; T_{lead} = 25°C ; Fig. 4; Fig. 5		400	-	-	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 0.25 A; I_B = 50 mA; T_{lead} = 25°C; Fig. 6		-	0.2	0.5	V
		I_C = 0.5 A; I_B = 125 mA; T_{lead} = 25°C; Fig. 6		-	09.3	1	V
		I_C = 0.75 A; I_B = 250 mA; T_{lead} = 25°C; Fig. 6		-	0.4	1.5	V
V_{BEsat}	base-emitter saturation voltage	I_C = 0.25 A; I_B = 50 mA; T_{lead} = 25°C; Fig. 7		-	-	1	V
		I_C = 0.5 A; I_B = 125 mA; T_{lead} = 25°C; Fig. 7		-	-	1.2	V
h_{FE}	DC current gain	I_C = 0.5 mA ; V_{CE} = 2 V; T_j = 25°C; Fig. 8; Fig. 9		12	-	-	
		I_C = 0.4 A ; V_{CE} = 5 V; T_j = 25°C; Fig. 8; Fig. 9		10	-	30	
		I_C = 0.8 A ; V_{CE} = 5 V; T_j = 25°C; Fig. 8; Fig. 9		5	7.5	20	
Dynamic characteristics							
t_f	fall time	I_C = 1 A; I_{Bon} = 200 mA; V_{BB} = -5 V; L_B = 1 µH; T_{lead} = 25 °C; inductive load; Fig. 10; Fig. 11		-	80	-	ns

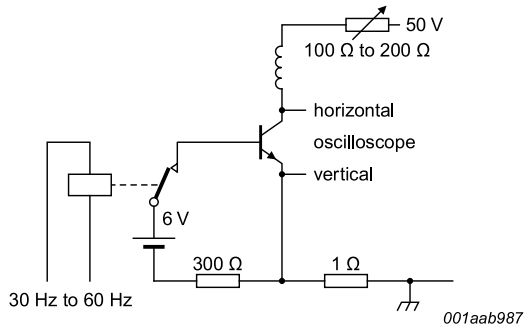


Fig. 4. Test circuit for collector-emitter sustaining voltage

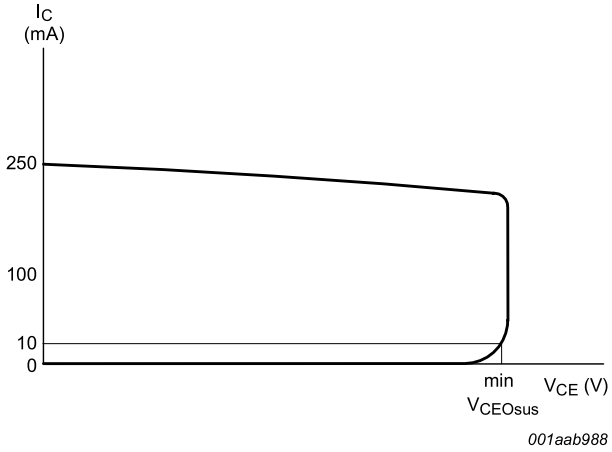
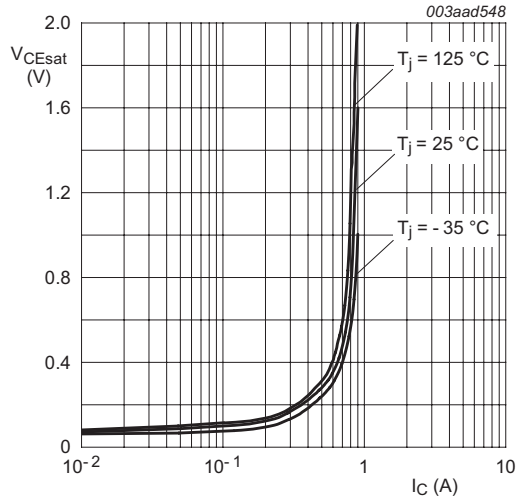
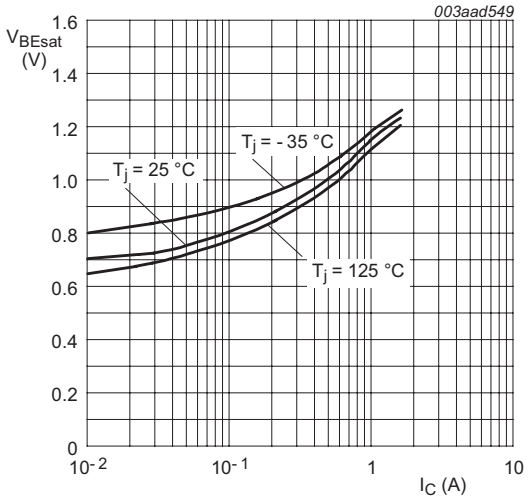


Fig. 5. Oscilloscope display for collector-emitter sustaining voltage test waveform



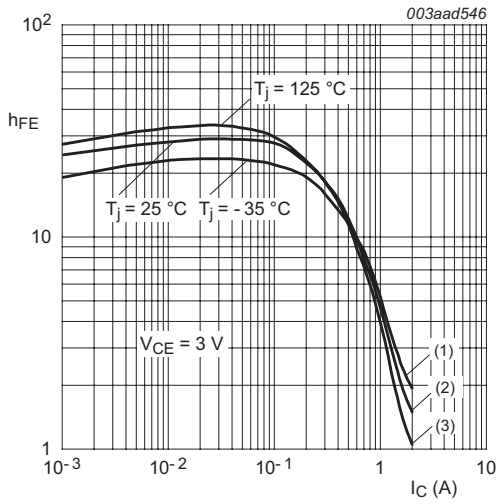
$I_C / I_B = 5$

Fig. 6. Collector-emitter saturation voltage as a function of collector current; typical values



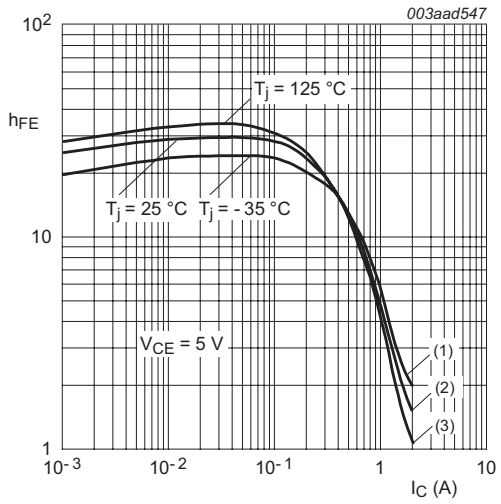
$I_C / I_B = 5$

Fig. 7. Base-emitter saturation voltage as a function of collector current; typical values



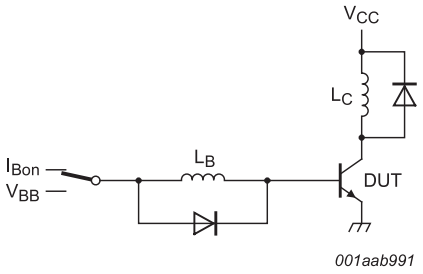
(1) T_j = -35 °C
(2) T_j = 25 °C
(3) T_j = 125 °C

Fig. 8. DC current gain as a function of collector current; typical values



(1) T_j = -35 °C
(2) T_j = 25 °C
(3) T_j = 125 °C

Fig. 9. DC current gain as a function of collector current; typical values



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

Fig. 7. Test circuit for inductive load switching

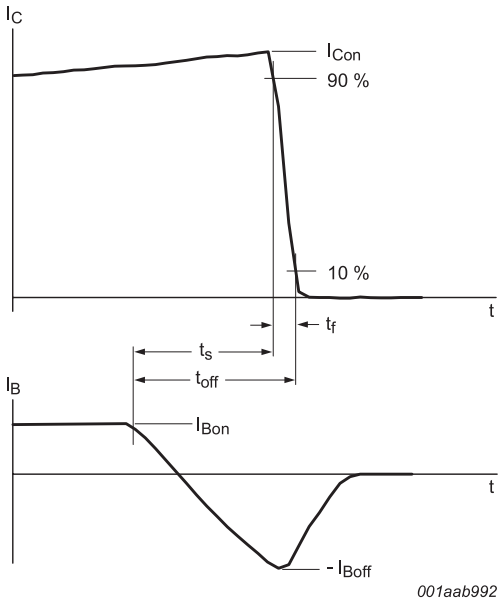
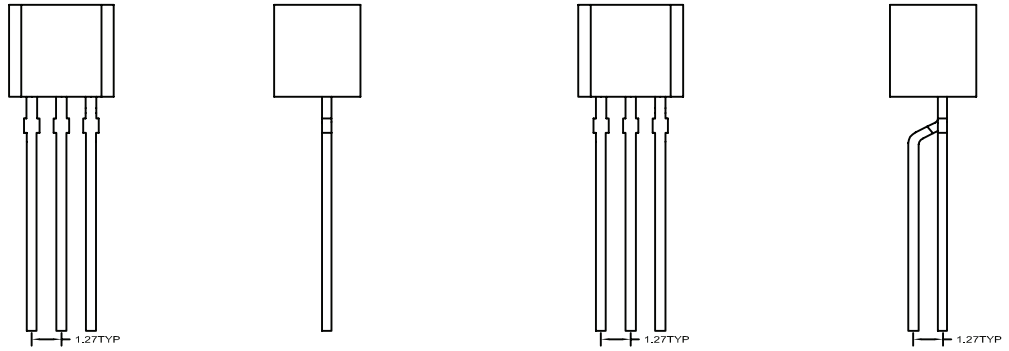


Fig. 8. Switching times waveforms for inductive load

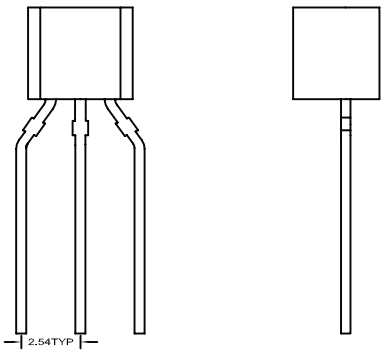
11. Package outline

SOT54 PACKAGE OUTLINE

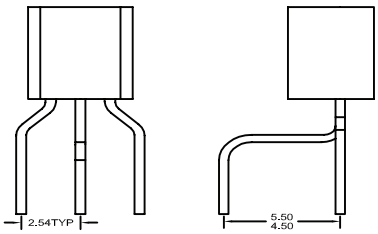


SOT54
Bulk Pack - 412

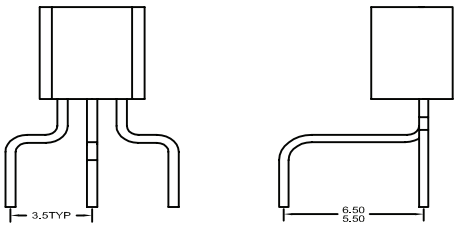
SOT54 LEADS ON CIRCLE
Bulk Pack - 112



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



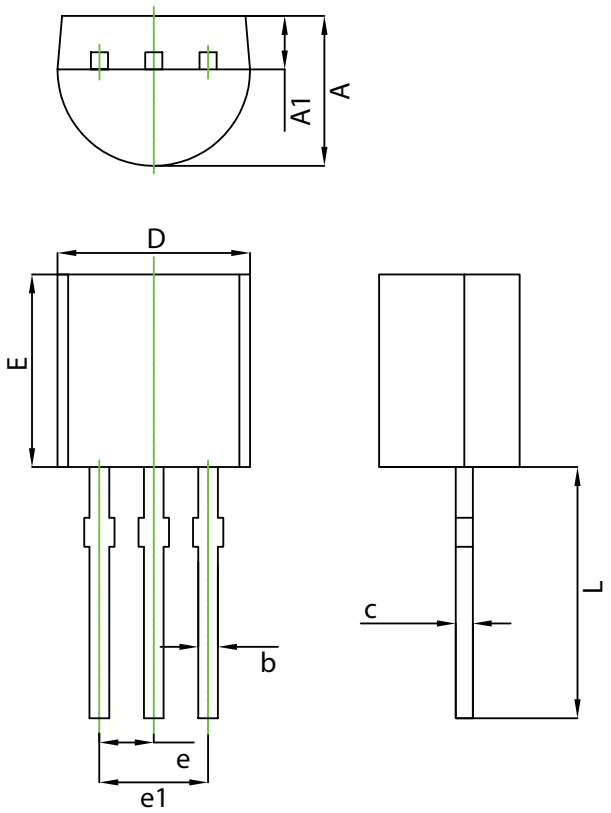
SOT54 LEAD BEND L01
Bulk Pack - 412



SOT54 LEAD BEND L02
Bulk Pack - 412

Remark: Detailed dimensions refer to POD drawing.

Plastic single-ended leaded(through hole) package; 3 leads TO92



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.300	4.700	0.169	0.185
E	4.300	4.700	0.169	0.185
e	1.270 TYP.		0.050 TYP.	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571

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.

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13. Contents

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