PHE13003A

NPN power transistor

3 October 2016 — Product data sheet

1. General description

High voltage, high speed, planar passivated NPN power switching transistor in a SOT54 (TO-92) plastic package.

2. Features and benefits

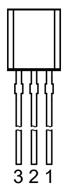
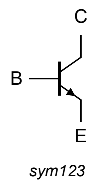
- Fast switching
- High voltage capability
- Very low switching and conduction losses

3. Applications

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

4. Pinning information

Table 1. Pinning information

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

5. Ordering information

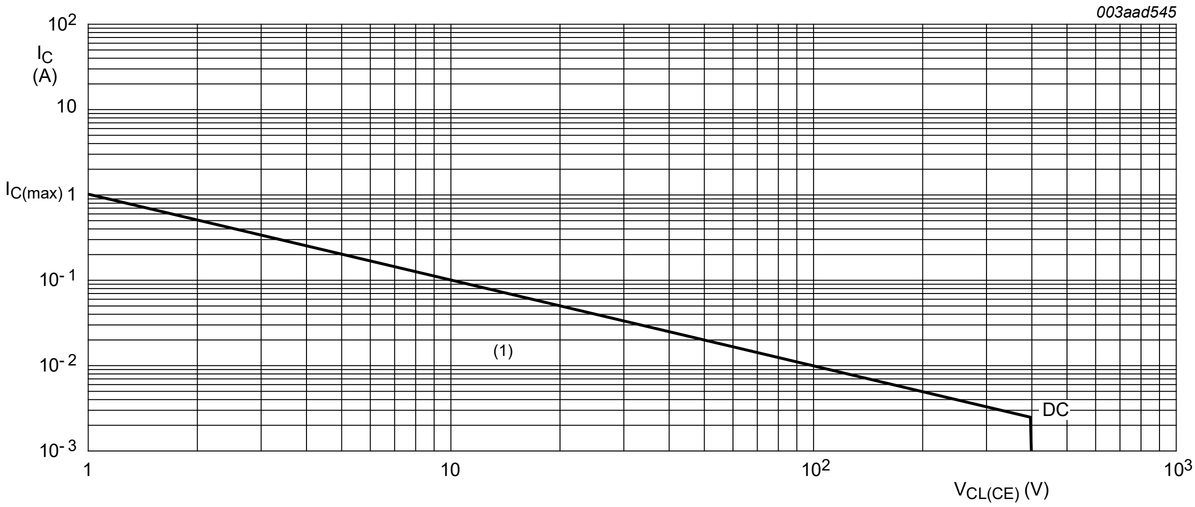
Table 2. Ordering information

Type number	Package		
	Name	Description	Version
PHE13003A	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

6. Limiting values

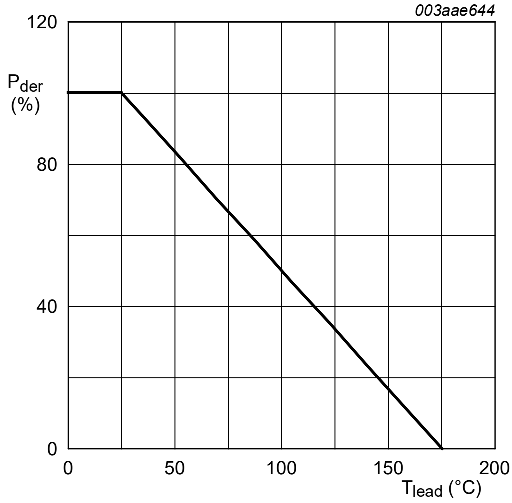
Table 3. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

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			-	2	A
I_B	base current	DC		-	0.5	A
I_{BM}	peak base current			-	1	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

7. Thermal characteristics

Table 4. 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 free air	printed circuit board mounted; lead length = 4 mm		-	150	-	K/W

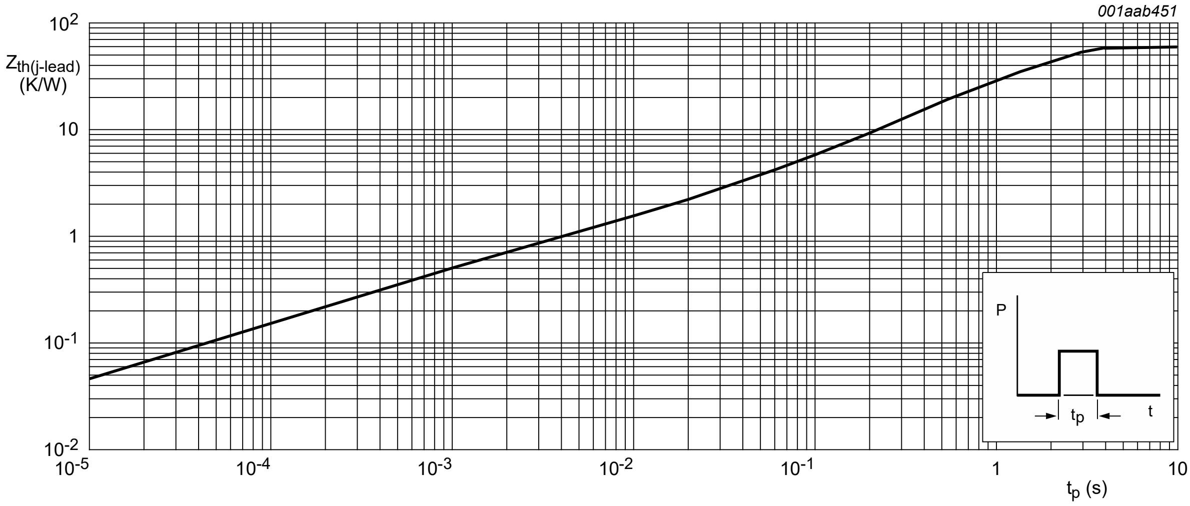


Fig. 3. Transient thermal impedance from junction to lead as a function of pulse width

8. Characteristics

Table 5. 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		-	0.3	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_{lead} = 25 °C; Fig. 8; Fig. 9		12	-	-	
		I_C = 0.4 A; V_{CE} = 5 V; T_{lead} = 25 °C; Fig. 8; Fig. 9		10	-	30	
		I_C = 0.8 A; V_{CE} = 5 V; T_{lead} = 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

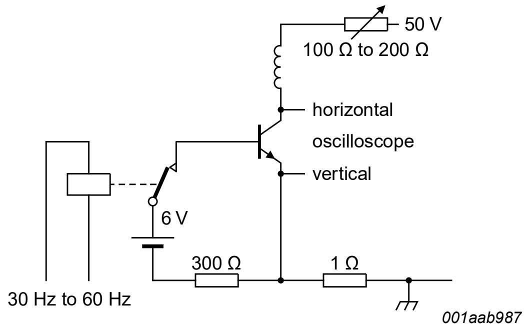


Fig. 4. Test circuit for collector-emitter sustaining voltage

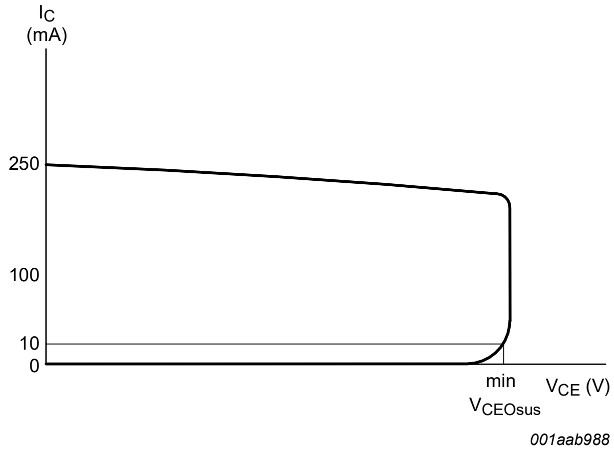
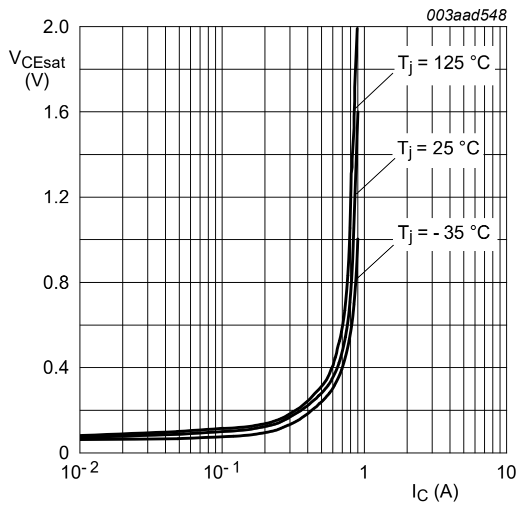
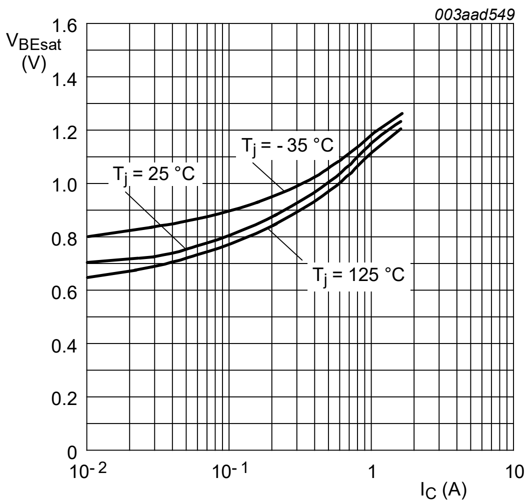


Fig. 5. Oscilloscope display for collector-emitter sustaining voltage test waveform



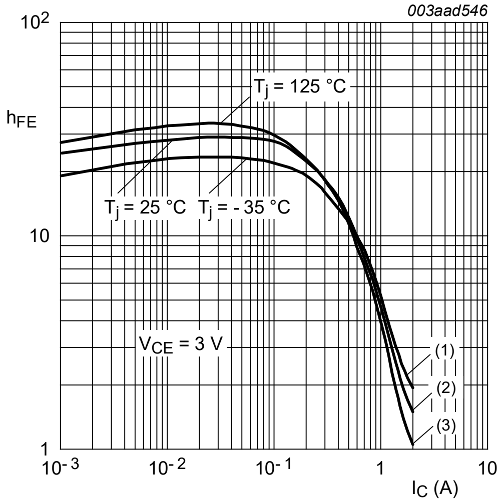
$$\frac{I_C}{I_B} = 5$$

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



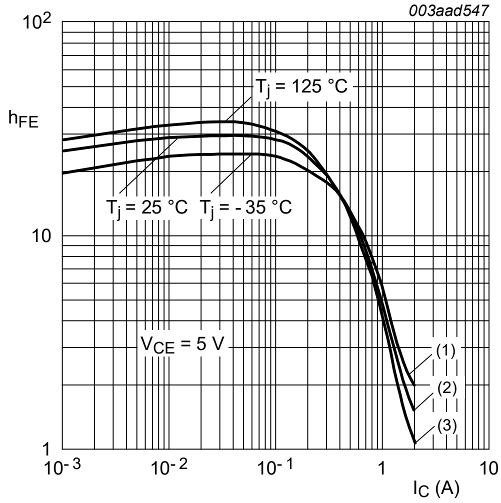
$$\frac{I_C}{I_B} = 5$$

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



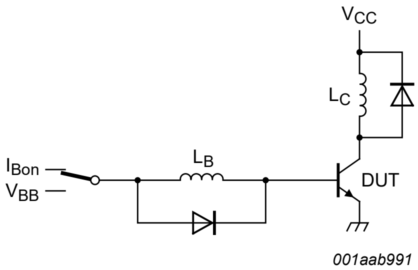
(1) $T_j = -35$ °C (2) $T_j = 25$ °C (3) $T_j = 125$ °C

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. 10. Test circuit for inductive load switching

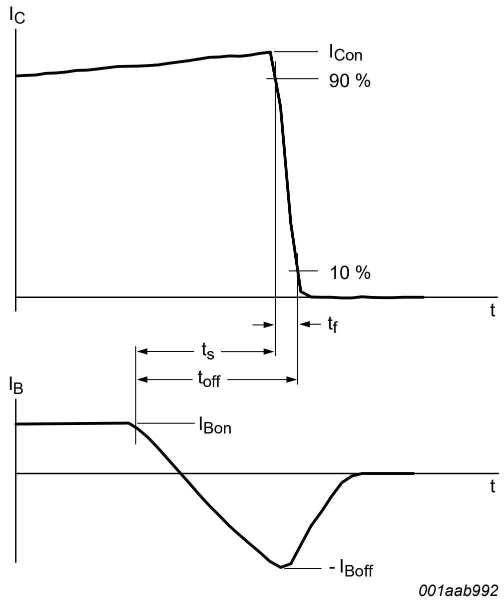


Fig. 11. Switching times waveforms for inductive load

9. Package outline

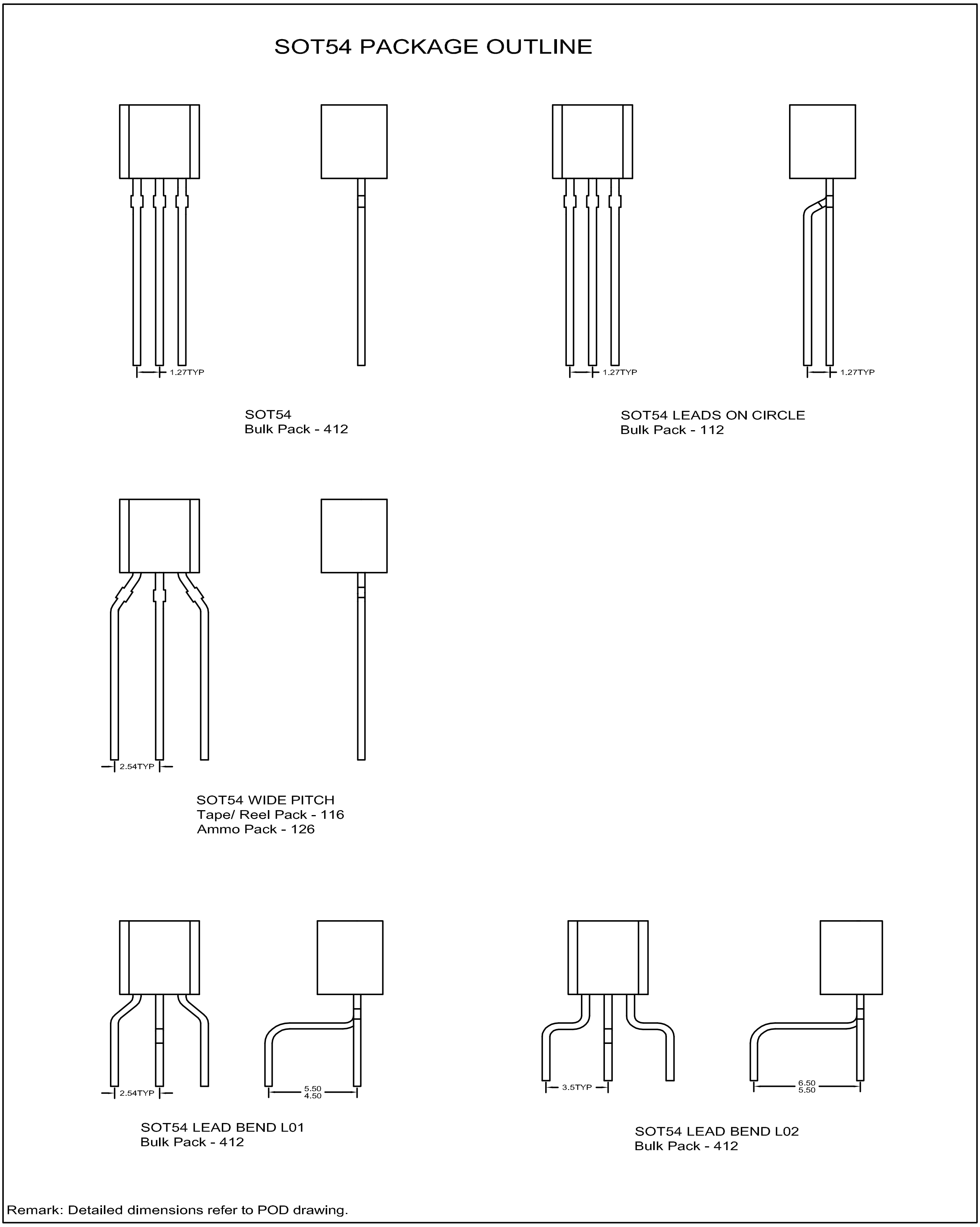


Fig. 12. Package outline TO-92 (SOT54)

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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.
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