

# DATA SHEET

## **BUW13F; BUW13AF** Silicon diffused power transistors

Product specification  
Supersedes data of February 1996  
File under Discrete Semiconductors, SC06

1997 Aug 13

Silicon diffused power transistors

BUW13F; BUW13AF

DESCRIPTION

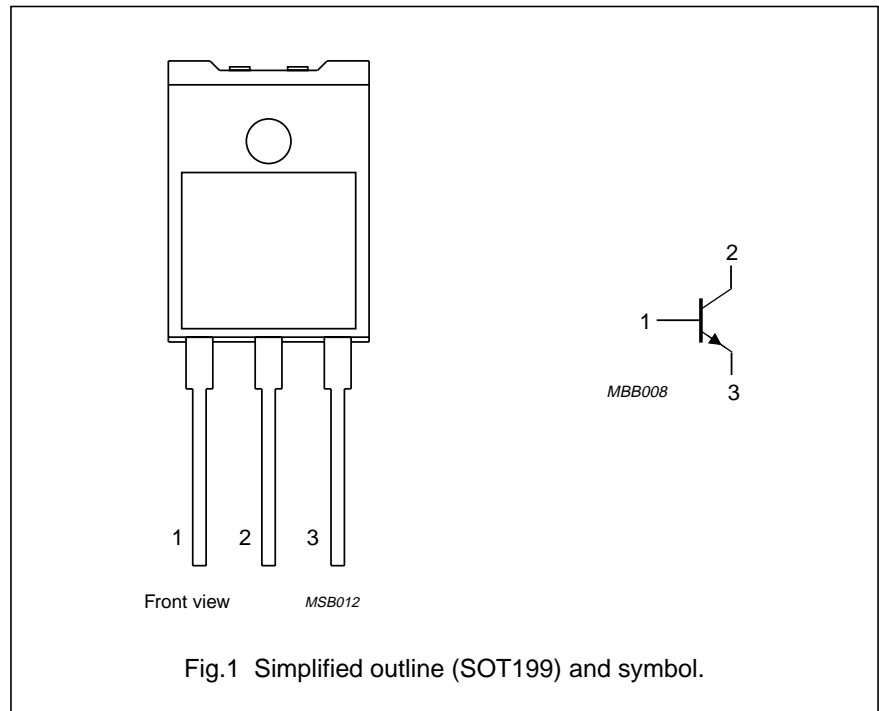
High-voltage, high-speed, glass-passivated NPN power transistor in a SOT199 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0$	850	V
	BUW13F			
$V_{CEO}$	collector-emitter voltage	open base	400	V
	BUW13AF			
$V_{CEsat}$	collector-emitter saturation voltage	see Figs 8 and 10	1.5	V
$I_{Csat}$	collector saturation current		10	A
	BUW13AF			
$I_C$	collector current (DC)	see Figs 3 and 4	15	A
$I_{CM}$	collector current (peak value)	$t_p < 20$ ms; see Fig 4	30	A
$P_{tot}$	total power dissipation	$T_h \leq 25$ °C; see Fig.2	37	W
$t_f$	fall time	resistive load; see Fig.13	0.8	$\mu$ s

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## THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R <sub>th j-h</sub>	thermal resistance from junction to external heatsink	note 1	3.4	K/W
		note 2	2.5	K/W
R <sub>th j-a</sub>	thermal resistance from junction to ambient		35	K/W

## Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V <sub>CESM</sub>	collector-emitter peak voltage BUW13F BUW13AF	V <sub>BE</sub> = 0	–	850	V
			–	1000	V
V <sub>CEO</sub>	collector-emitter voltage BUW13F BUW13AF	open base	–	400	V
			–	450	V
I <sub>Csat</sub>	collector saturation current BUW13F BUW13AF		–	10	A
			–	8	A
I <sub>C</sub>	collector current (DC)	see Figs 3 and 4	–	15	A
I <sub>CM</sub>	collector current (peak value)	t <sub>p</sub> < 20 ms; see Fig 4	–	30	A
I <sub>B</sub>	base current (DC)		–	6	A
I <sub>BM</sub>	base current (peak value)	t <sub>p</sub> = –20 ms	–	9	A
P <sub>tot</sub>	total power dissipation	T <sub>h</sub> ≤ 25 °C; see Fig.2; note 1	–	37	W
		T <sub>h</sub> ≤ 25 °C; see Fig.2; note 2	–	50	W
T <sub>stg</sub>	storage temperature		–65	+150	°C
T <sub>j</sub>	junction temperature		–	150	°C

## Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

## ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	MAX.	UNIT
V <sub>isolM</sub>	isolation voltage from all terminals to external heatsink (peak value); note 1	2000	V
C <sub>isol</sub>	isolation capacitance from collector to external heatsink	21	pF

## Note

1. Repetitive peak operation with RH ≤ 65% under clean and dust-free conditions.

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## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage BUW13F BUW13AF	$I_C = 100\text{ mA}$ ; $I_{Boff} = 0$ ; $L = 25\text{ mH}$ ; see Figs 6 and 7	400	–	–	V
			450	–	–	V
$V_{CEsat}$	collector-emitter saturation voltage BUW13F	$I_C = 10\text{ A}$ ; $I_B = 2\text{ A}$ ; see Figs 8 and 10	–	–	1.5	V
	BUW13AF		$I_C = 8\text{ A}$ ; $I_B = 1.6\text{ A}$ ; see Figs 8 and 10	–	–	1.5
$V_{BEsat}$	base-emitter saturation voltage BUW13F BUW13AF	$I_C = 10\text{ A}$ ; $I_B = 2\text{ A}$ ; see Fig.8	–	–	1.6	V
		$I_C = 8\text{ A}$ ; $I_B = 1.6\text{ A}$ ; see Fig.8	–	–	1.6	V
$I_{Csat}$	collector saturation current BUW13F BUW13AF	$V_{CE} = 1.5\text{ V}$	–	–	10	A
			–	–	8	A
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$ ; $V_{BE} = 0$ ; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$ ; $V_{BE} = 0$ ; $T_j = 125\text{ °C}$ ; note 1	–	–	4	mA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 9\text{ V}$ ; $I_C = 0$	–	–	10	mA
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V}$ ; $I_C = 20\text{ mA}$ ; see Fig.11	10	18	35	
		$V_{CE} = 5\text{ V}$ ; $I_C = 1.5\text{ A}$ ; see Fig.11	10	20	35	
<b>Switching times resistive load</b> (see Figs 12 and 13)						
$t_{on}$	turn-on time BUW13F BUW13AF	$I_{Con} = 10\text{ A}$ ; $I_{Bon} = I_{Boff} = 2\text{ A}$	–	–	1	$\mu\text{s}$
		$I_{Con} = 8\text{ A}$ ; $I_{Bon} = I_{Boff} = 1.6\text{ A}$	–	–	1	$\mu\text{s}$
$t_s$	storage time BUW13F BUW13AF	$I_{Con} = 10\text{ A}$ ; $I_{Bon} = I_{Boff} = 2\text{ A}$	–	–	4	$\mu\text{s}$
		$I_{Con} = 8\text{ A}$ ; $I_{Bon} = I_{Boff} = 1.6\text{ A}$	–	–	4	$\mu\text{s}$
$t_f$	fall time BUW13F BUW13AF	$I_{Con} = 10\text{ A}$ ; $I_{Bon} = I_{Boff} = 2\text{ A}$	–	–	0.8	$\mu\text{s}$
		$I_{Con} = 8\text{ A}$ ; $I_{Bon} = I_{Boff} = 1.6\text{ A}$	–	–	0.8	$\mu\text{s}$
<b>Switching times inductive load</b> (see Figs 14 and 15)						
$t_s$	storage time BUW13F	$I_{Con} = 10\text{ A}$ ; $I_B = 2\text{ A}$ ; $V_{CL} = 250\text{ V}$ ; $T_c = 100\text{ °C}$	–	2.8	3.5	$\mu\text{s}$
	BUW13AF		$I_{Con} = 8\text{ A}$ ; $I_B = 1.6\text{ A}$ ; $V_{CL} = 300\text{ V}$ ; $T_c = 100\text{ °C}$	–	2.8	3.5

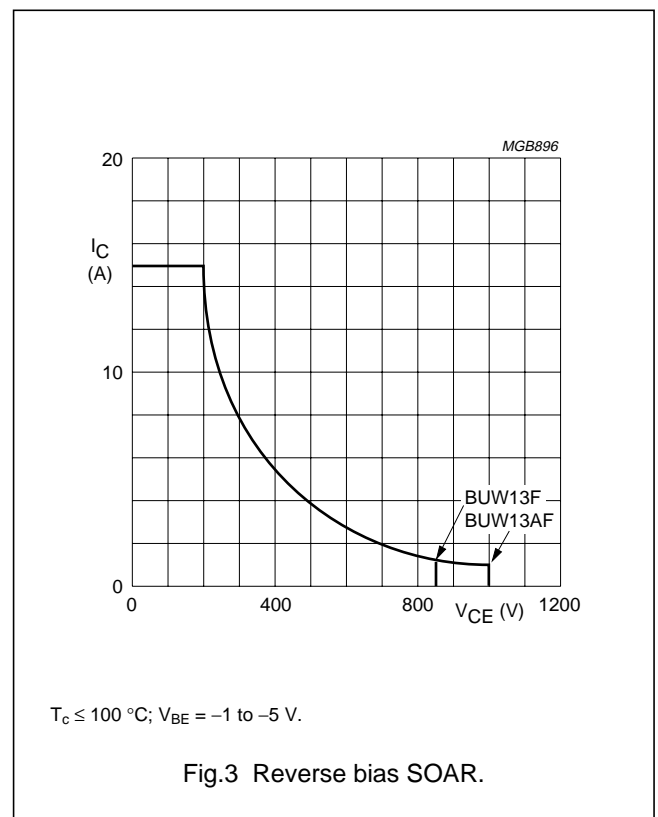
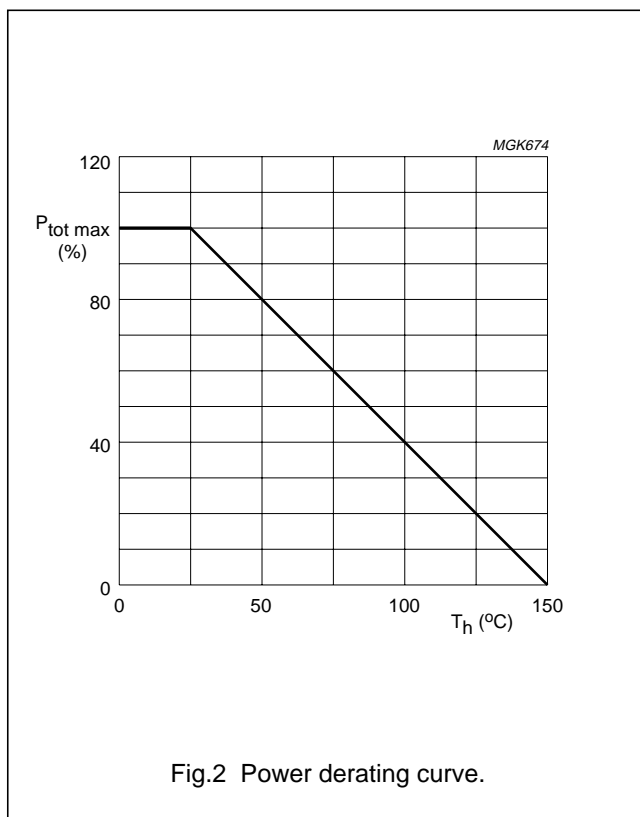
Silicon diffused power transistors

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
t <sub>f</sub>	fall time BUW13F	I <sub>Con</sub> = 10 A; I <sub>B</sub> = 2 A; V <sub>CL</sub> = 250 V; T <sub>c</sub> = 100 °C	–	200	300	ns
	BUW13AF	I <sub>Con</sub> = 8 A; I <sub>B</sub> = 1.6 A; V <sub>CL</sub> = 300 V; T <sub>c</sub> = 100 °C	–	200	300	ns

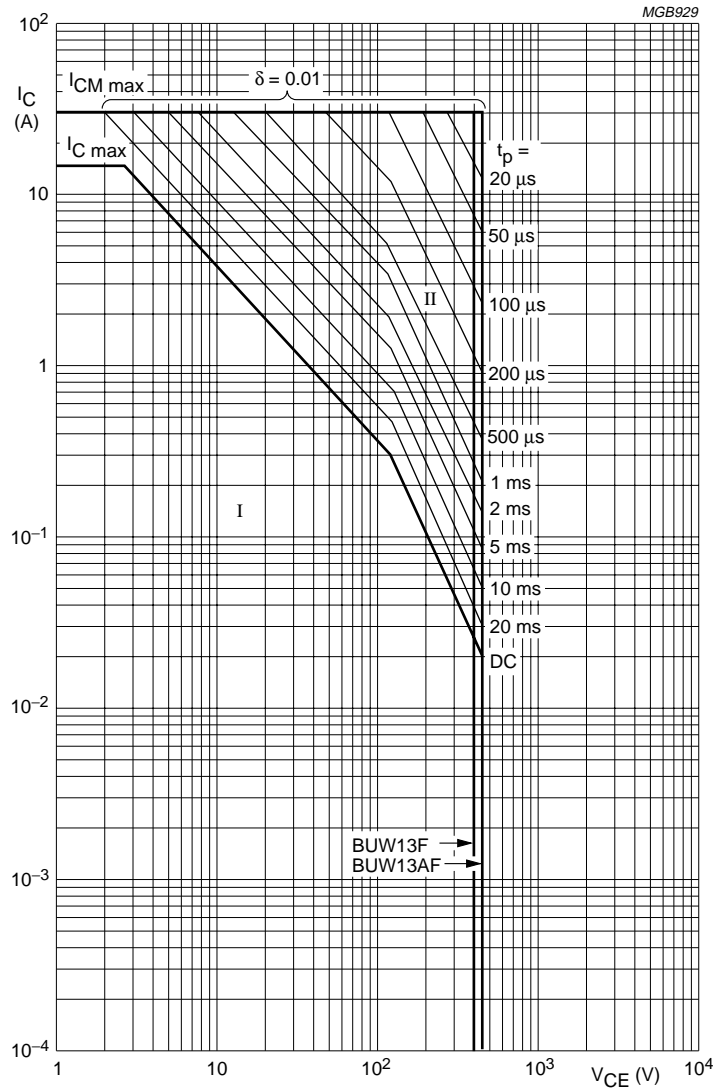
Note

1. Measured with a half-sinewave voltage (curve tracer).



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$T_{mb} = 25\text{ }^{\circ}\text{C}$ .

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

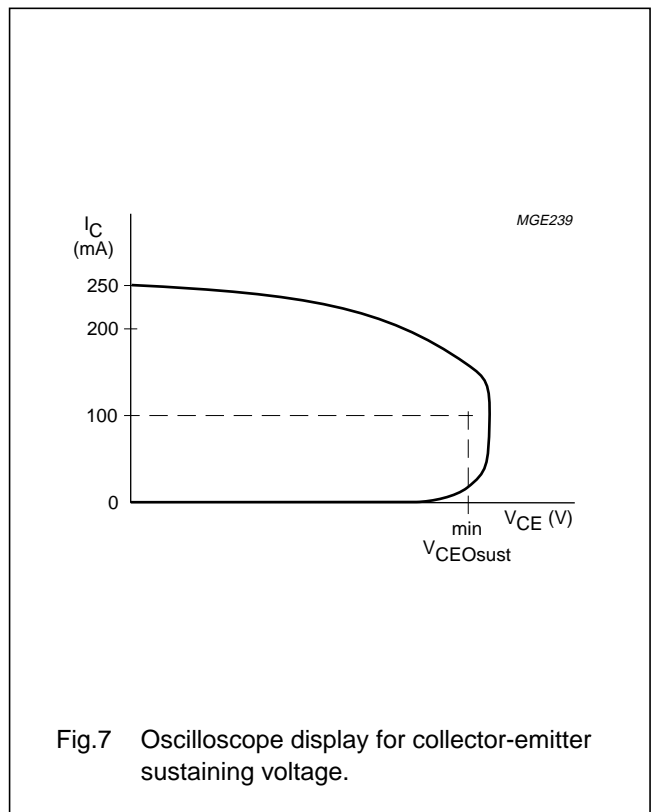
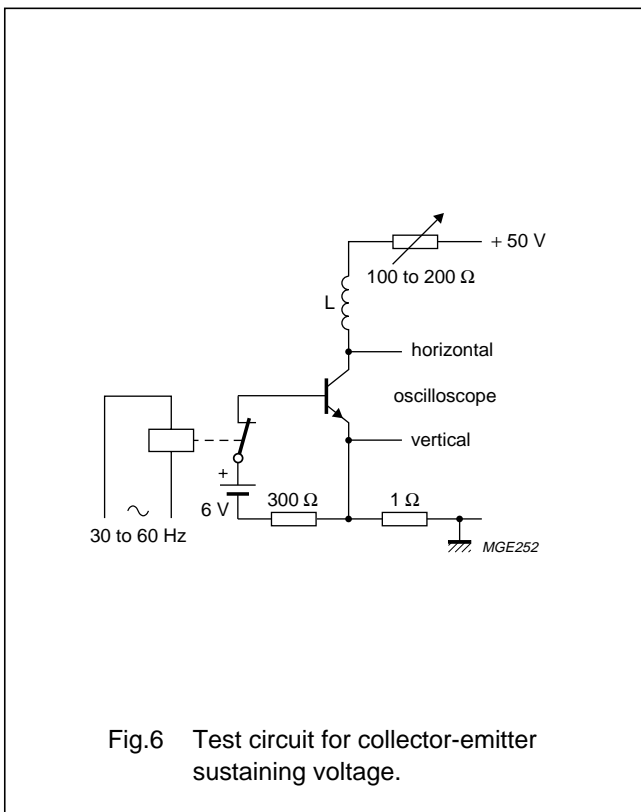
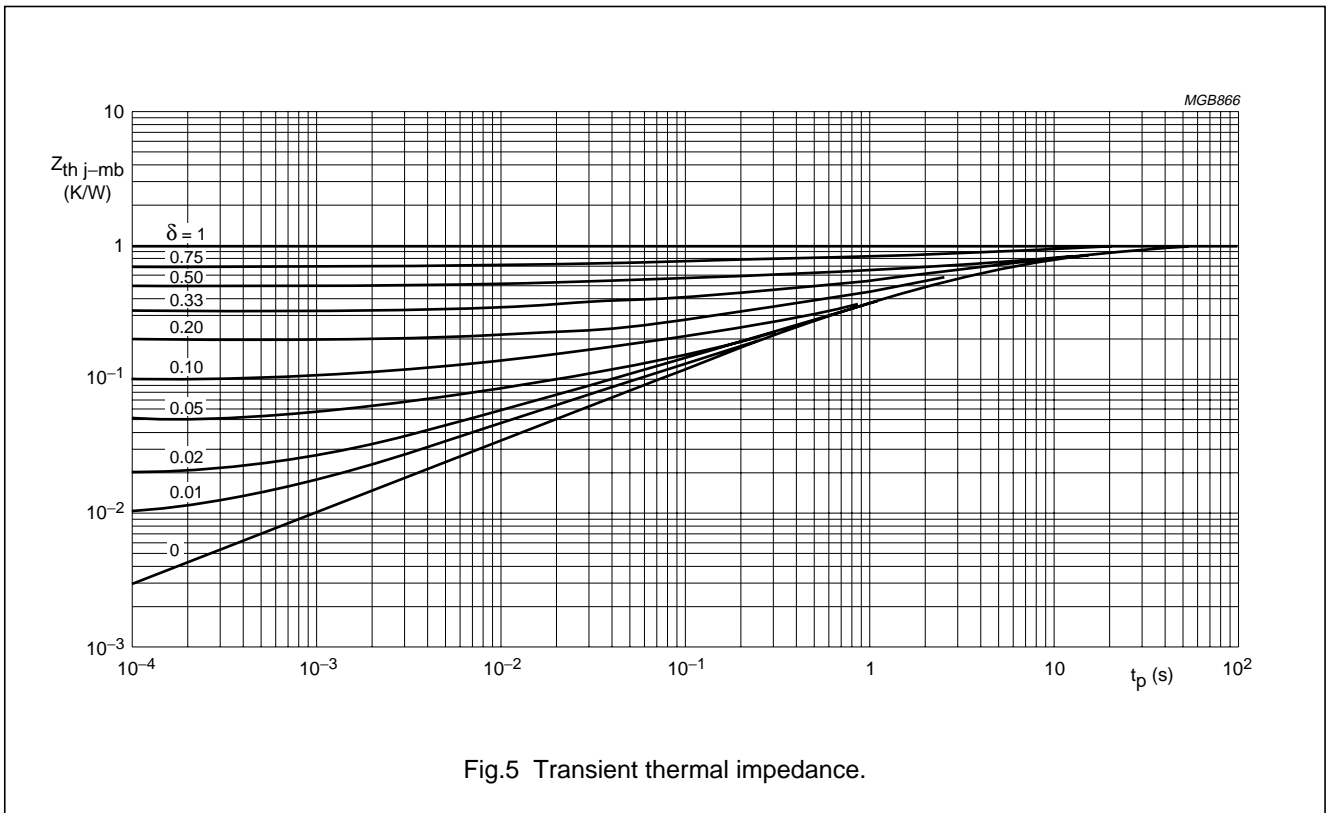
(1)  $P_{tot\ max}$  and  $P_{tot\ peak\ max}$  lines.

(2) Second breakdown limits (independent of temperature).

Fig.4 Forward bias SOAR.

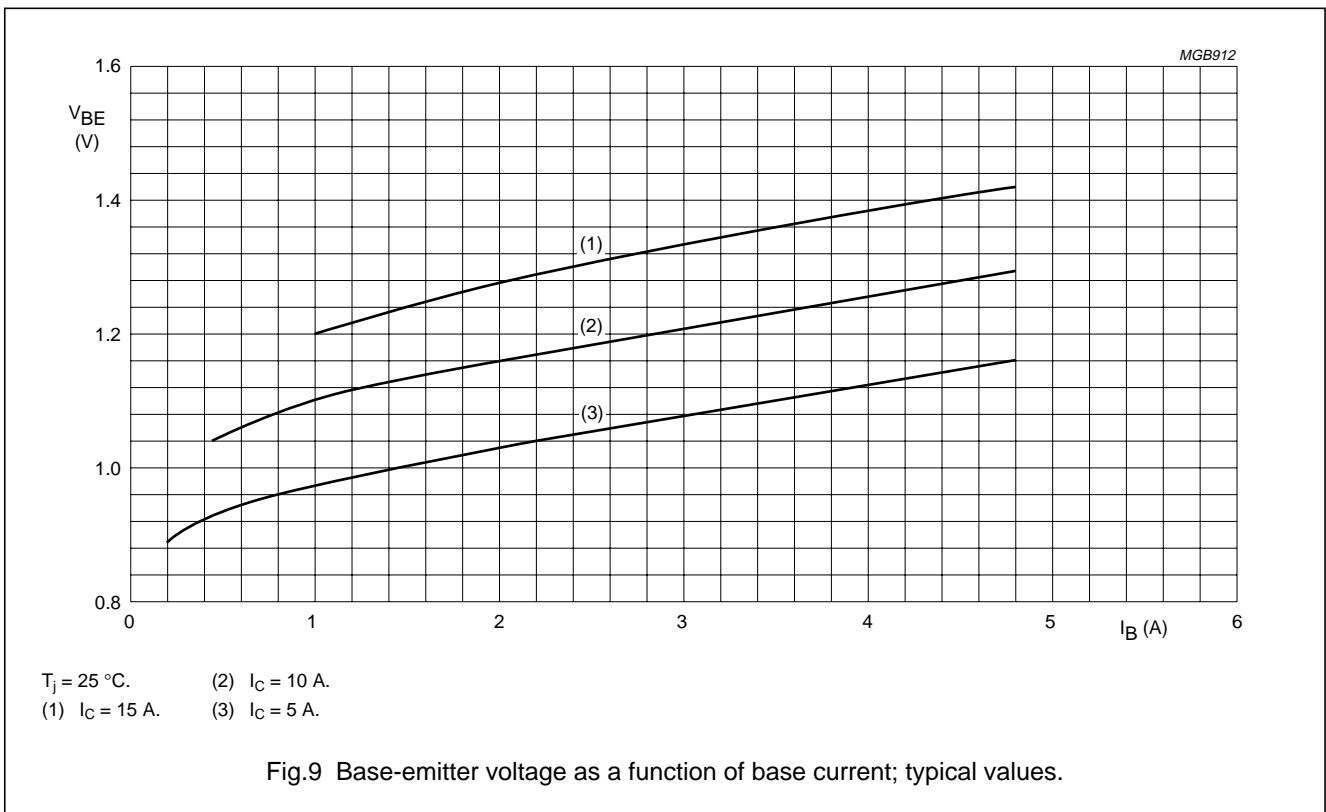
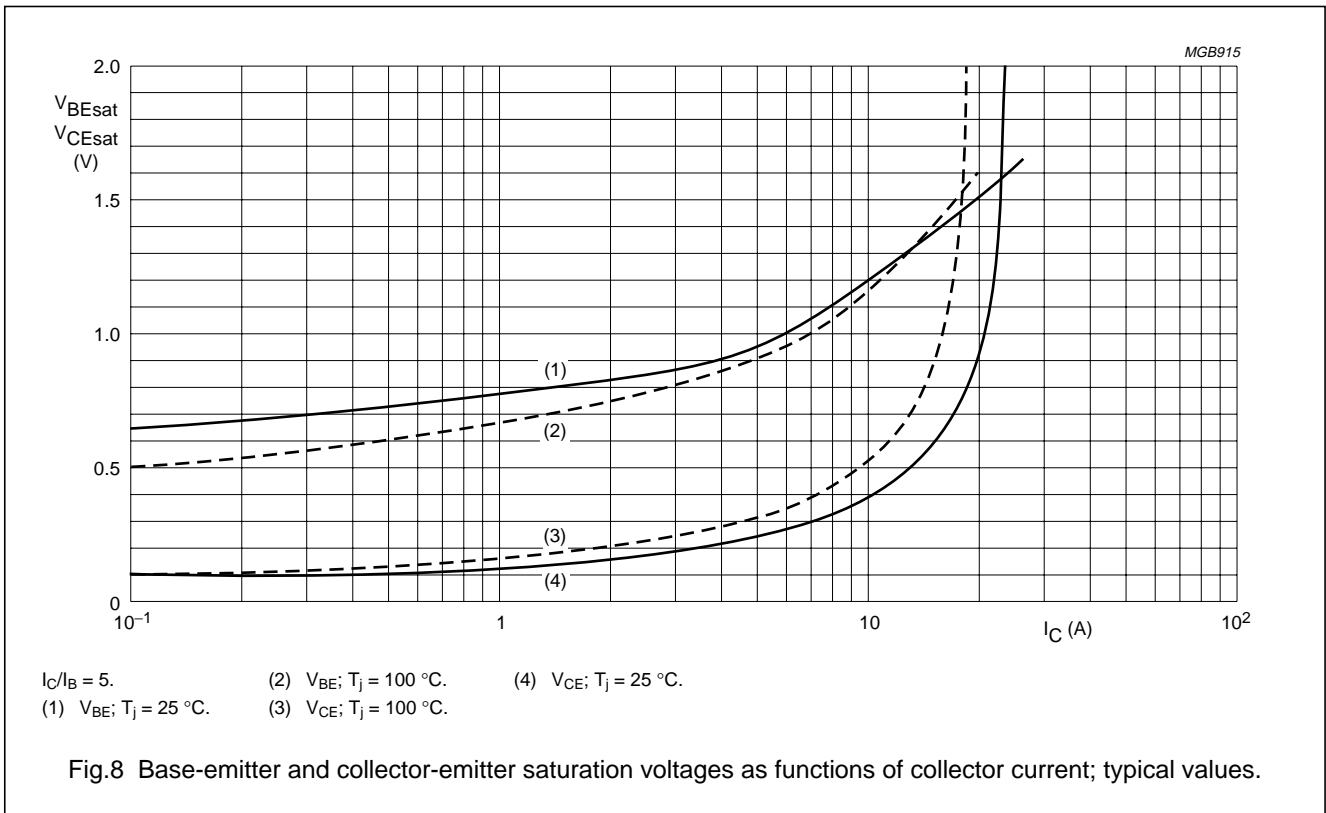
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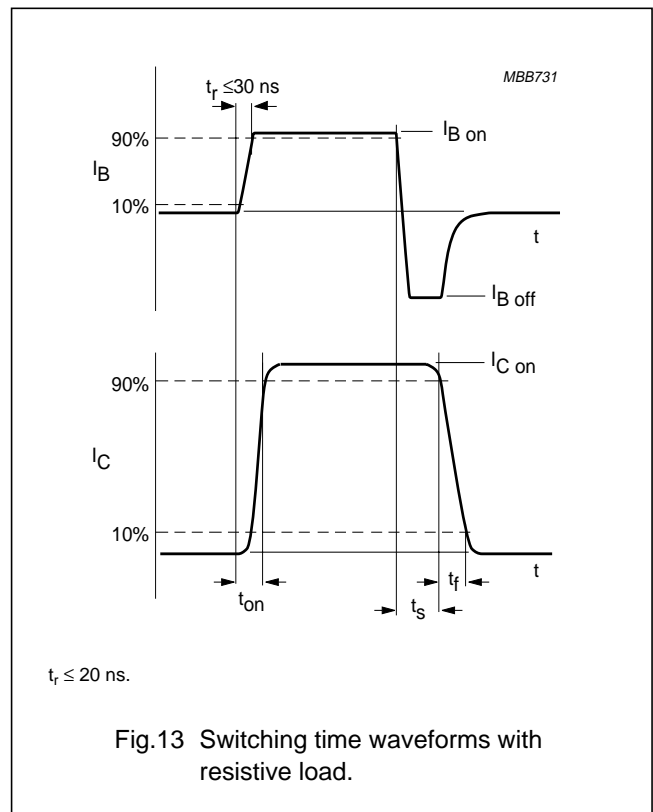
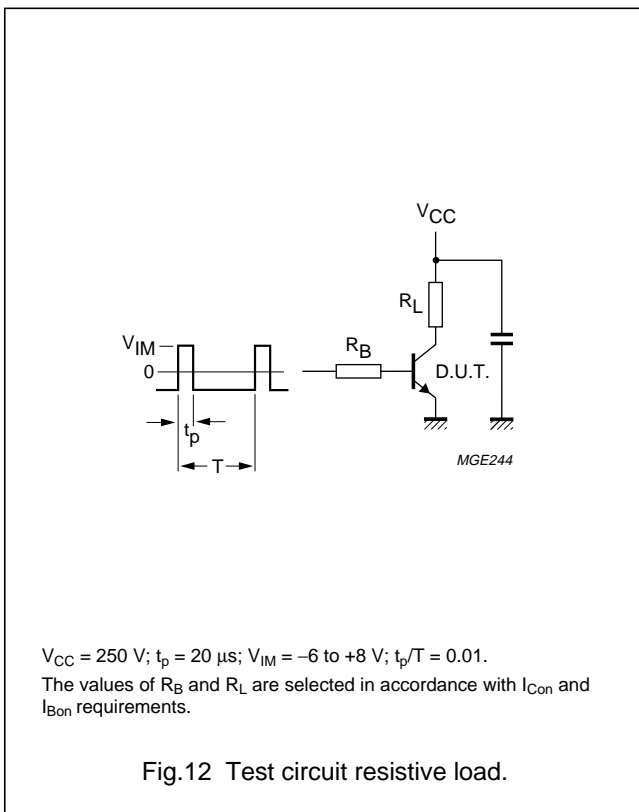
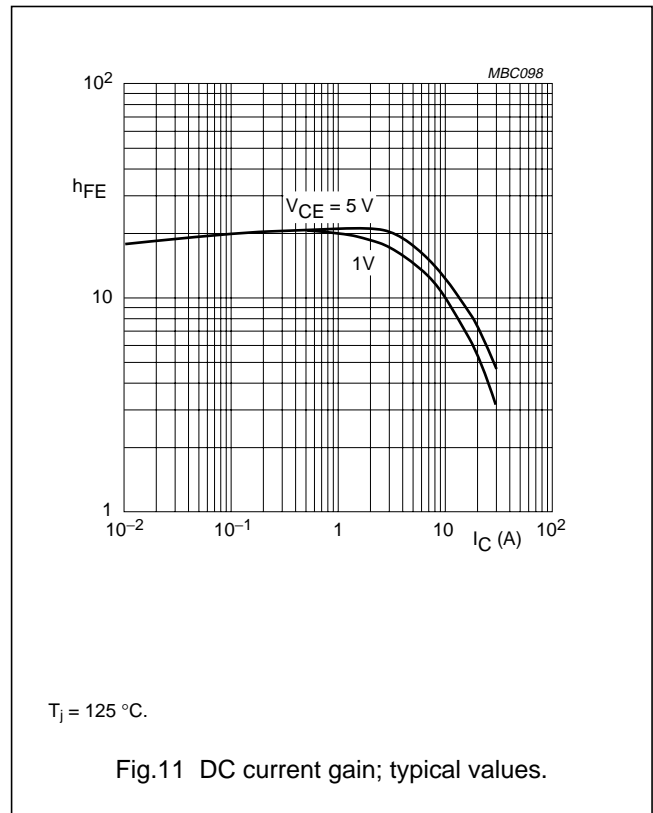
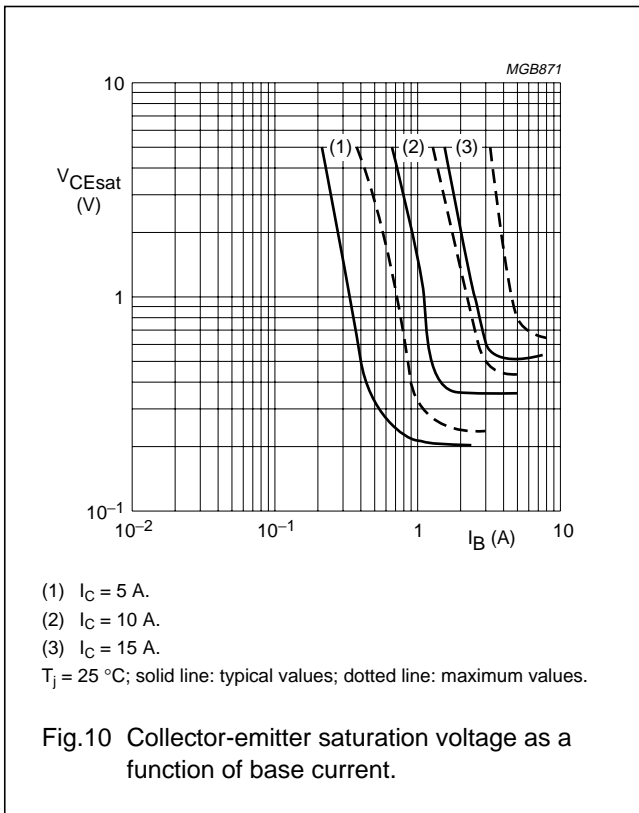
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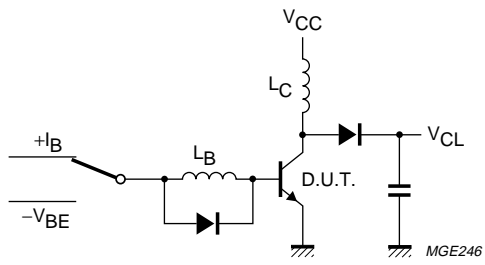
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$V_{CL} \leq$  up to 1000 V;  $V_{CC} = 30$  V;  $V_{BE} = -5$  V;  $L_B = 1 \mu\text{H}$ ;  
 $L_C = 200 \mu\text{H}$ .

Fig.14 Test circuit inductive load and reverse bias SOAR.

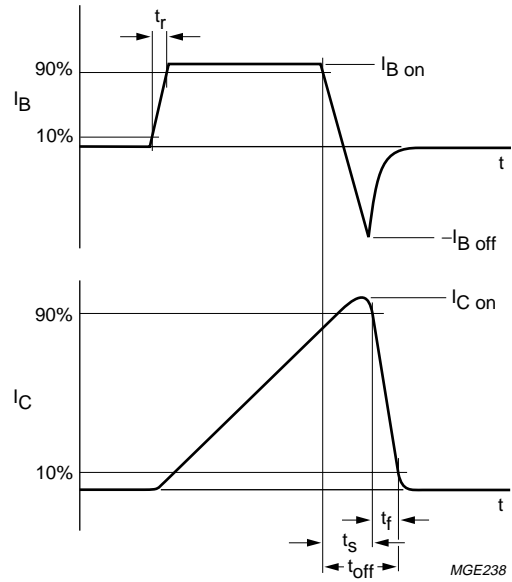


Fig.15 Switching time waveforms with inductive load.

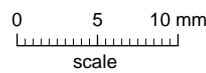
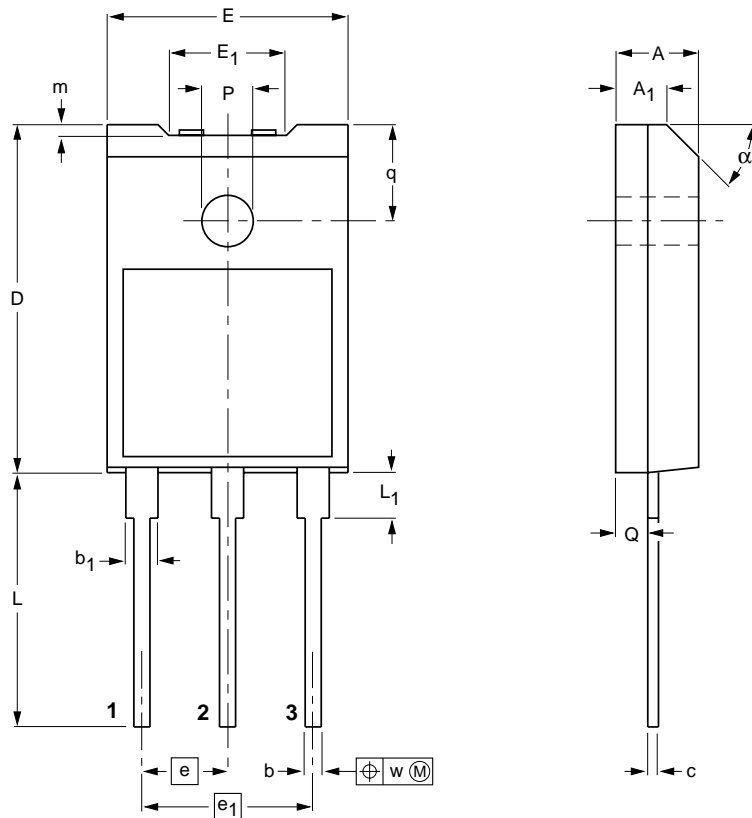
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PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3 leads (in-line)

SOT199



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	c	D	E	E <sub>1</sub>	e	e <sub>1</sub>	L	L <sub>1</sub> <sup>(1)</sup>	m	P	Q	q	w	α
mm	5.2 4.8	3.4 3.0	1.2 1.0	2.1 1.9	0.6 0.5	21.5 20.5	15.3 14.7	7.8 6.8	5.45	10.9	16.5 15.7	3.7 3.3	0.8 0.6	3.3 3.1	2.1 1.9	6.2 5.8	0.4	45°

Note

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT199						97-06-27

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**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
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**NOTES**

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**NOTES**

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