

# DATA SHEET

## **BUT12; BUT12A** Silicon diffused power transistors

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

1997 Aug 13

# Silicon diffused power transistors

# BUT12; BUT12A

## DESCRIPTION

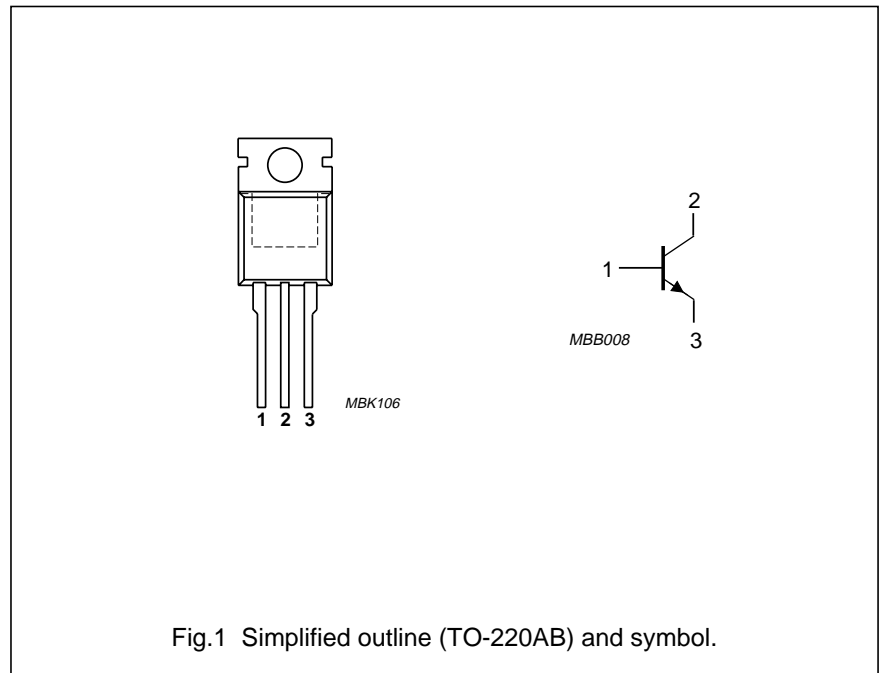
High-voltage, high-speed, glass-passivated NPN power transistor in a TO-220AB package.

## APPLICATIONS

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

## PINNING

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



## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0$	850 1000	V V
	BUT12 BUT12A			
$V_{CEO}$	collector-emitter voltage	open base	400 450	V V
	BUT12 BUT12A			
$V_{CEsat}$	collector-emitter saturation voltage	see Fig.8	1.5	V
$I_{Csat}$	collector saturation current		6 5	A A
	BUT12 BUT12A			
$I_C$	collector current (DC)	see Figs 3 and 4	8	A
$I_{CM}$	collector current (peak value)	see Fig. 4	20	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ }^\circ\text{C}$ ; see Fig.2	125	W
$t_f$	fall time	resistive load; see Figs 12 and 13	0.8	$\mu\text{s}$

## THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-mb}$	thermal resistance from junction to mounting base	1	K/W

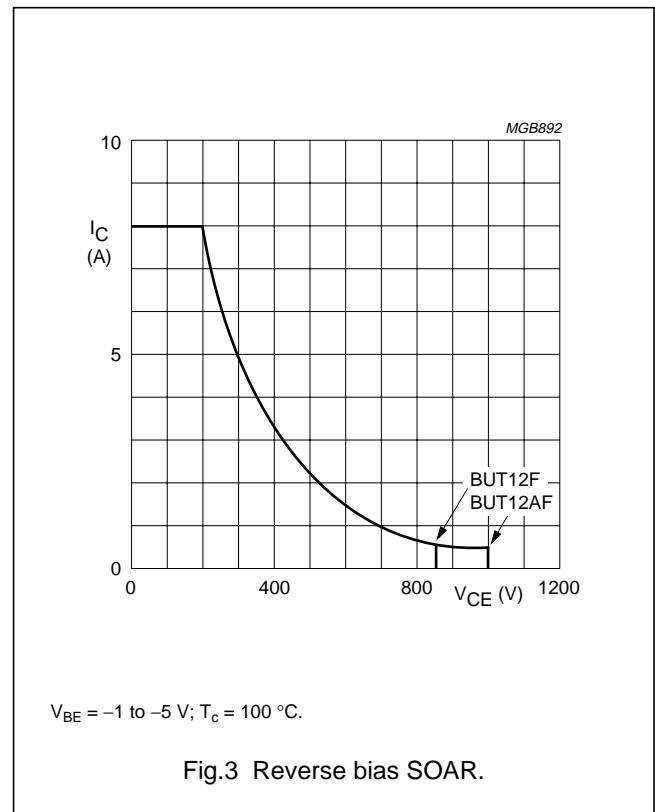
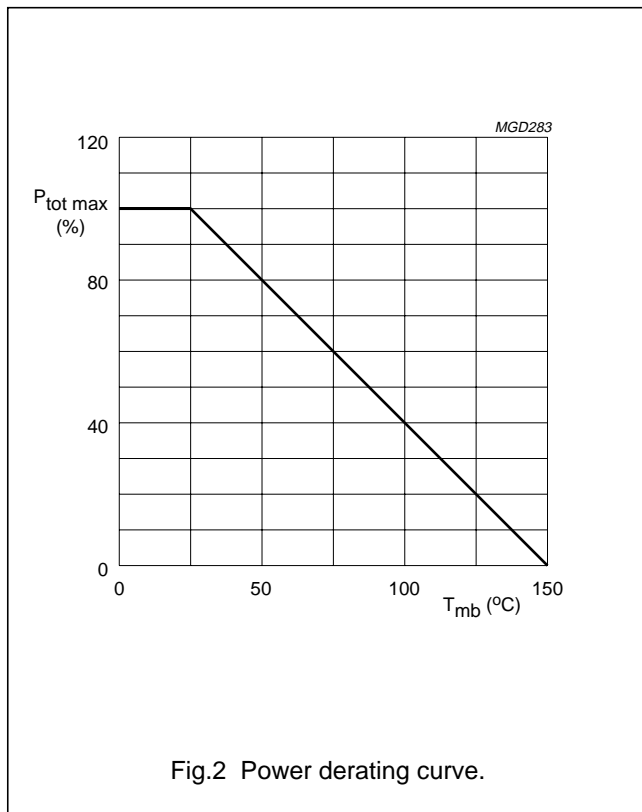
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**LIMITING VALUES**

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0$			
	BUT12		–	850	V
	BUT12A	–	1000	V	
$V_{CEO}$	collector-emitter voltage	open base			
	BUT12		–	400	V
	BUT12A	–	450	V	
$I_{Csat}$	collector saturation current				
	BUT12	–	6	A	
	BUT12A	–	5	A	
$I_C$	collector current (DC)	see Figs 3 and 4	–	8	A
$I_{CM}$	collector current (peak value)	see Fig. 4	–	20	A
$I_B$	base current (DC)		–	4	A
$I_{BM}$	base current (peak value)		–	6	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ }^\circ\text{C}$ ; see Fig.2	–	125	W
$T_{stg}$	storage temperature		–65	+150	$^\circ\text{C}$
$T_j$	junction temperature		–	150	$^\circ\text{C}$



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## CHARACTERISTICS

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

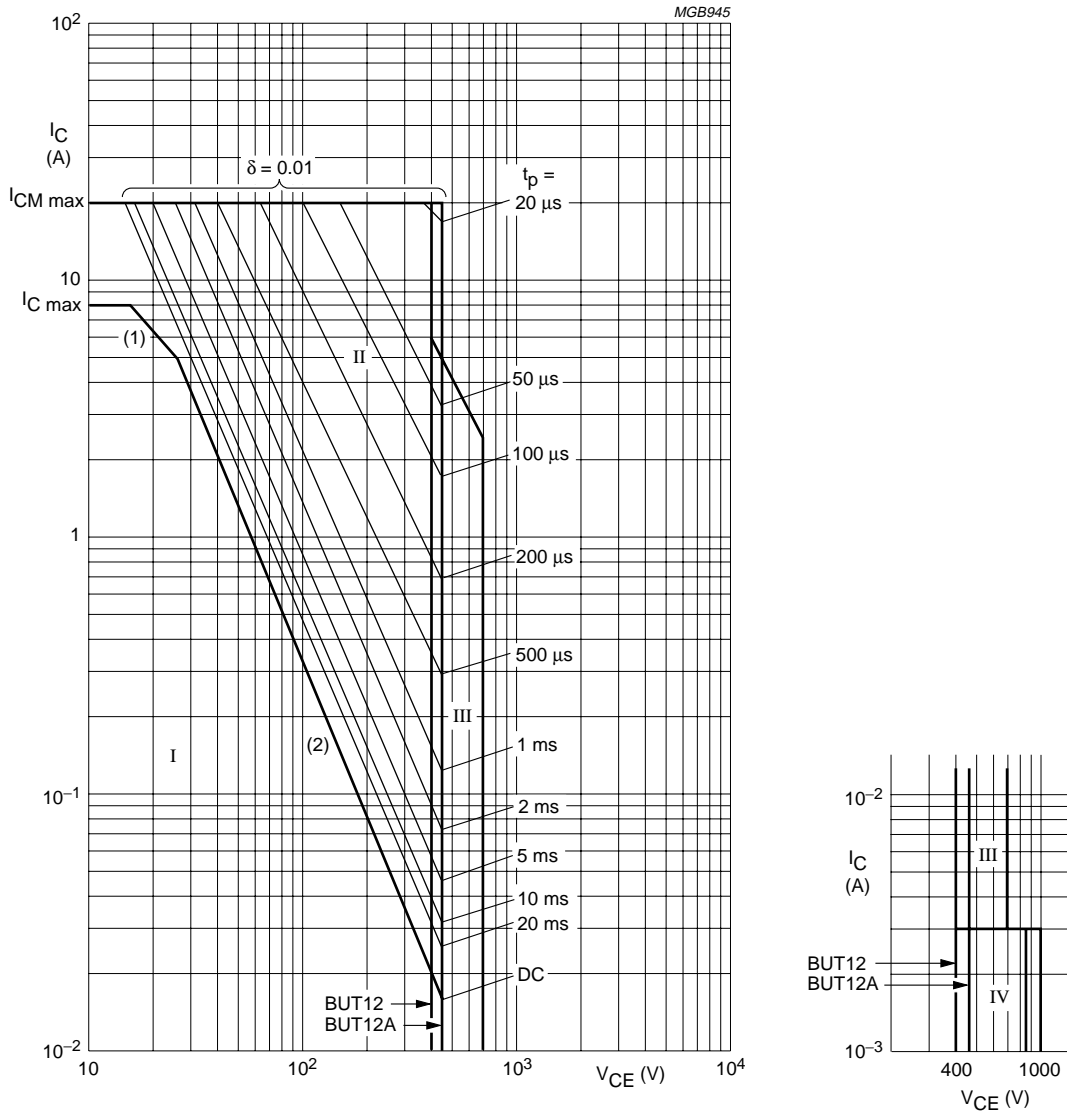
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage BUT12 BUT12A	$I_C = 100\text{ mA}$ ; $I_{Boff} = 0$ ; $L = 25\text{ mH}$ ; see Figs 6 and 7	400	–	–	V
			450	–	–	V
$V_{CEsat}$	collector-emitter saturation voltage BUT12 BUT12A	$I_C = 6\text{ A}$ ; $I_B = 1.2\text{ A}$ ; see Figs 8 and 10	–	–	1.5	V
		$I_C = 5\text{ A}$ ; $I_B = 1\text{ A}$ ; see Figs 8 and 10	–	–	1.5	V
$V_{BEsat}$	base-emitter saturation voltage BUT12 BUT12A	$I_C = 6\text{ A}$ ; $I_B = 1.2\text{ A}$ ; see Fig.8	–	–	1.5	V
		$I_C = 5\text{ A}$ ; $I_B = 1\text{ A}$ ; see Fig.8	–	–	1.5	V
$I_{CES}$	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$ ; $V_{BE} = 0$ ; note 1	–	–	1	mA
		$V_{CE} = V_{CESmax}$ ; $V_{BE} = 0$ ; $T_j = 125\text{ }^\circ\text{C}$ ; note 1	–	–	3	mA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 9\text{ V}$ ; $I_C = 0$	–	–	10	mA
$h_{FE}$	DC current gain	$V_{CE} = 5\text{ V}$ ; $I_C = 10\text{ mA}$ ; see Fig.11	10	18	35	
		$V_{CE} = 5\text{ V}$ ; $I_C = 1\text{ A}$ ; see Fig.11	10	20	35	
<b>Switching times resistive load</b> (see Figs 12 and 13)						
$t_{on}$	turn-on time BUT12 BUT12A	$I_{Con} = 6\text{ A}$ ; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	1	$\mu\text{s}$
		$I_{Con} = 5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	1	$\mu\text{s}$
$t_s$	storage time BUT12 BUT12A	$I_{Con} = 6\text{ A}$ ; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	4	$\mu\text{s}$
		$I_{Con} = 5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	4	$\mu\text{s}$
$t_f$	fall time BUT12 BUT12A	$I_{Con} = 6\text{ A}$ ; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	0.8	$\mu\text{s}$
		$I_{Con} = 5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	0.8	$\mu\text{s}$
<b>Switching times inductive load</b> (see Figs 14 and 15)						
$t_s$	storage time BUT12 BUT12A	$I_{Con} = 6\text{ A}$ ; $I_{Bon} = 1.2\text{ A}$ ; $V_{CL} = 250\text{ V}$ ; $T_c = 100\text{ }^\circ\text{C}$	–	1.9	2.5	$\mu\text{s}$
		$I_{Con} = 5\text{ A}$ ; $I_{Bon} = 1\text{ A}$ ; $V_{CL} = 300\text{ V}$ ; $T_c = 100\text{ }^\circ\text{C}$	–	1.9	2.5	$\mu\text{s}$
$t_f$	fall time BUT12 BUT12A	$I_{Con} = 6\text{ A}$ ; $I_{Bon} = 1.2\text{ A}$ ; $V_{CL} = 250\text{ V}$ ; $T_c = 100\text{ }^\circ\text{C}$	–	200	300	ns
		$I_{Con} = 5\text{ A}$ ; $I_{Bon} = 1\text{ A}$ ; $V_{CL} = 300\text{ V}$ ; $T_c = 100\text{ }^\circ\text{C}$	–	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.

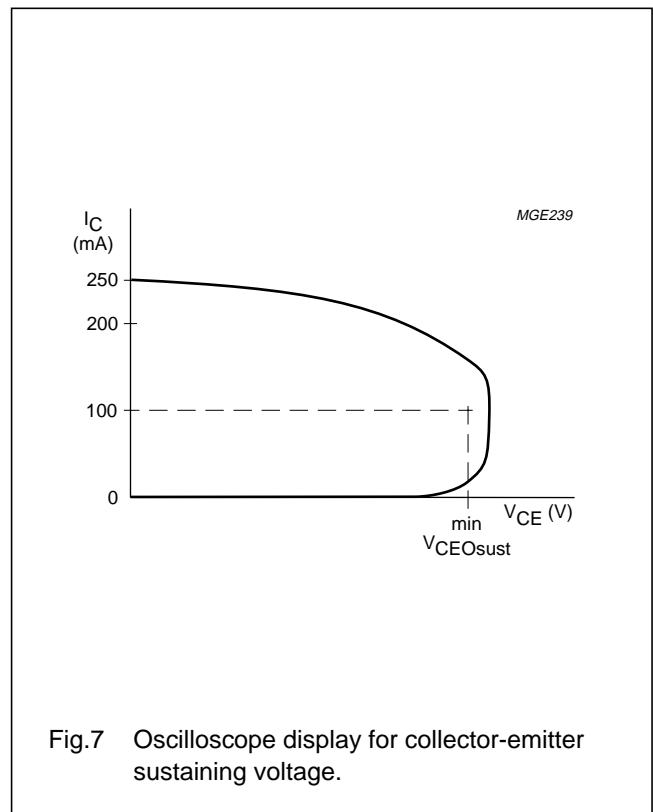
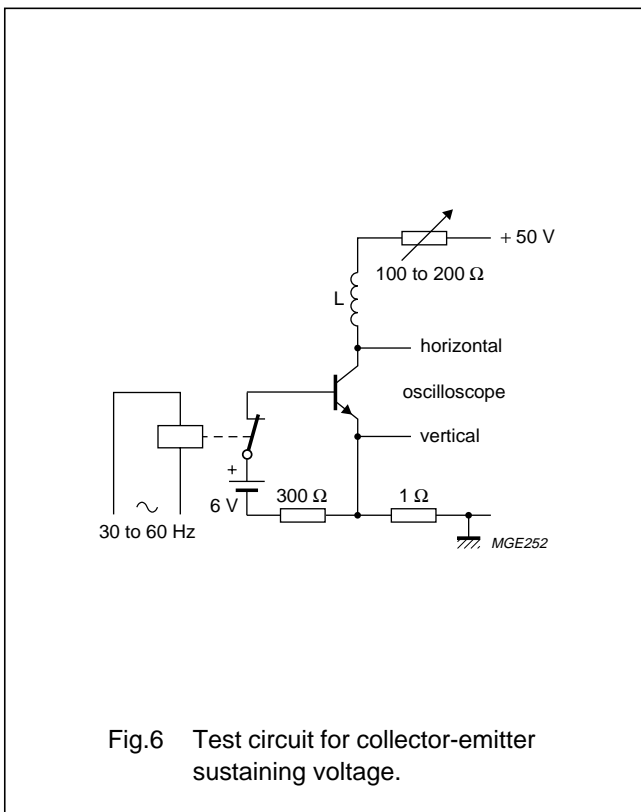
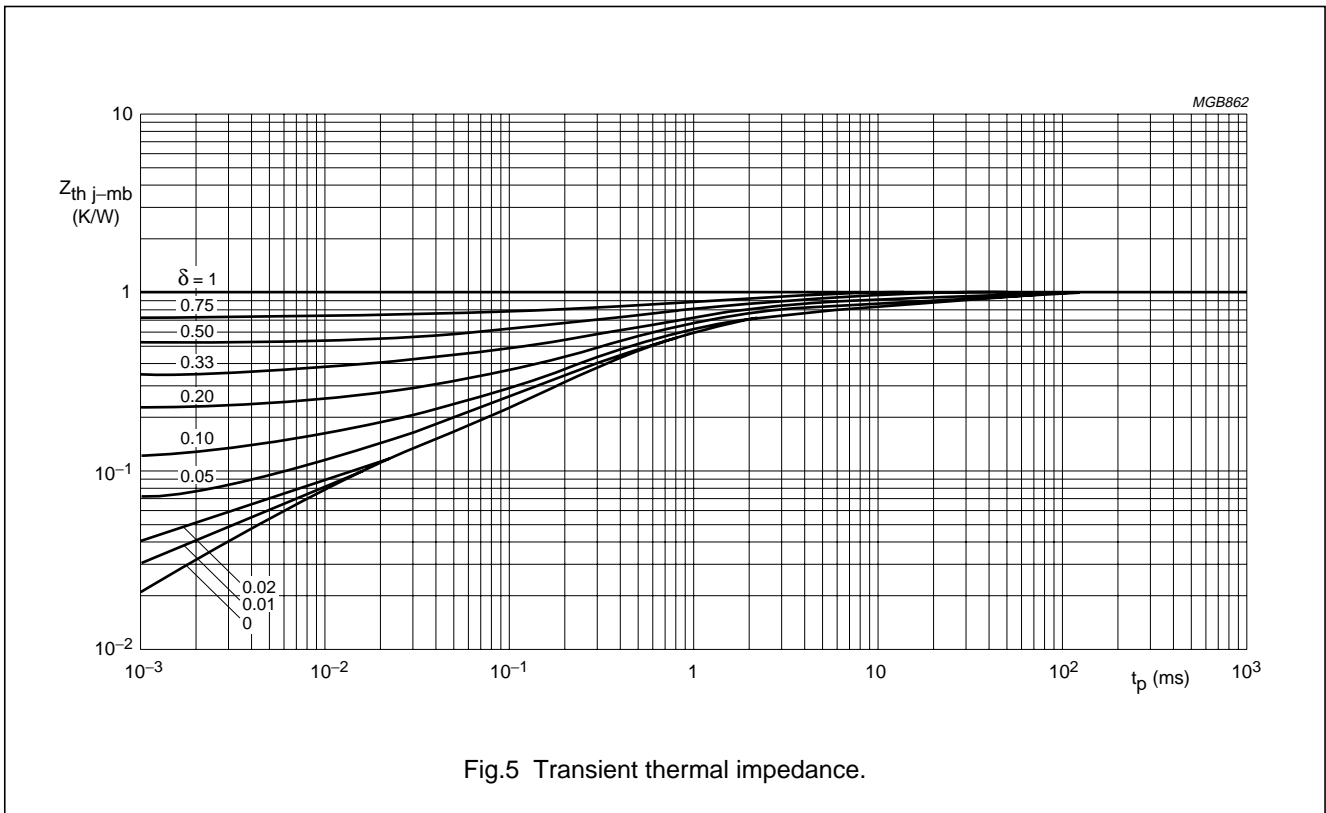
(1)  $P_{tot\ max}$  and  $P_{tot\ peak\ max}$  lines.

(2) Second breakdown limits.

Fig.4 Forward bias SOAR.

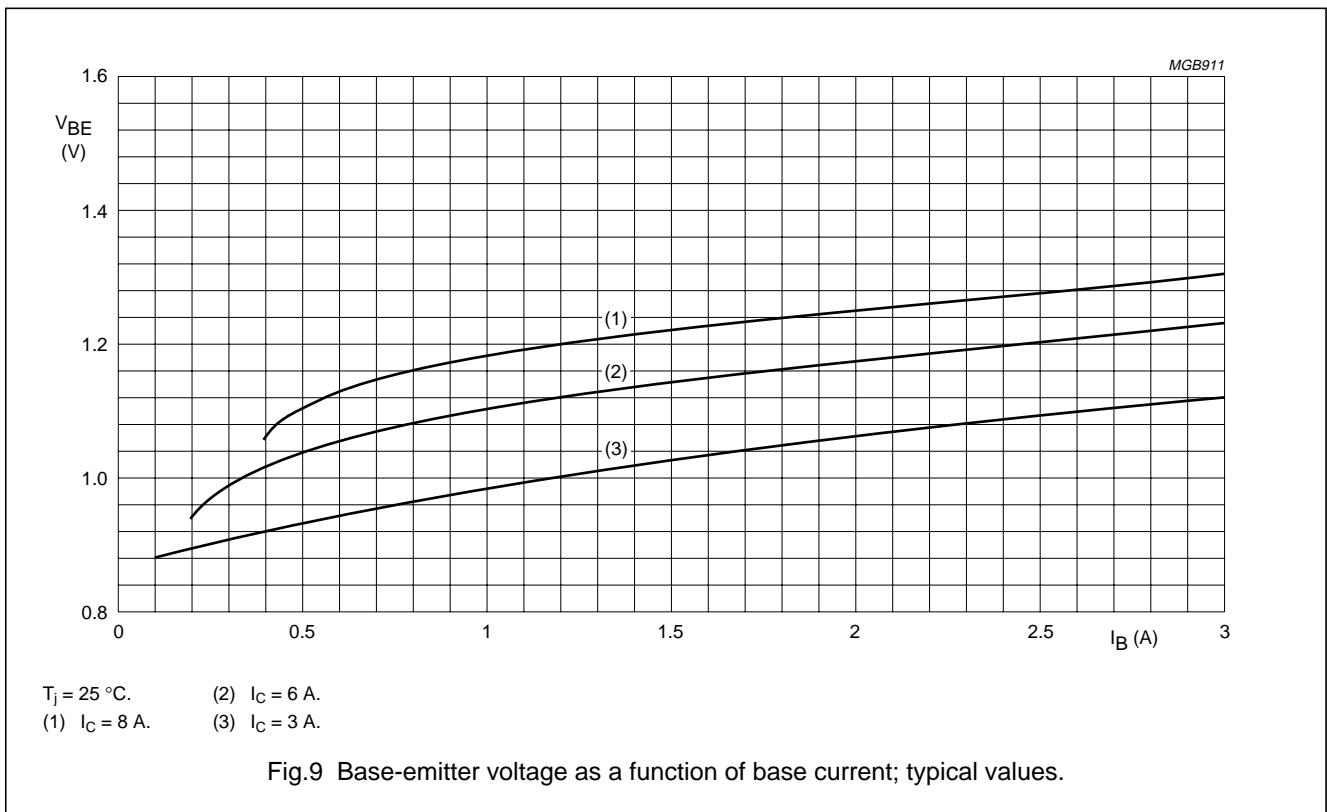
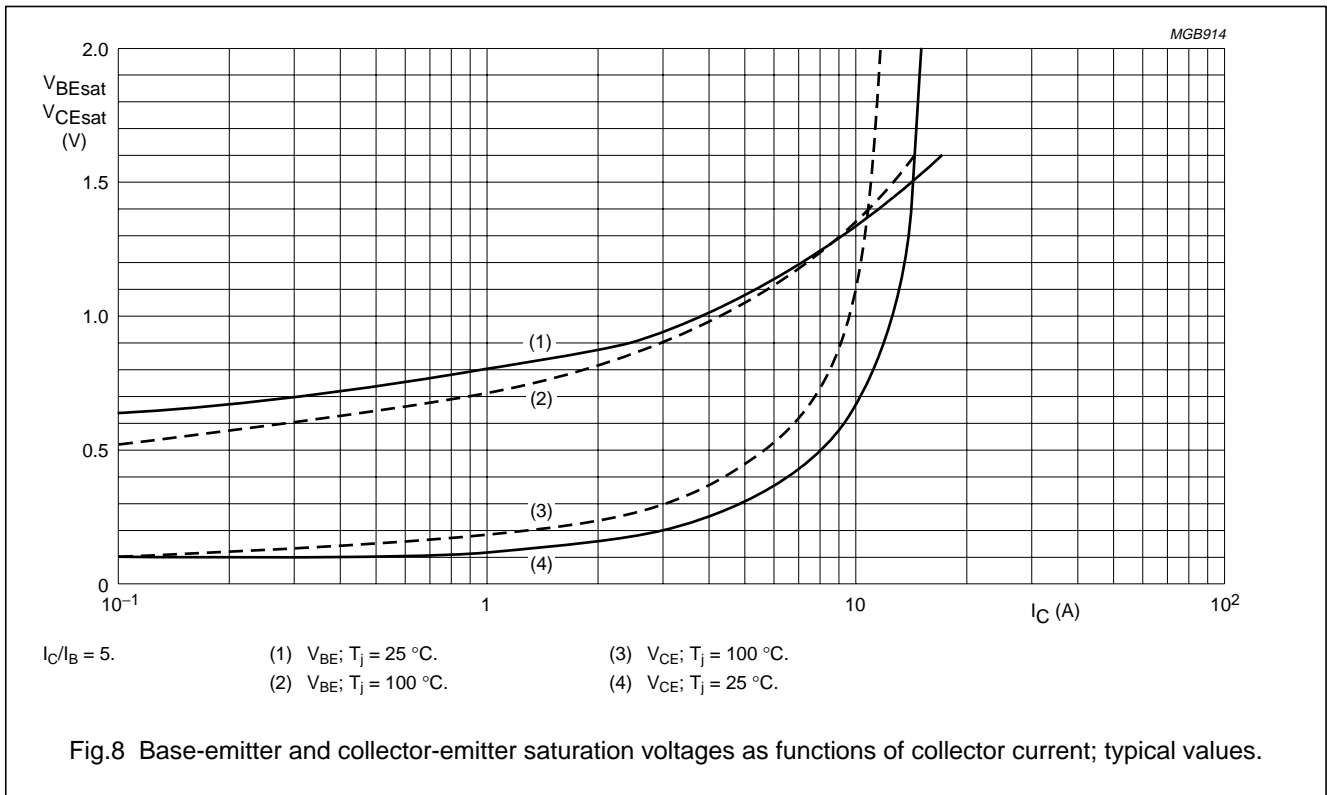
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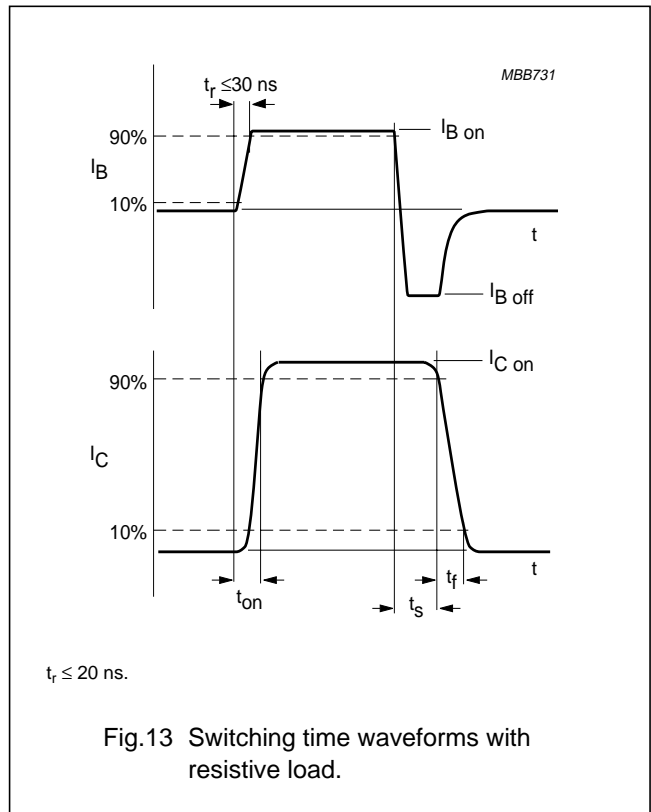
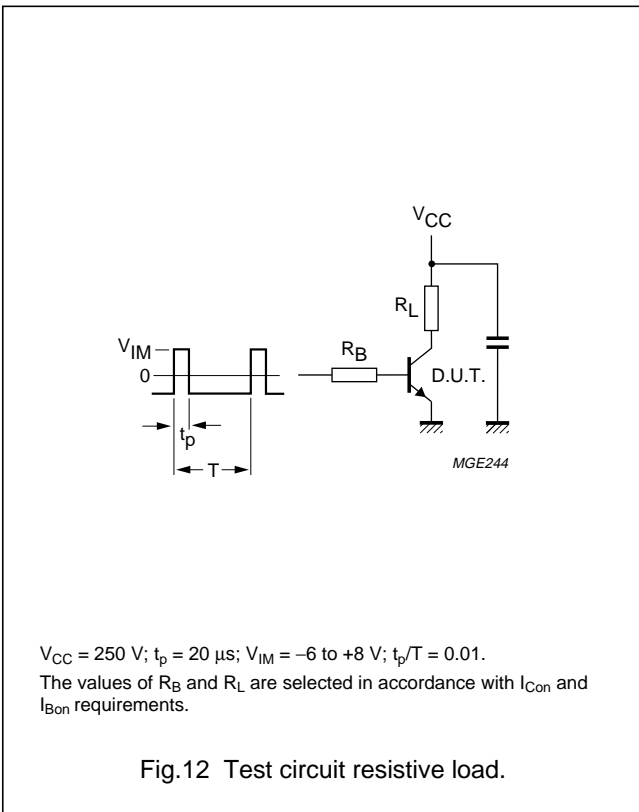
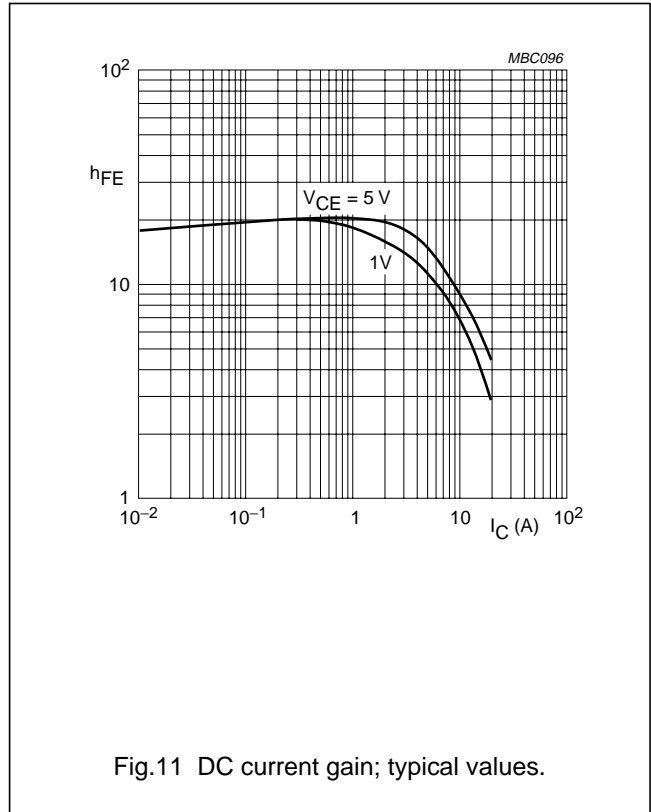
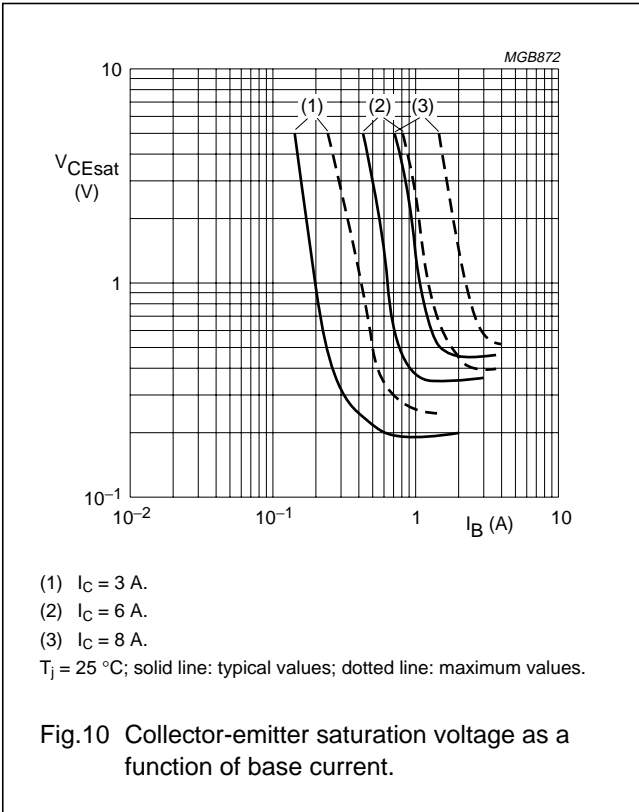
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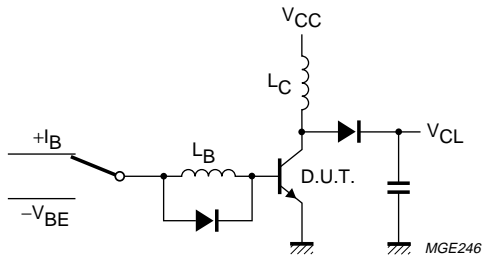
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$V_{CL}$  = up to 1000 V;  $V_{CC}$  = 30 V;  $V_{BE}$  = -1 to -5 V;  $L_B$  = 1  $\mu$ H;  
 $L_C$  = 200  $\mu$ H.

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

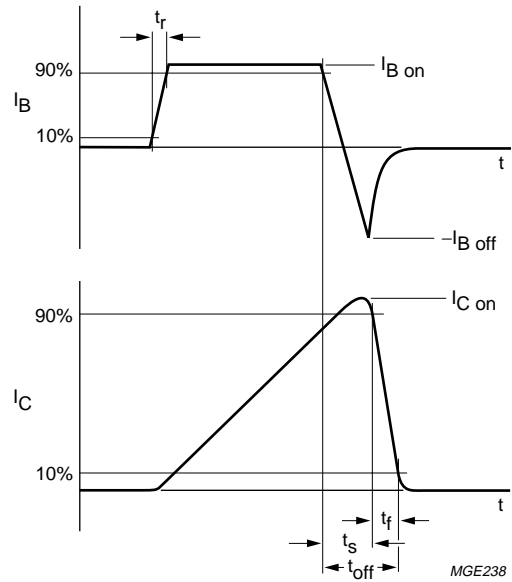


Fig.15 Switching time waveforms with inductive load.

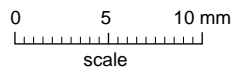
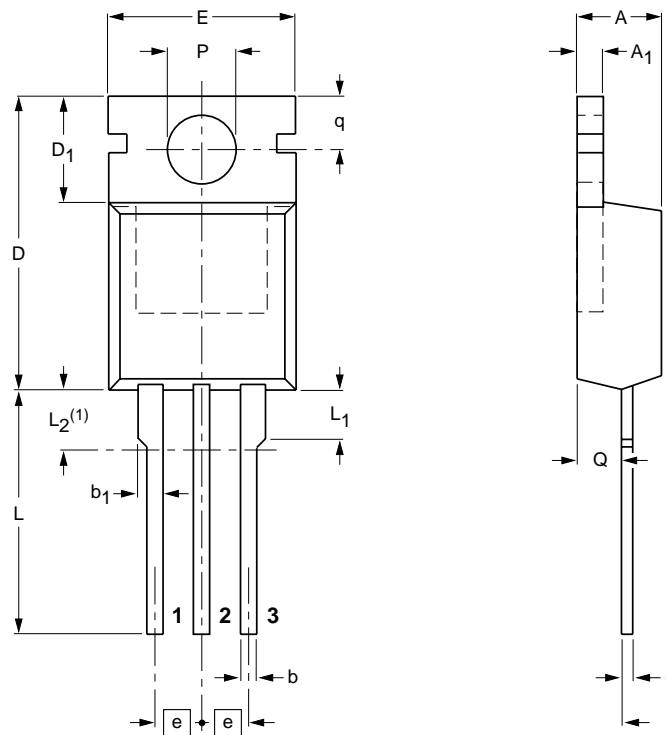
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PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-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**

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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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