

# DATA SHEET

## **BUT11; BUT11A** Silicon diffused power transistors

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

1997 Aug 13

# Silicon diffused power transistors

# BUT11; BUT11A

### DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a TO-220AB package.

### APPLICATIONS

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

### PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

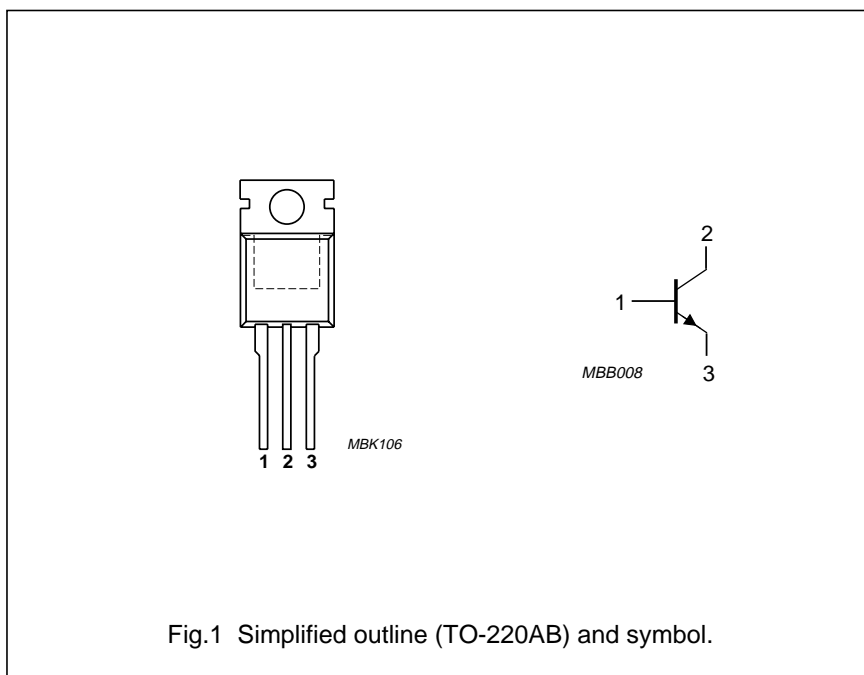


Fig.1 Simplified outline (TO-220AB) and symbol.

### QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$V_{CESM}$	collector-emitter peak voltage BUT11 BUT11A	$V_{BE} = 0$	850 1000	V V
$V_{CEO}$	collector-emitter voltage BUT11 BUT11A	open base	400 450	V V
$V_{CEsat}$	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
$I_C$	collector current (DC)	see Figs 2 and 4	5	A
$I_{CM}$	collector current (peak value)	see Fig. 4	10	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ }^\circ\text{C}$ ; see Fig.3	100	W
$t_f$	fall time	resistive load; see Figs 11 and 12	0.8	$\mu\text{s}$

### THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-mb}$	thermal resistance from junction to mounting base	1.25	K/W

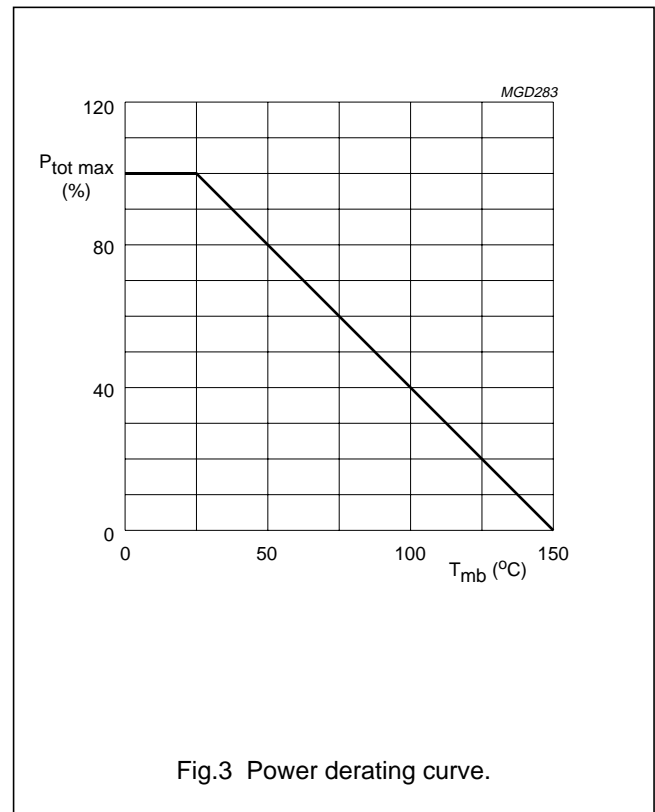
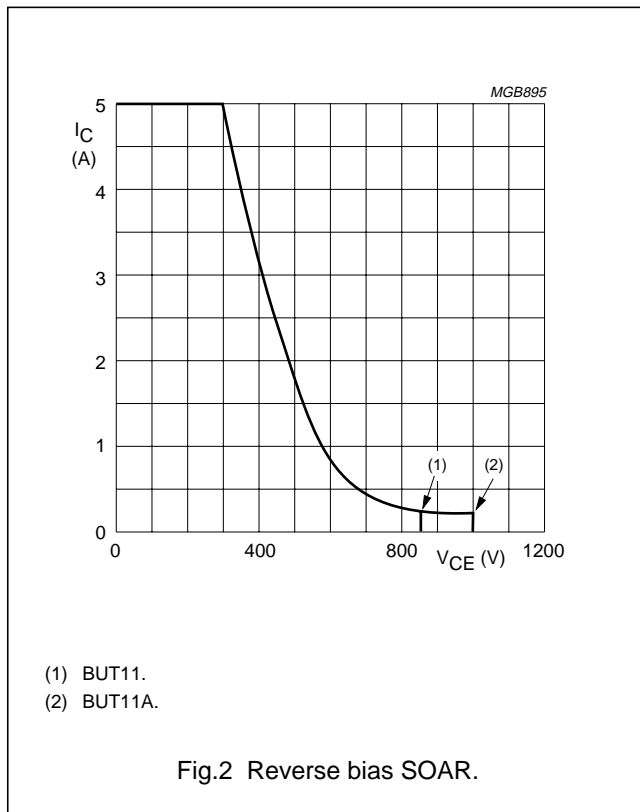
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**LIMITING VALUES**

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0$	-	850	V
	BUT11			1000	V
$V_{CEO}$	collector-emitter voltage	open base	-	400	V
	BUT11A			450	V
$I_C$	collector current (DC)	see Figs 2 and 4	-	5	A
$I_{CM}$	collector current (peak value)	$t_p < 2$ ms; see Fig. 4	-	10	A
$I_B$	base current (DC)		-	2	A
$I_{BM}$	base current (peak value)	$t_p < 2$ ms	-	4	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	-	100	W
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	150	°C



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## CHARACTERISTICS

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

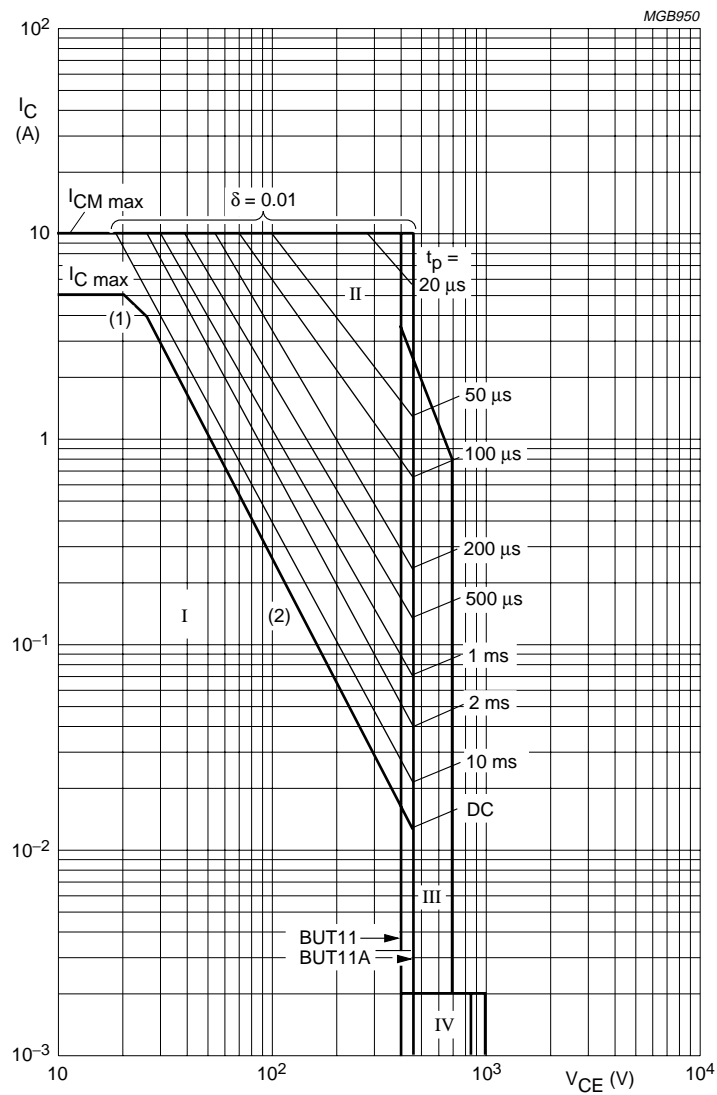
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage BUT11 BUT11A	$I_C = 100\text{ mA}$ ; $I_{Boff} = 0$ ; $L = 25\text{ mH}$ ; see Figs 5 and 6	400	–	–	V
			450	–	–	V
$V_{CEsat}$	collector-emitter saturation voltage BUT11 BUT11A	$I_C = 3\text{ A}$ ; $I_B = 600\text{ mA}$ ; see Figs 7 and 9	–	–	1.5	V
		$I_C = 2.5\text{ A}$ ; $I_B = 500\text{ mA}$ ; see Figs 7 and 9	–	–	1.5	V
$V_{BEsat}$	base-emitter saturation voltage BUT11 BUT11A	$I_C = 3\text{ A}$ ; $I_B = 0.6\text{ A}$ ; see Fig.7	–	–	1.3	V
		$I_C = 2.5\text{ A}$ ; $I_B = 0.5\text{ A}$ ; see Fig.7	–	–	1.3	V
$I_{CES}$	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	–	–	2	mA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 9\text{ V}$ ; $I_C = 0$	–	–	10	mA
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V}$ ; $I_C = 5\text{ mA}$ ; see Fig.10	10	18	35	
		$V_{CE} = 5\text{ V}$ ; $I_C = 500\text{ mA}$ ; see Fig.10	10	20	35	
<b>Switching times resistive load (see Fig.12)</b>						
$t_{on}$	turn-on time BUT11 BUT11A	$I_{Con} = 3\text{ A}$ ; $I_{Bon} = -I_{Boff} = 600\text{ mA}$	–	–	1	$\mu\text{s}$
		$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 500\text{ mA}$	–	–	1	$\mu\text{s}$
$t_s$	storage time BUT11 BUT11A	$I_{Con} = 3\text{ A}$ ; $I_{Bon} = -I_{Boff} = 600\text{ mA}$	–	–	4	$\mu\text{s}$
		$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 500\text{ mA}$	–	–	4	$\mu\text{s}$
$t_f$	fall time BUT11 BUT11A	$I_{Con} = 3\text{ A}$ ; $I_{Bon} = -I_{Boff} = 600\text{ mA}$	–	–	0.8	$\mu\text{s}$
		$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 500\text{ mA}$	–	–	0.8	$\mu\text{s}$
<b>Switching times inductive load (see Fig.14)</b>						
$t_s$	storage time BUT11	$I_{Con} = 3\text{ A}$ ; $I_{Bon} = 600\text{ mA}$	–	1.1	1.4	$\mu\text{s}$
		$I_{Con} = 3\text{ A}$ ; $I_{Bon} = 600\text{ mA}$ ; $T_j = 100\text{ °C}$	–	1.2	1.5	$\mu\text{s}$
	BUT11A	$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = 500\text{ mA}$	–	1.1	1.4	$\mu\text{s}$
		$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = 500\text{ mA}$ ; $T_j = 100\text{ °C}$	–	1.2	1.5	$\mu\text{s}$
$t_f$	fall time BUT11	$I_{Con} = 3\text{ A}$ ; $I_{Bon} = 600\text{ mA}$	–	80	150	ns
		$I_{Con} = 3\text{ A}$ ; $I_{Bon} = 600\text{ mA}$ ; $T_j = 100\text{ °C}$	–	140	300	ns
	BUT11A	$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = 500\text{ mA}$	–	80	150	ns
		$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = 500\text{ mA}$ ; $T_j = 100\text{ °C}$	–	140	300	ns

## Note

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

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$T_{mb} \leq 25\ ^\circ C$ .

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

III - Area of permissible operation during turn-on in single transistor converters, provided  $R_{BE} \leq 100\ \Omega$  and  $t_p \leq 0.6\ \mu s$ .

IV - Repetitive pulse operation in this region is permissible provided  $V_{BE} \leq 0$  and  $t_p \leq 5\ ms$ .

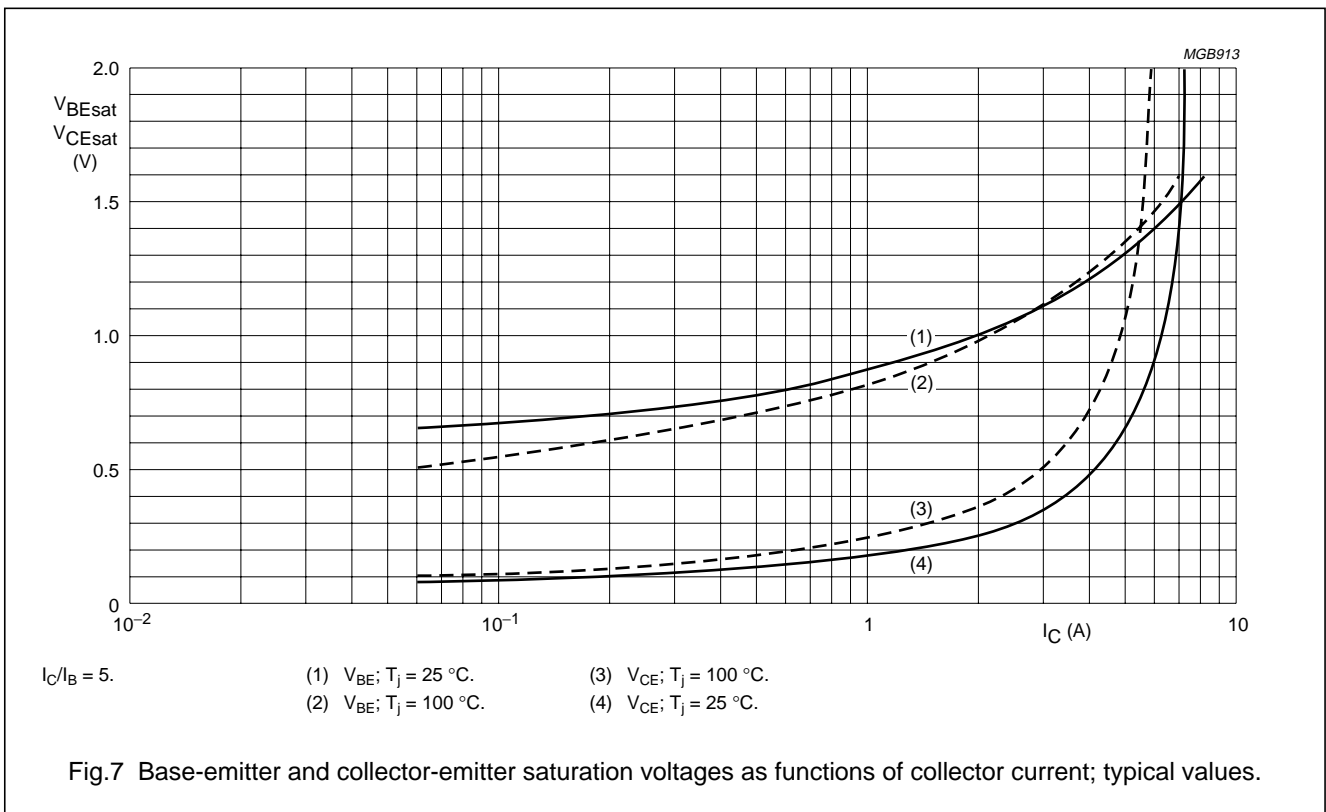
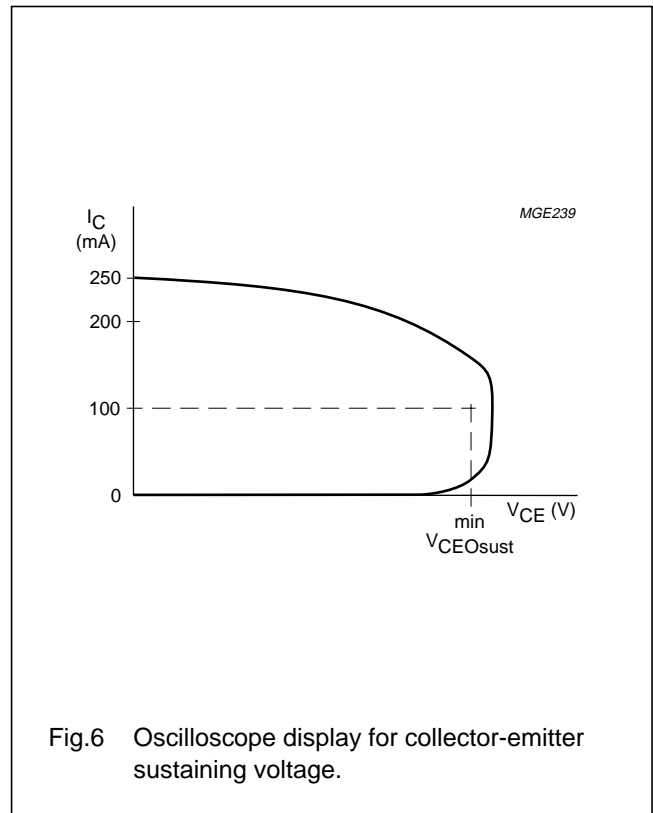
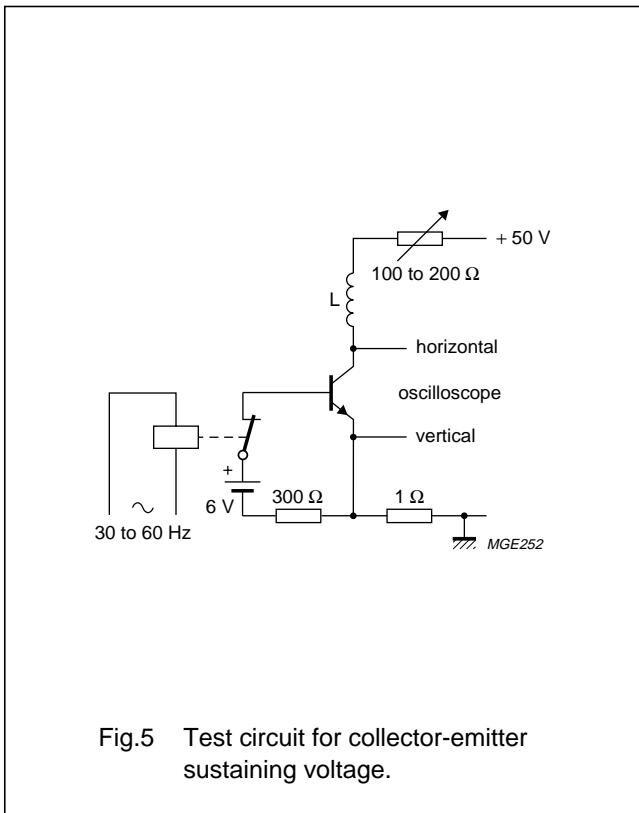
(1)  $P_{tot\ max}$  and  $P_{tot\ peak\ max}$  lines.

(2) Second breakdown limits.

Fig.4 Forward bias SOAR.

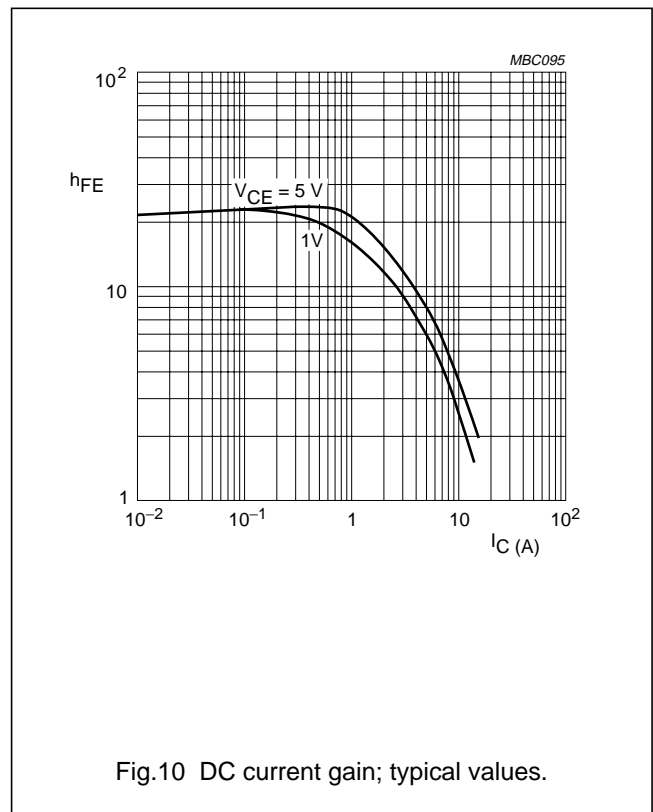
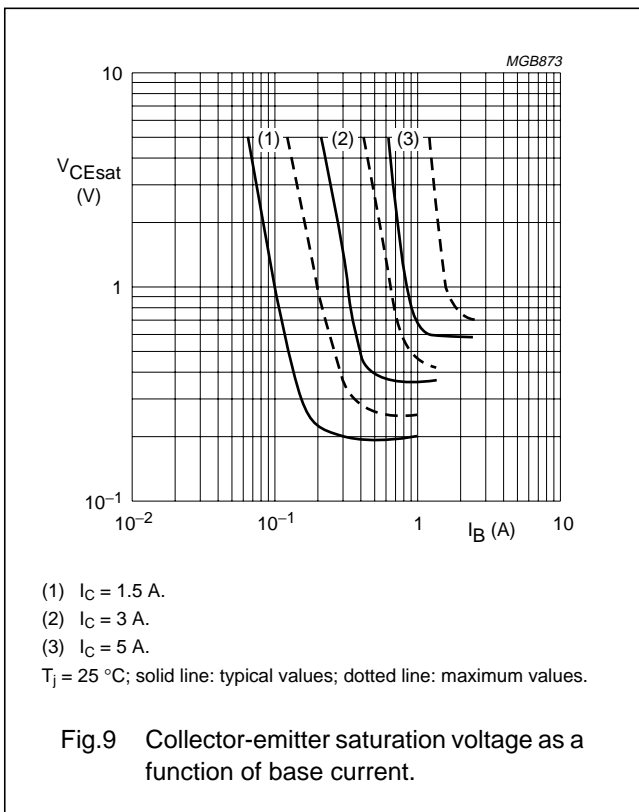
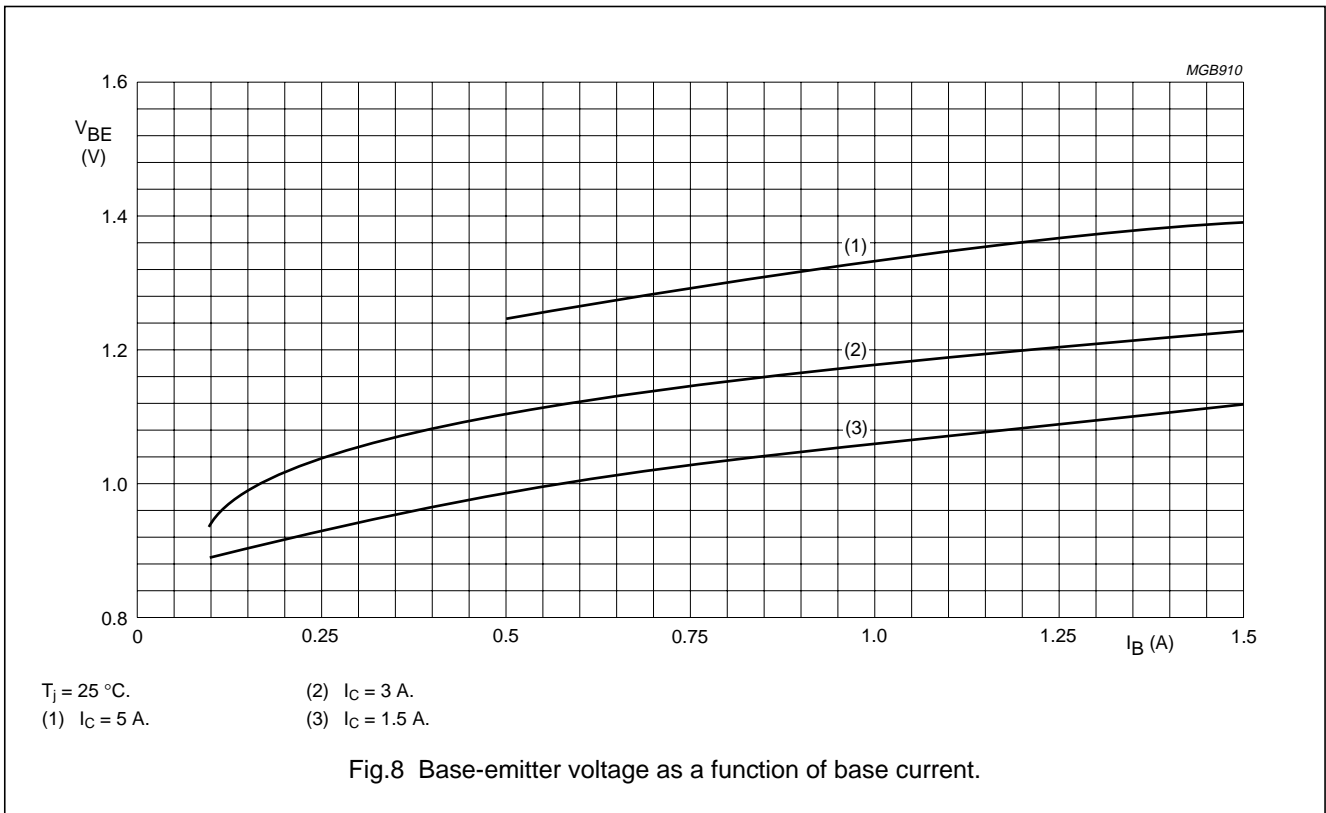
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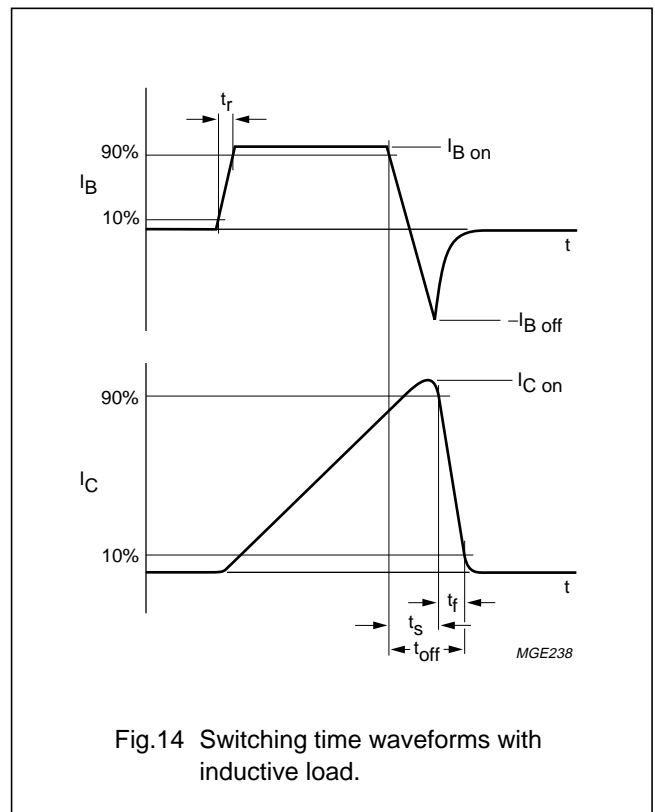
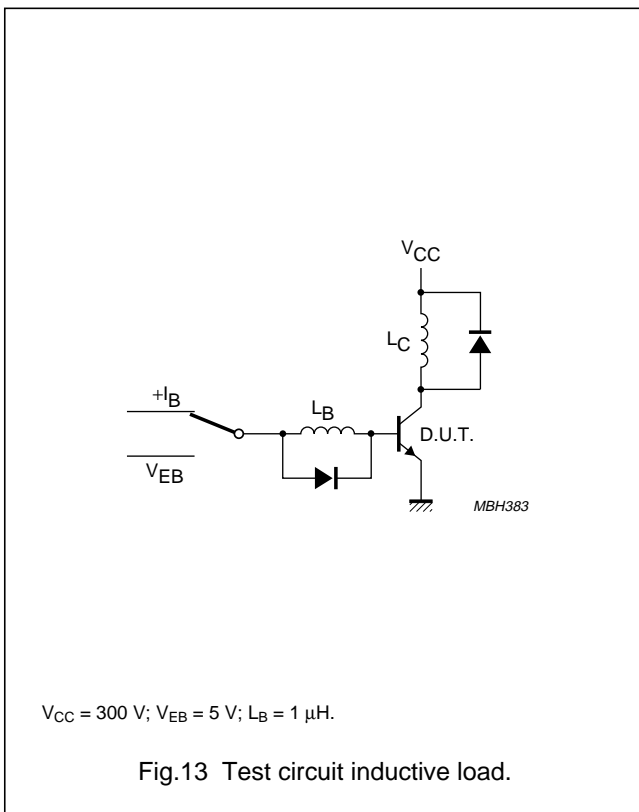
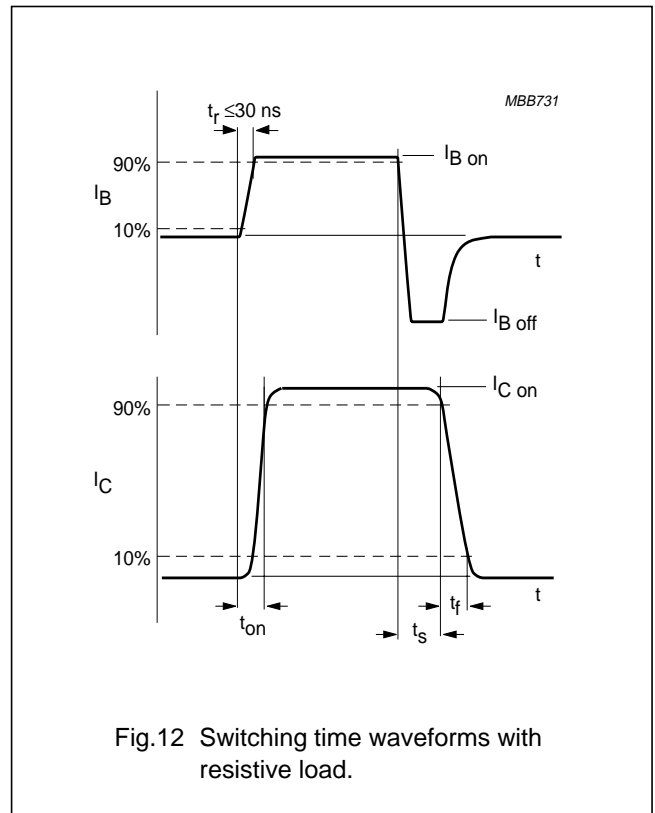
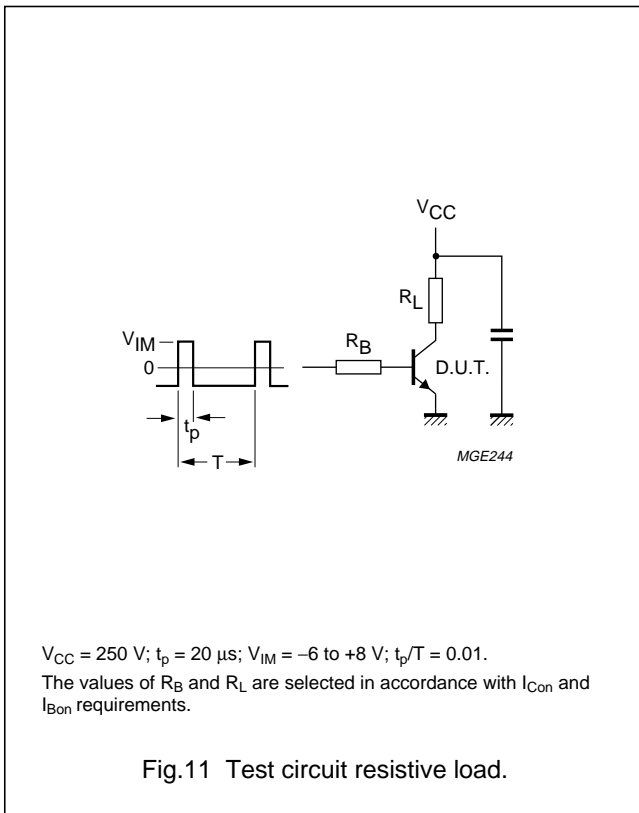
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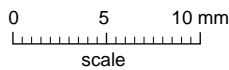
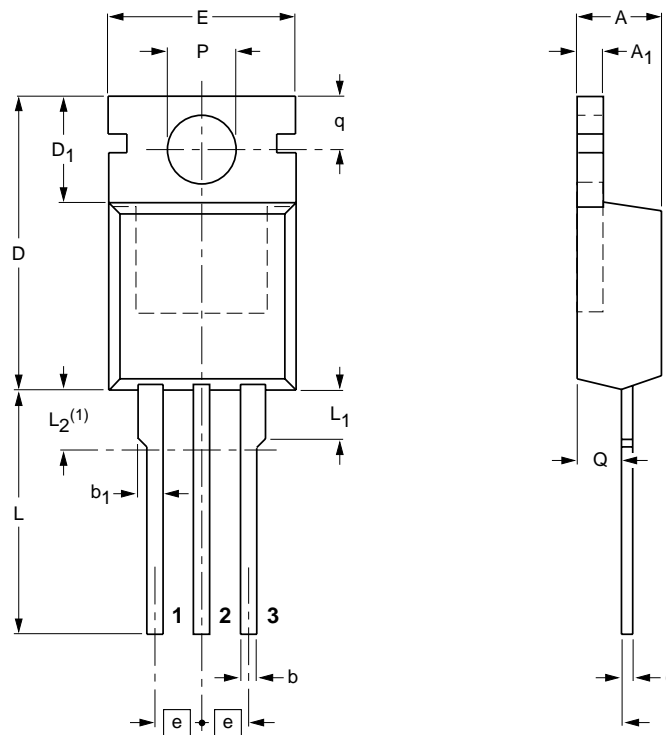
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PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220

SOT78



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub>	L <sub>2</sub> <sup>(1)</sup> max.	P	q	Q
mm	4.5 4.1	1.39 1.27	0.9 0.7	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

Note

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT78		TO-220				97-06-11

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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.
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Printed in The Netherlands

137067/00/01/pp11

Date of release: 1997 Aug 13

Document order number: 9397 750 02713

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