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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WeEn Semiconductors

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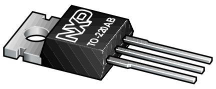


PHE13005

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

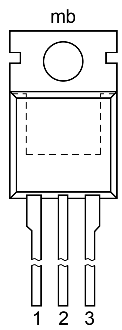
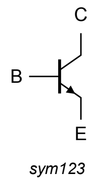
Table 1. Quick reference data

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} ≤ 25 °C; Fig. 3		-	-	75	W
V_{CESM}	collector-emitter peak voltage	V_{BE} = 0 V		-	-	700	V
Static characteristics							
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V; T_{mb} = 25 °C; Fig. 11		12	20	40	
		I_C = 2 A; V_{CE} = 5 V; T_{mb} = 25 °C; Fig. 11		10	17	28	

Scan or click this QR code to view the latest information for this product

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 TO-220AB (SOT78)	
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 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
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} ≤ 25 °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 A		-	9	V

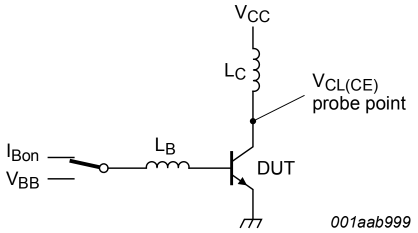


Fig. 1. Test circuit for reverse bias safe operating area

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

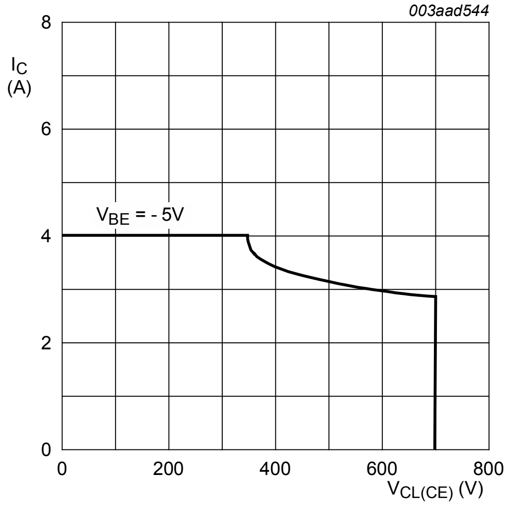


Fig. 2. Reverse bias safe operating area

$$T_j \leq T_{j(max)}\ °C$$

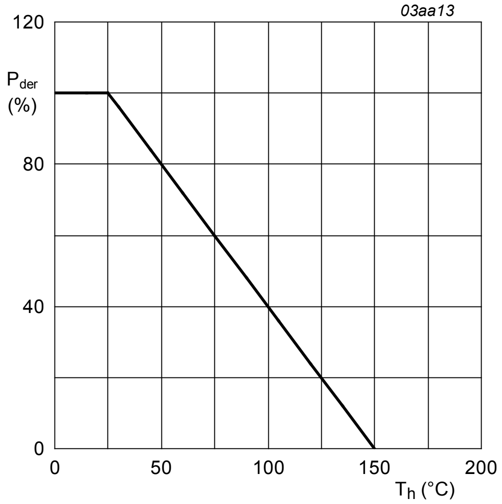


Fig. 3. Normalized total power dissipation as a function of heatsink temperature

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

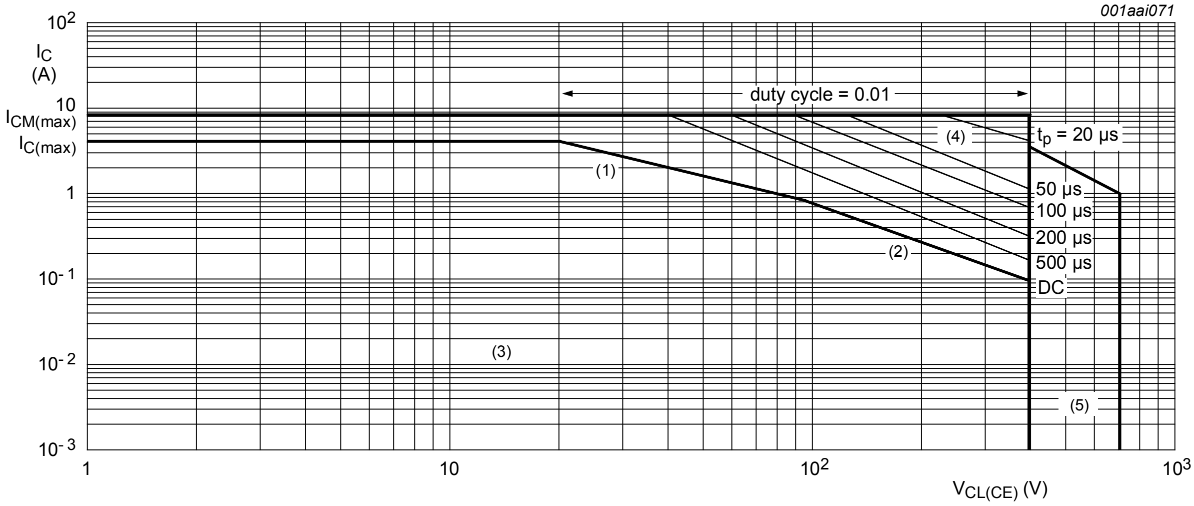


Fig. 4. Forward bias safe operating area

k maximum lines(2)Second breakdown limits(3)Region of permissible DC operation(4)Extension of operating region for repetitive pulse operat

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

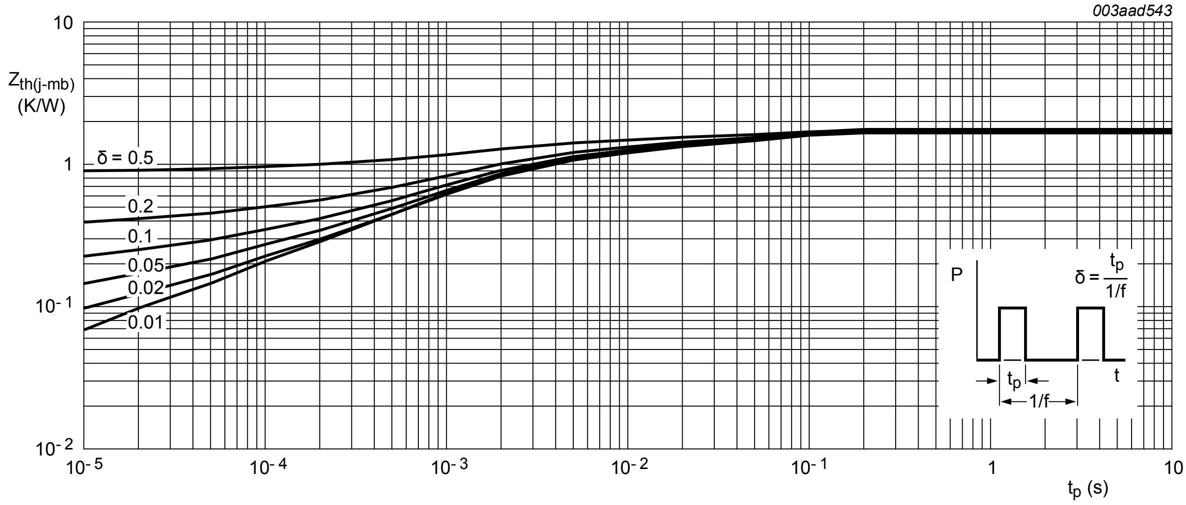


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
t_s	storage time	I_C = 2 A; I_{Bon} = 0.4 A; I_{Boff} = -0.4 A; R_L = 75 Ω; T_{mb} = 25 °C; resistive load; Fig. 12; Fig. 13		-	2.7	4	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_{mb} = 25 °C; inductive load; Fig. 14; Fig. 15		-	1.2	2	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_{mb} = 100 °C; inductive load; Fig. 14; Fig. 15		-	1.4	4	µs
t_f	fall time	I_C = 2 A; I_{Bon} = 0.4 A; I_{Boff} = -0.4 A; R_L = 75 Ω; T_{mb} = 25 °C; resistive load; Fig. 12; Fig. 13		-	0.3	0.9	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_{mb} = 25 °C; inductive load; Fig. 14; Fig. 15		-	0.1	0.5	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_{mb} = 100 °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 V; V_{CE} = 700 V; T_j = 25 °C		-	-	1	mA
		V_{BE} = -1.5 V; V_{CE} = 700 V; T_j = 100 °C		-	-	5	mA
I_{CBO}	collector-base cut-off current	V_{CB} = 700 V; I_E = 0 A; T_{mb} = 25 °C		-	-	1	mA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 400 V; I_B = 0 A; T_{mb} = 25 °C		-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0 A; T_{mb} = 25 °C		-	-	1	mA
V_{CEOsus}	collector-emitter sustaining voltage	I_B = 0 A; I_C = 10 mA; L_C = 25 mH; T_{mb} = 25 °C; Fig. 6; Fig. 7		400	-	-	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 1 A; I_B = 0.2 A; T_{mb} = 25 °C; Fig. 8; Fig. 9		-	0.1	0.5	V
		I_C = 2 A; I_B = 0.5 A; T_{mb} = 25 °C; Fig. 8; Fig. 9		-	0.2	0.6	V
		I_C = 4 A; I_B = 1 A; T_{mb} = 25 °C; Fig. 8; Fig. 9		-	0.3	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 1 A; I_B = 0.2 A; T_{mb} = 25 °C; Fig. 10		-	0.85	1.2	V

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

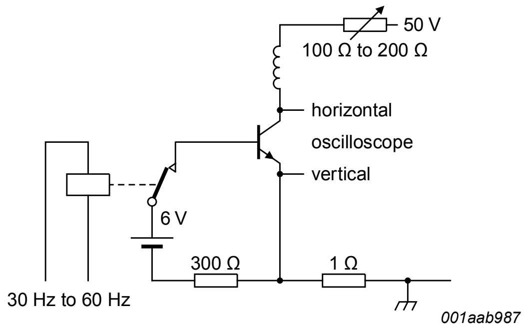


Fig. 6. Test circuit for collector-emitter sustaining voltage

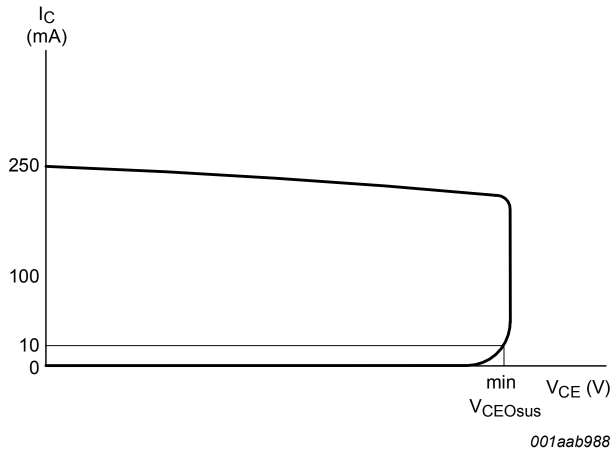


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

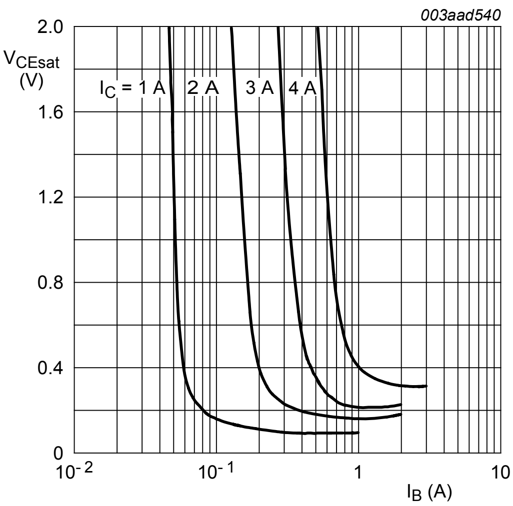


Fig. 8. Collector-emitter saturation voltage; typical values

$$T_j = 25\ °C$$

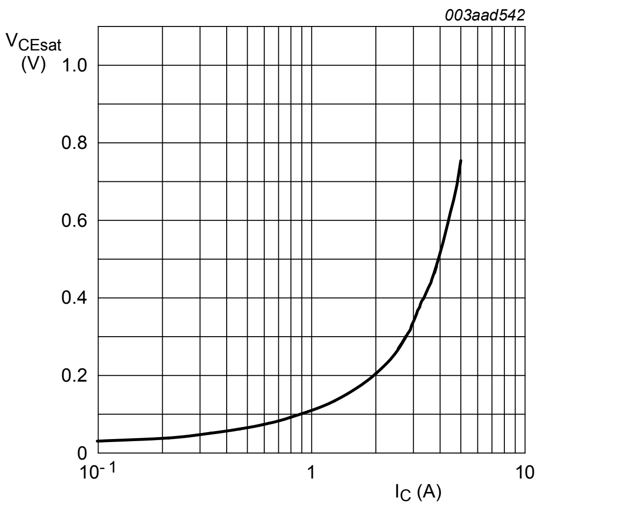


Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

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

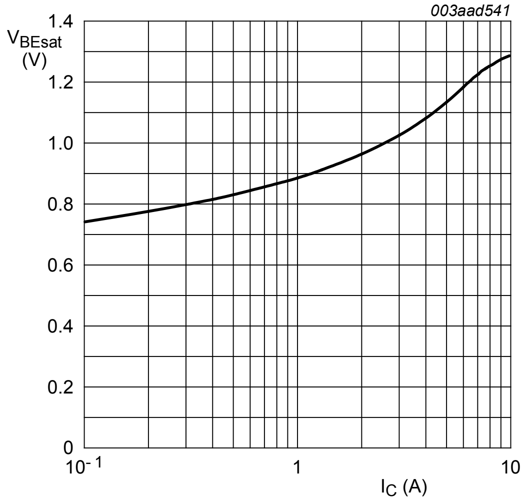


Fig. 10. Base-emitter saturation voltage; typical values

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

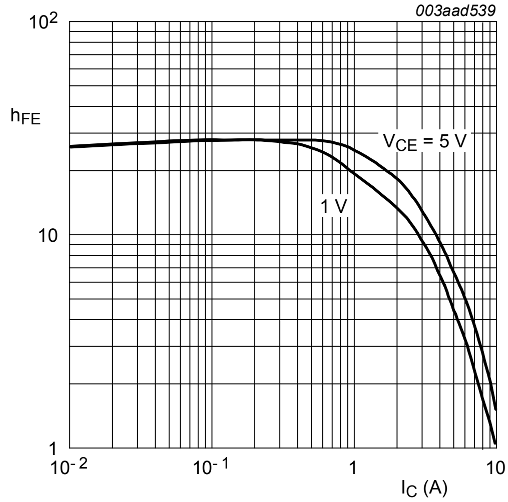


Fig. 11. DC current gain as a function of collector current; typical values

$$T_j = 25\ °C$$

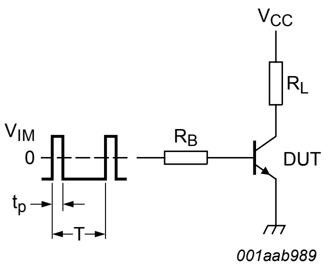


Fig. 12. Test circuit for resistive load switching

$$V_{IM} = -6 \text{ to } +8\ V;\ V_{CC} = 250\ V;\ t_p = 20\ \mu s;\ \delta = \frac{t_p}{T} = 0.01$$

R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

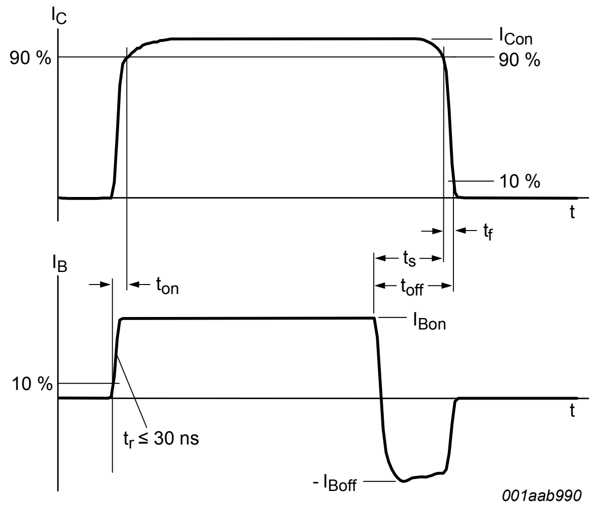


Fig. 13. Switching times waveforms for resistive load

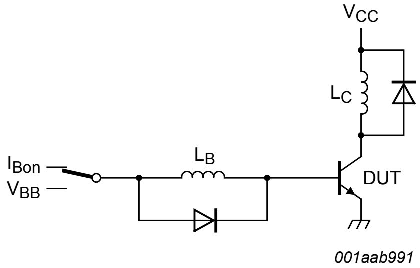


Fig. 14. Test circuit for inductive load switching

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

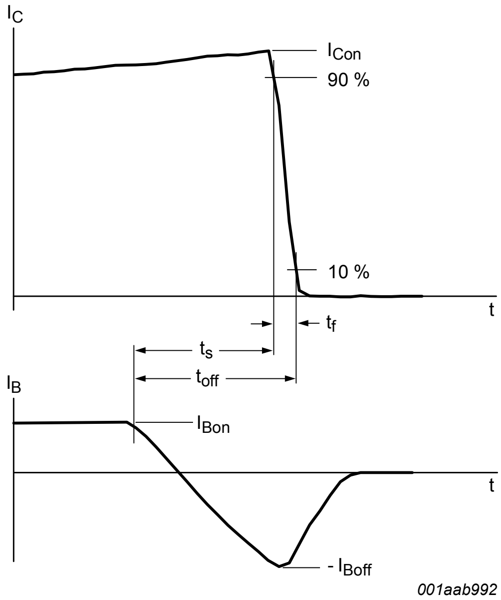
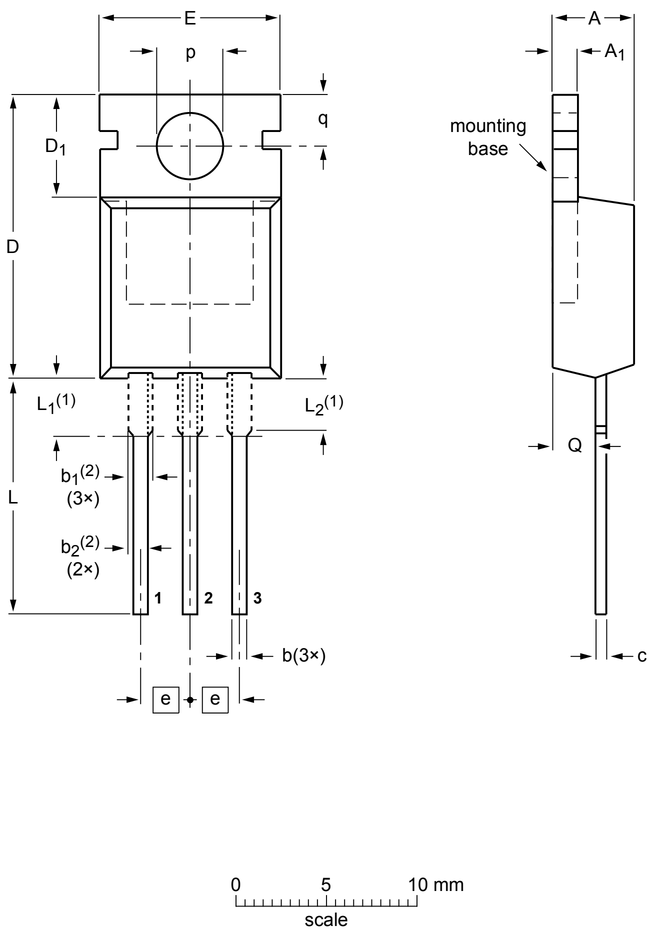


Fig. 15. Switching times waveforms for inductive load

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.

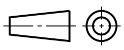
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			~~08-04-23~~ 08-06-13

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

11. Legal information

11.1 Data sheet status

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.
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Date of release: 21 January 2014