



IMPORTANT NOTICE

10 December 2015

1. Global joint venture starts operations as WeEn Semiconductors

Dear customer,

As from November 9th, 2015 NXP Semiconductors N.V. and Beijing JianGuang Asset Management Co. Ltd established Bipolar Power joint venture (JV), **WeEn Semiconductors**, which will be used in future Bipolar Power documents together with new contact details.

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Thank you for your cooperation and understanding,

WeEn Semiconductors





PHE13005

Silicon diffused power transistor

21 January 2014

Product data sheet

1. General description

High voltage, high speed NPN planar-passivated power switching transistor in a SOT78 plastic package intended for use in high frequency electronic lighting ballast applications

2. Features and benefits

- Fast switching
- High voltage capability of 700 V
- Low thermal resistance

3. Applications

- Electronic lighting ballasts

4. Quick reference data

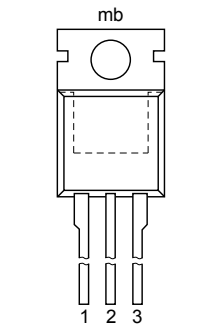
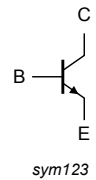
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_C	collector current	DC; Fig. 4 ; Fig. 1 ; Fig. 2	-	-	4	A
P_{tot}	total power dissipation	$T_{mb} \leq 25\text{ °C}$; Fig. 3	-	-	75	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	700	V
Static characteristics						
h_{FE}	DC current gain	$I_C = 1\text{ A}$; $V_{CE} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 11	12	20	40	
		$I_C = 2\text{ A}$; $V_{CE} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 11	10	17	28	



5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>TO-220AB (SOT78)</p>	
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
PHE13005	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	Min	Max	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; Fig. 4; Fig. 1; Fig. 2	-	4	A
I_{CM}	peak collector current		-	8	A
I_B	base current	DC	-	2	A
I_{BM}	peak base current		-	4	A
P_{tot}	total power dissipation	$T_{mb} \leq 25\text{ °C}$; Fig. 3	-	75	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C
V_{EBO}	emitter-base voltage	$I_C = 0\text{ A}$	-	9	V

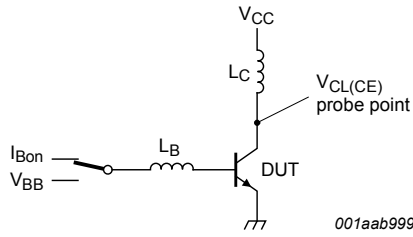


Fig. 1. Test circuit for reverse bias safe operating area

$$V_{CL(CE)} \leq 1000 \text{ V}; V_{CC} = 150 \text{ V}; V_{BB} = -5 \text{ V};$$

$$L_B = 1 \mu\text{H}; L_C = 200 \mu\text{H}$$

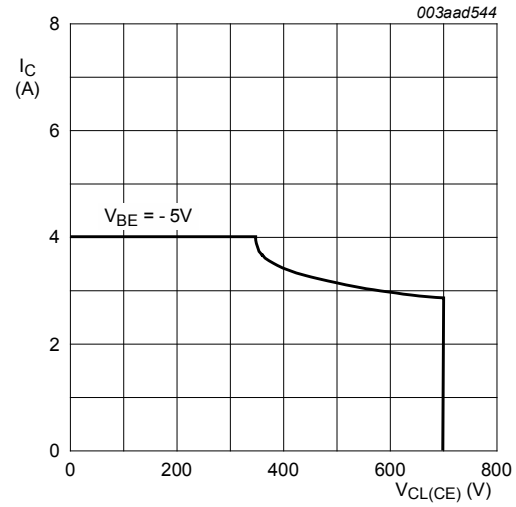


Fig. 2. Reverse bias safe operating area

$$T_j \leq T_{j(max)} \text{ } ^\circ\text{C}$$

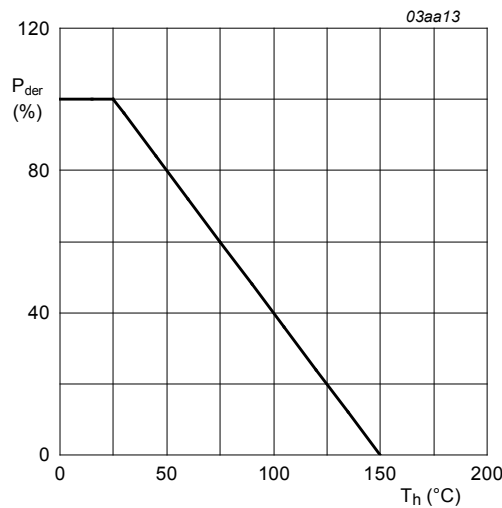


Fig. 3. Normalized total power dissipation as a function of heatsink temperature

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

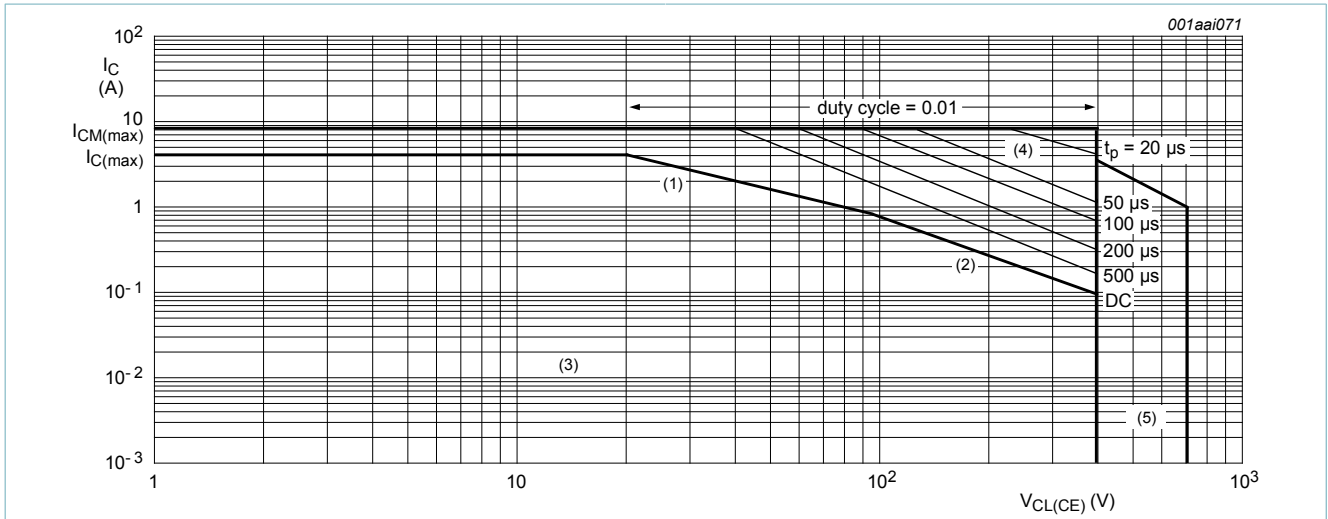


Fig. 4. Forward bias safe operating area

(1) Maximum current limits (2) Second breakdown limits (3) Region of permissible DC operation (4) Extension of operating region for repetitive pulse operation (5) Region of permissible DC operation

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	Fig. 5	-	-	1.67	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

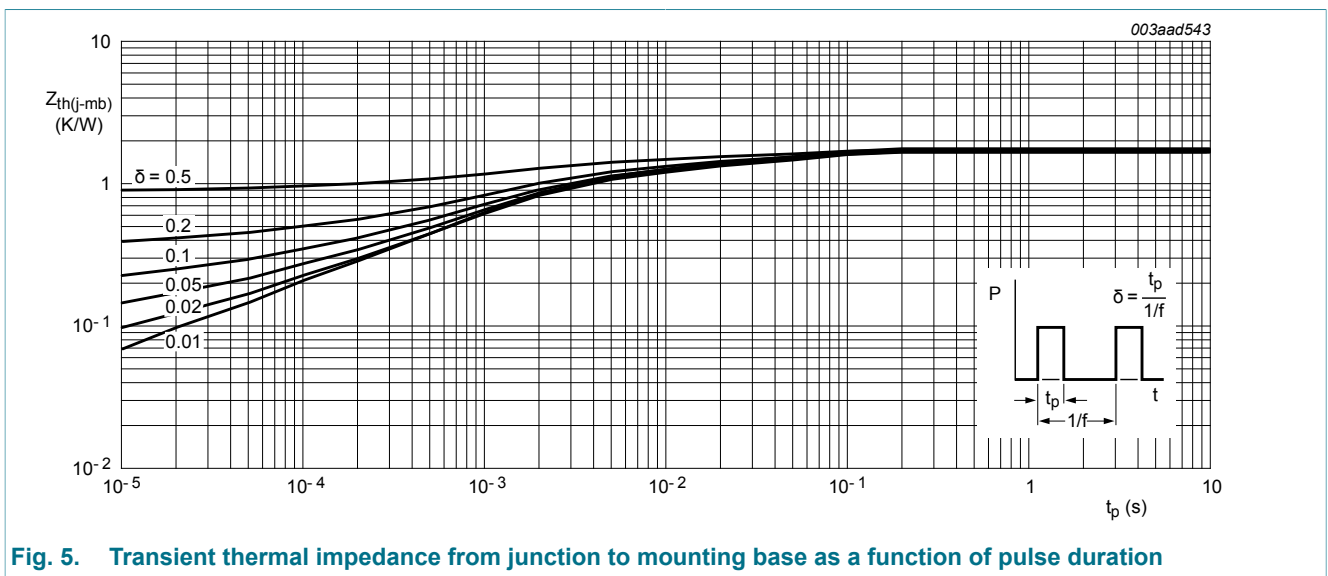


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
t_s	storage time	$I_C = 2\text{ A}$; $I_{B(on)} = 0.4\text{ A}$; $I_{B(off)} = -0.4\text{ A}$; $R_L = 75\ \Omega$; $T_{mb} = 25\text{ }^\circ\text{C}$; resistive load; Fig. 12 ; Fig. 13	-	2.7	4	μs
		$I_C = 2\text{ A}$; $I_{B(on)} = 0.4\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\ \mu\text{H}$; $T_{mb} = 25\text{ }^\circ\text{C}$; inductive load; Fig. 14 ; Fig. 15	-	1.2	2	μs
		$I_C = 2\text{ A}$; $I_{B(on)} = 0.4\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\ \mu\text{H}$; $T_{mb} = 100\text{ }^\circ\text{C}$; inductive load; Fig. 14 ; Fig. 15	-	1.4	4	μs
t_f	fall time	$I_C = 2\text{ A}$; $I_{B(on)} = 0.4\text{ A}$; $I_{B(off)} = -0.4\text{ A}$; $R_L = 75\ \Omega$; $T_{mb} = 25\text{ }^\circ\text{C}$; resistive load; Fig. 12 ; Fig. 13	-	0.3	0.9	μs
		$I_C = 2\text{ A}$; $I_{B(on)} = 0.4\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\ \mu\text{H}$; $T_{mb} = 25\text{ }^\circ\text{C}$; inductive load; Fig. 14 ; Fig. 15	-	0.1	0.5	μs
		$I_C = 2\text{ A}$; $I_{B(on)} = 0.4\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\ \mu\text{H}$; $T_{mb} = 100\text{ }^\circ\text{C}$; inductive load; Fig. 14 ; Fig. 15	-	0.16	0.9	μs
Static characteristics						
I_{CES}	collector-emitter cut-off current	$V_{BE} = -1.5\text{ V}$; $V_{CE} = 700\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$	-	-	1	mA
		$V_{BE} = -1.5\text{ V}$; $V_{CE} = 700\text{ V}$; $T_j = 100\text{ }^\circ\text{C}$	-	-	5	mA
I_{CBO}	collector-base cut-off current	$V_{CB} = 700\text{ V}$; $I_E = 0\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$	-	-	1	mA
I_{CEO}	collector-emitter cut-off current	$V_{CE} = 400\text{ V}$; $I_B = 0\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9\text{ V}$; $I_C = 0\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$	-	-	1	mA
$V_{CEO(sus)}$	collector-emitter sustaining voltage	$I_B = 0\text{ A}$; $I_C = 10\text{ mA}$; $L_C = 25\text{ mH}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 6 ; Fig. 7	400	-	-	V
$V_{CE(sat)}$	collector-emitter saturation voltage	$I_C = 1\text{ A}$; $I_B = 0.2\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 8 ; Fig. 9	-	0.1	0.5	V
		$I_C = 2\text{ A}$; $I_B = 0.5\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 8 ; Fig. 9	-	0.2	0.6	V
		$I_C = 4\text{ A}$; $I_B = 1\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 8 ; Fig. 9	-	0.3	1	V
$V_{BE(sat)}$	base-emitter saturation voltage	$I_C = 1\text{ A}$; $I_B = 0.2\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 10	-	0.85	1.2	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$I_C = 2\text{ A}$; $I_B = 0.5\text{ A}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 10	-	0.92	1.6	V
h_{FE}	DC current gain	$I_C = 1\text{ A}$; $V_{CE} = 5\text{ V}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 11	12	20	40	
		$I_C = 2\text{ A}$; $V_{CE} = 5\text{ V}$; $T_{mb} = 25\text{ }^\circ\text{C}$; Fig. 11	10	17	28	

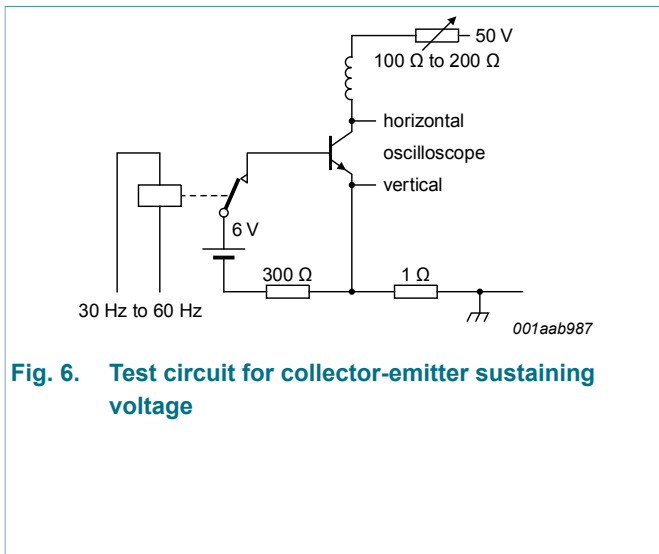


Fig. 6. Test circuit for collector-emitter sustaining voltage

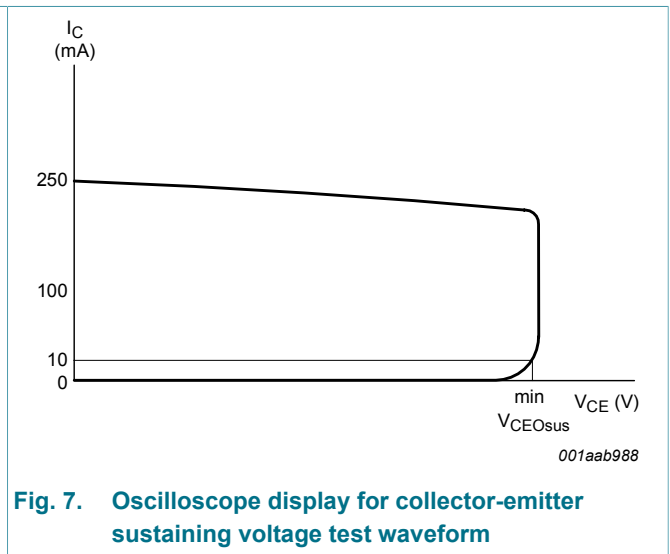


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

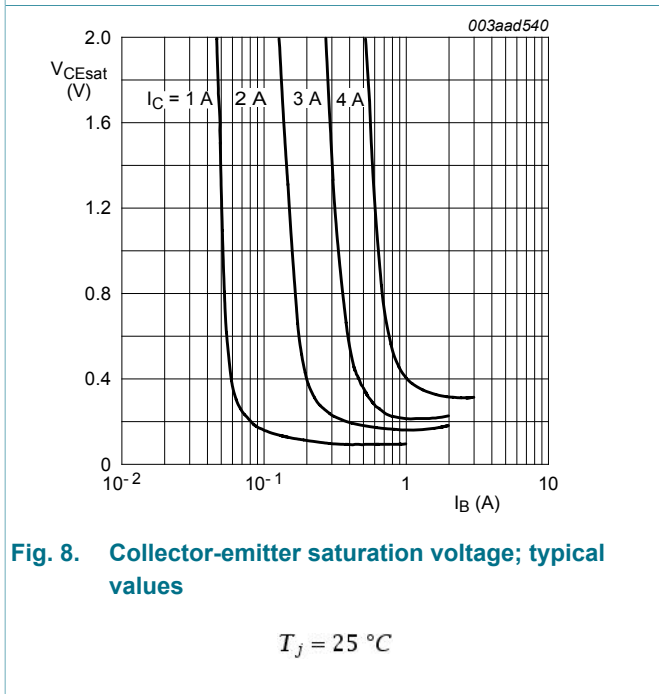


Fig. 8. Collector-emitter saturation voltage; typical values

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

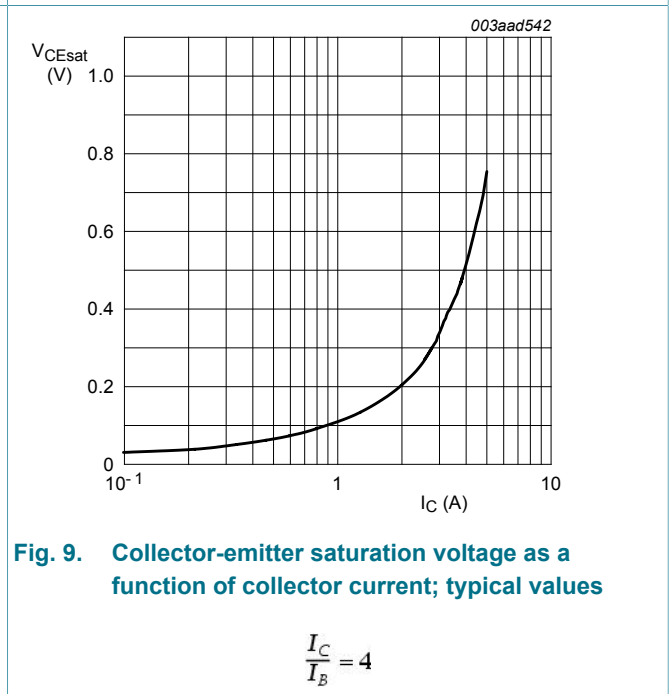


Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

$$\frac{I_C}{I_B} = 4$$

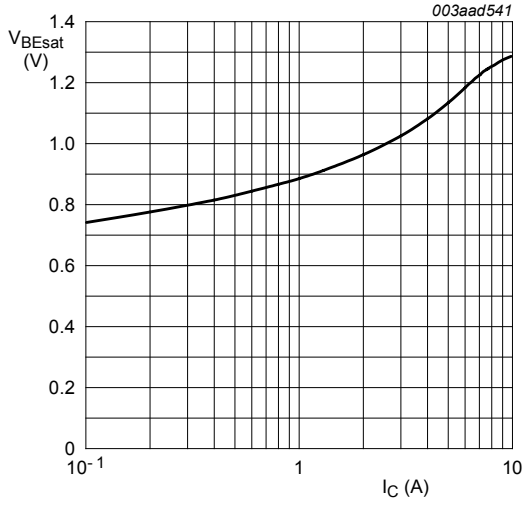


Fig. 10. Base-emitter saturation voltage; typical values

$$\frac{I_C}{I_B} = 4$$

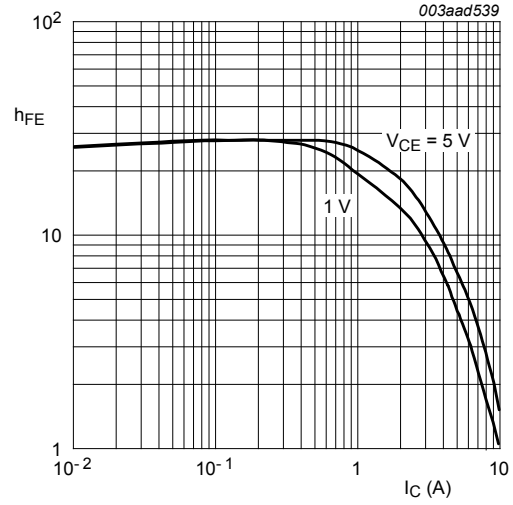


Fig. 11. DC current gain as a function of collector current; typical values

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

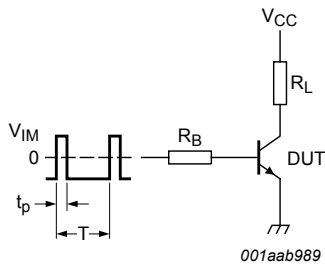


Fig. 12. Test circuit for resistive load switching

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

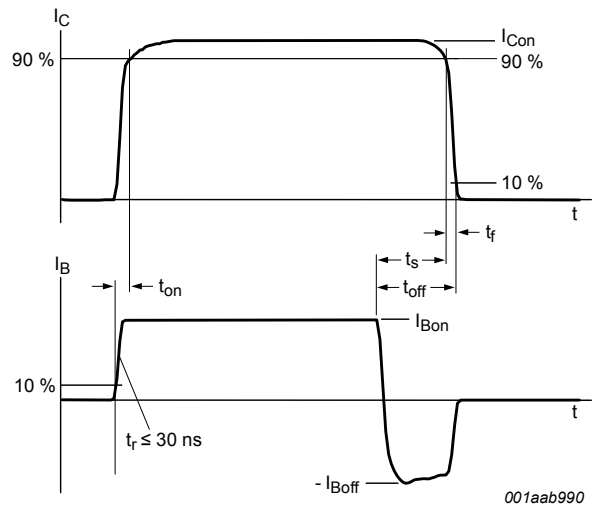


Fig. 13. Switching times waveforms for resistive load

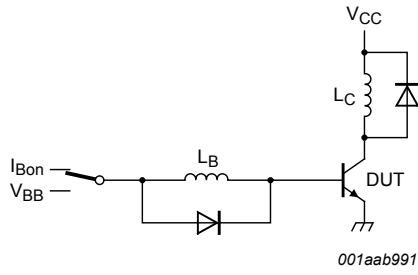


Fig. 14. Test circuit for inductive load switching

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

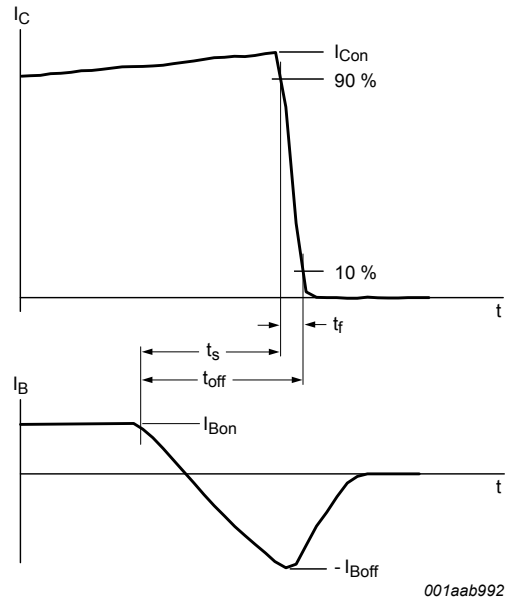


Fig. 15. Switching times waveforms for inductive load

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 ₁	b	b ₁ (2)	b ₂ (2)	c	D	D ₁	E	e	L	L ₁ (1)	L ₂ (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

Fig. 16. Package outline TO-220AB (SOT78)

11. Legal information

11.1 Data sheet status

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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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