

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

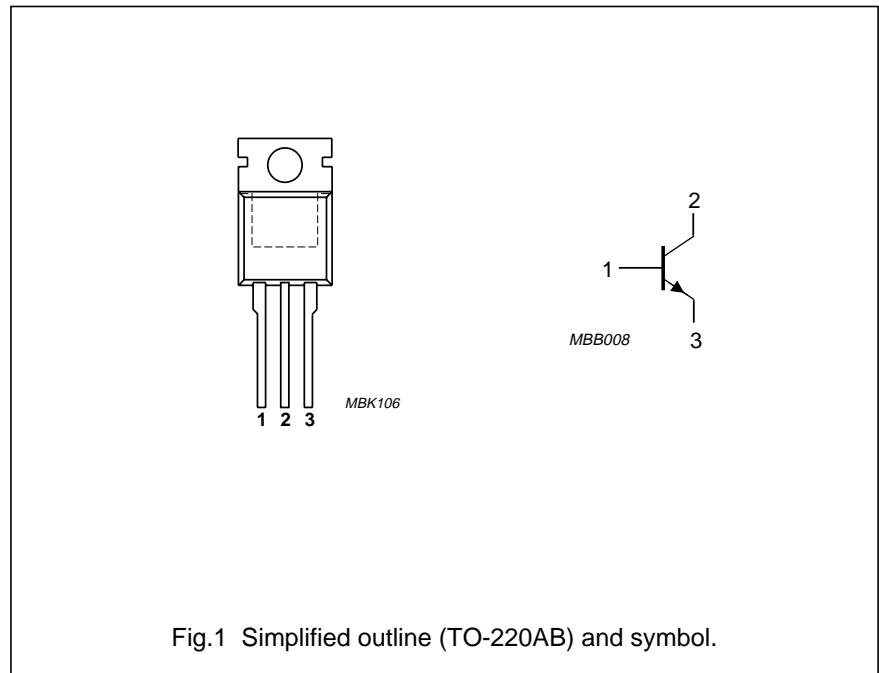


Fig.1 Simplified outline (TO-220AB) and symbol.

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	μs

THERMAL CHARACTERISTICS

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

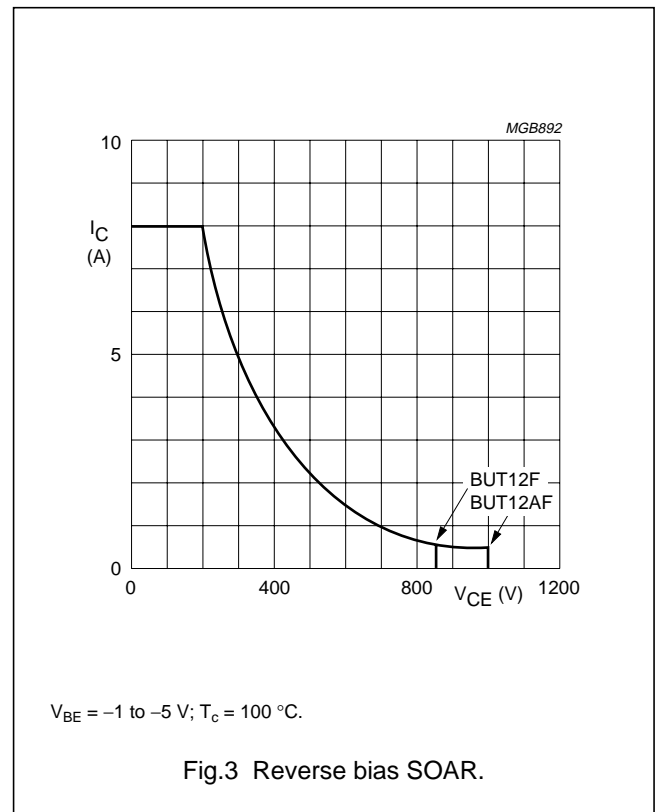
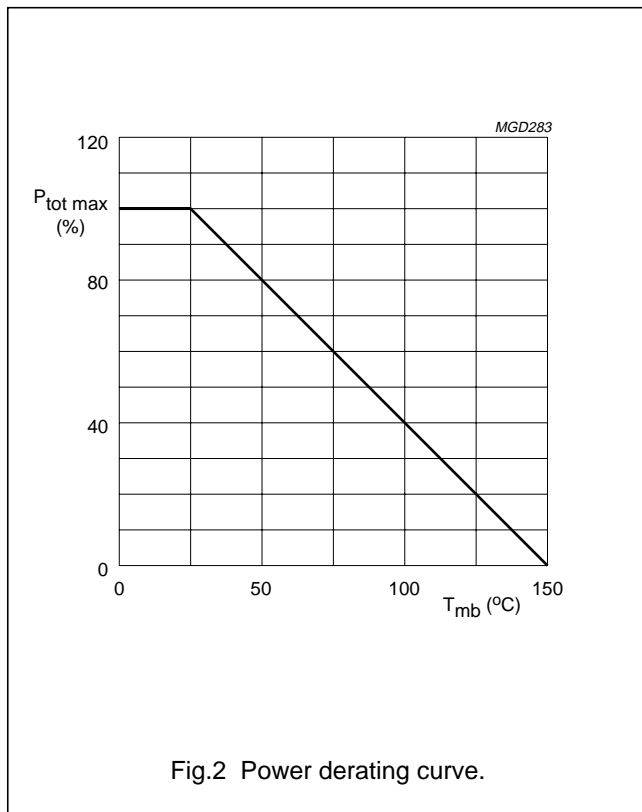
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LIMITING VALUES

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} ≤ 25 °C; see Fig.2	–	125	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.

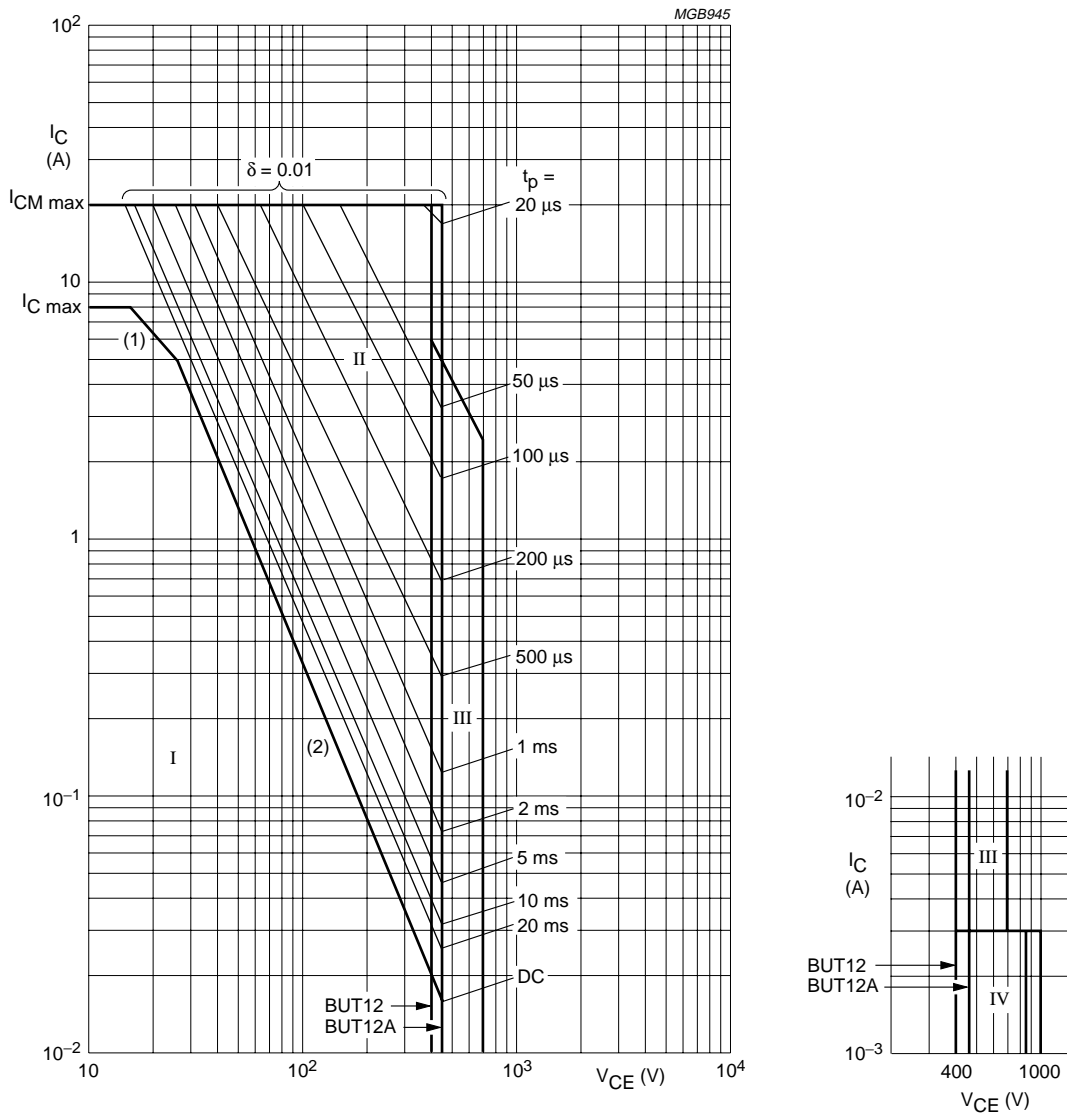
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage BUT12 BUT12A	$I_C = 100\text{ mA}$; $I_{Boff} = 0$; $L = 25\text{ mH}$; see Figs 6 and 7	400	–	–	V
			450	–	–	V
V_{CEsat}	collector-emitter saturation voltage BUT12 BUT12A	$I_C = 6\text{ A}$; $I_B = 1.2\text{ A}$; 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
		$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125\text{ °C}$; 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	
Switching times resistive load (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	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	1	μs
t_s	storage time BUT12 BUT12A	$I_{Con} = 6\text{ A}$; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	4	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	4	μs
t_f	fall time BUT12 BUT12A	$I_{Con} = 6\text{ A}$; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	0.8	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	0.8	μs
Switching times inductive load (see Figs 14 and 15)						
t_s	storage time BUT12 BUT12A	$I_{Con} = 6\text{ A}$; $I_{Bon} = 1.2\text{ A}$; $V_{CL} = 250\text{ V}$; $T_c = 100\text{ °C}$	–	1.9	2.5	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = 1\text{ A}$; $V_{CL} = 300\text{ V}$; $T_c = 100\text{ °C}$	–	1.9	2.5	μs
t_f	fall time BUT12 BUT12A	$I_{Con} = 6\text{ A}$; $I_{Bon} = 1.2\text{ A}$; $V_{CL} = 250\text{ V}$; $T_c = 100\text{ °C}$	–	200	300	ns
		$I_{Con} = 5\text{ A}$; $I_{Bon} = 1\text{ A}$; $V_{CL} = 300\text{ V}$; $T_c = 100\text{ °C}$	–	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.

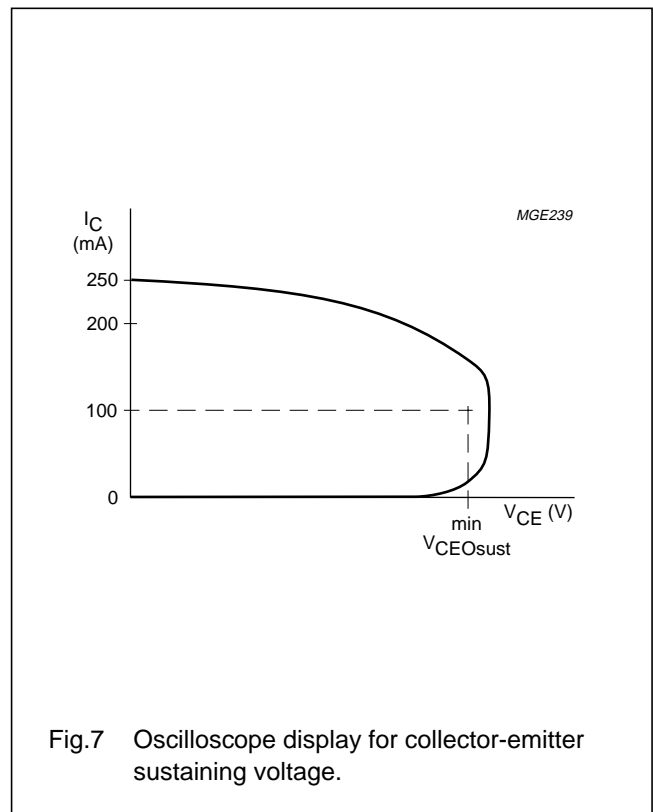
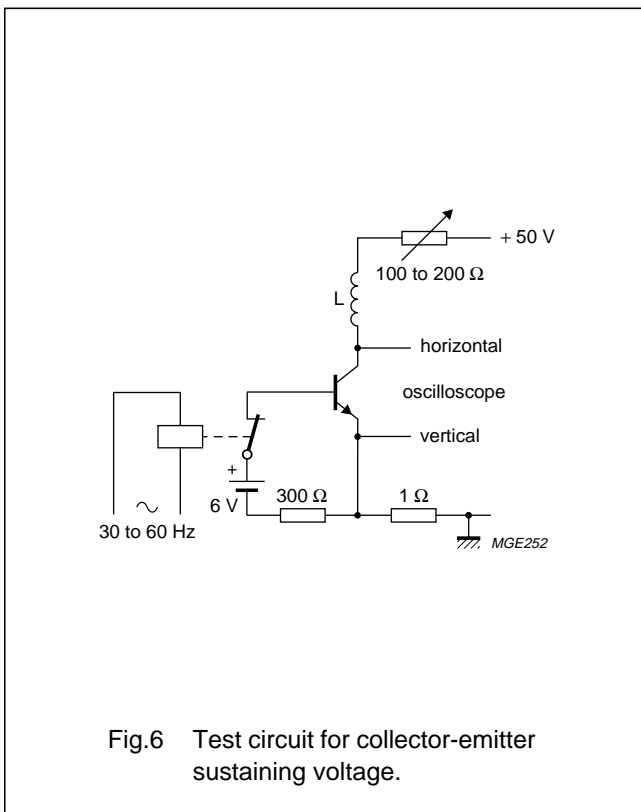
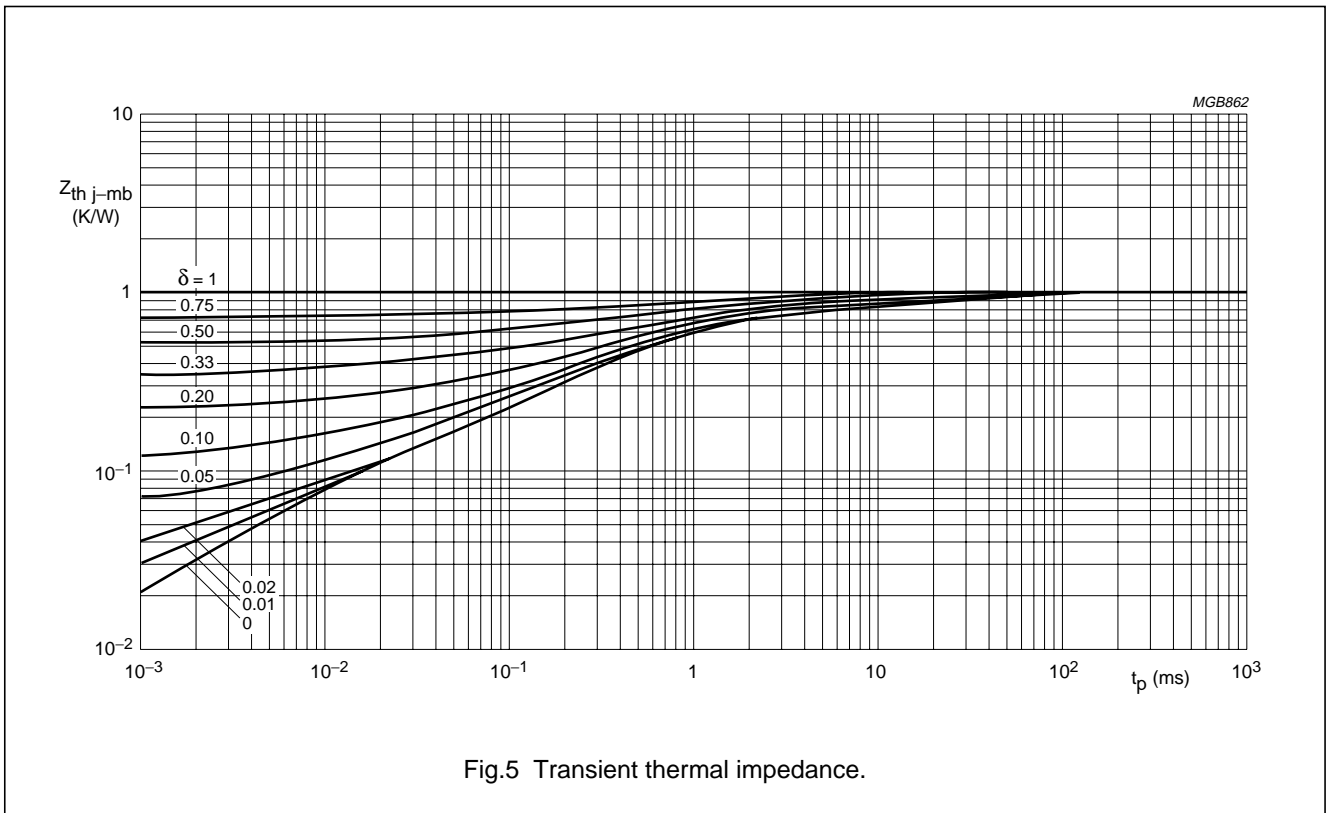
(1) $P_{tot\ max}$ and $P_{tot\ peak\ max}$ lines.

(2) Second breakdown limits.

Fig.4 Forward bias SOAR.

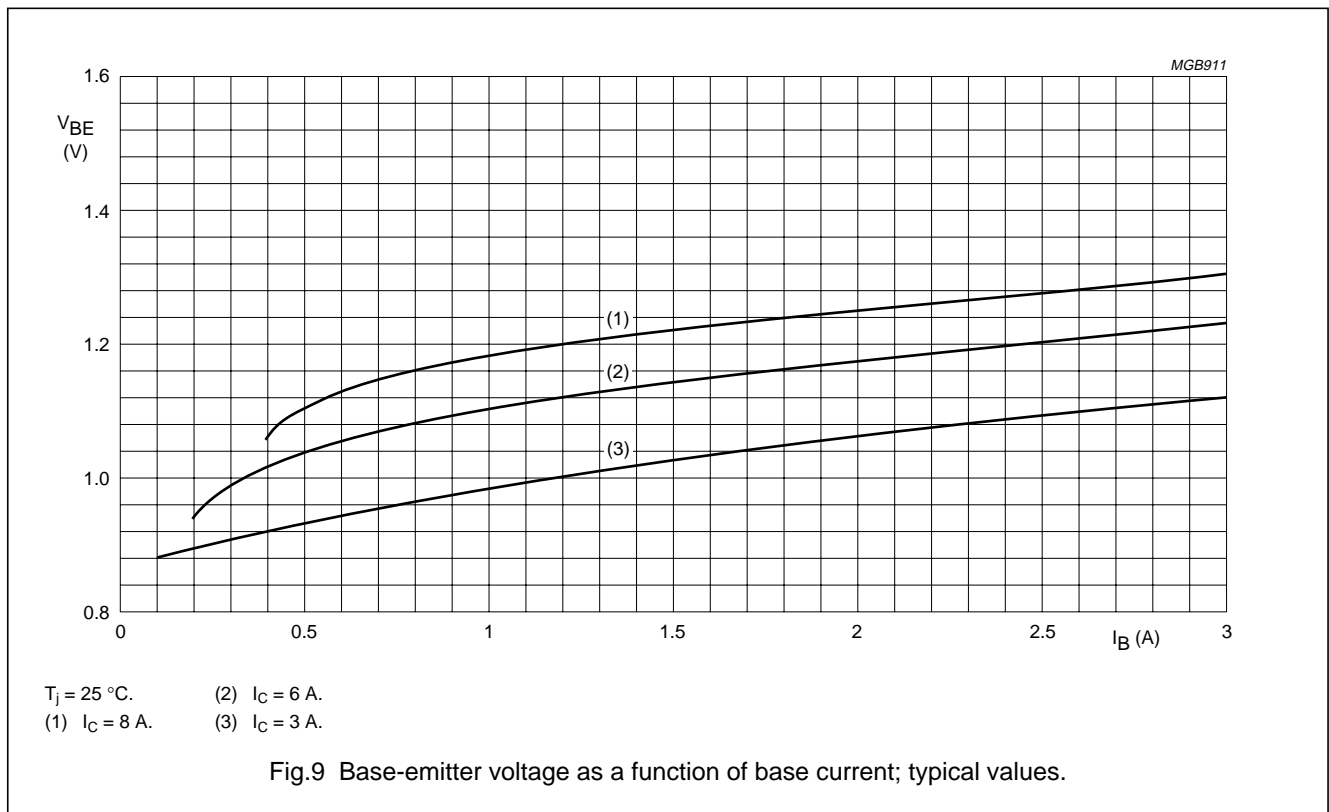
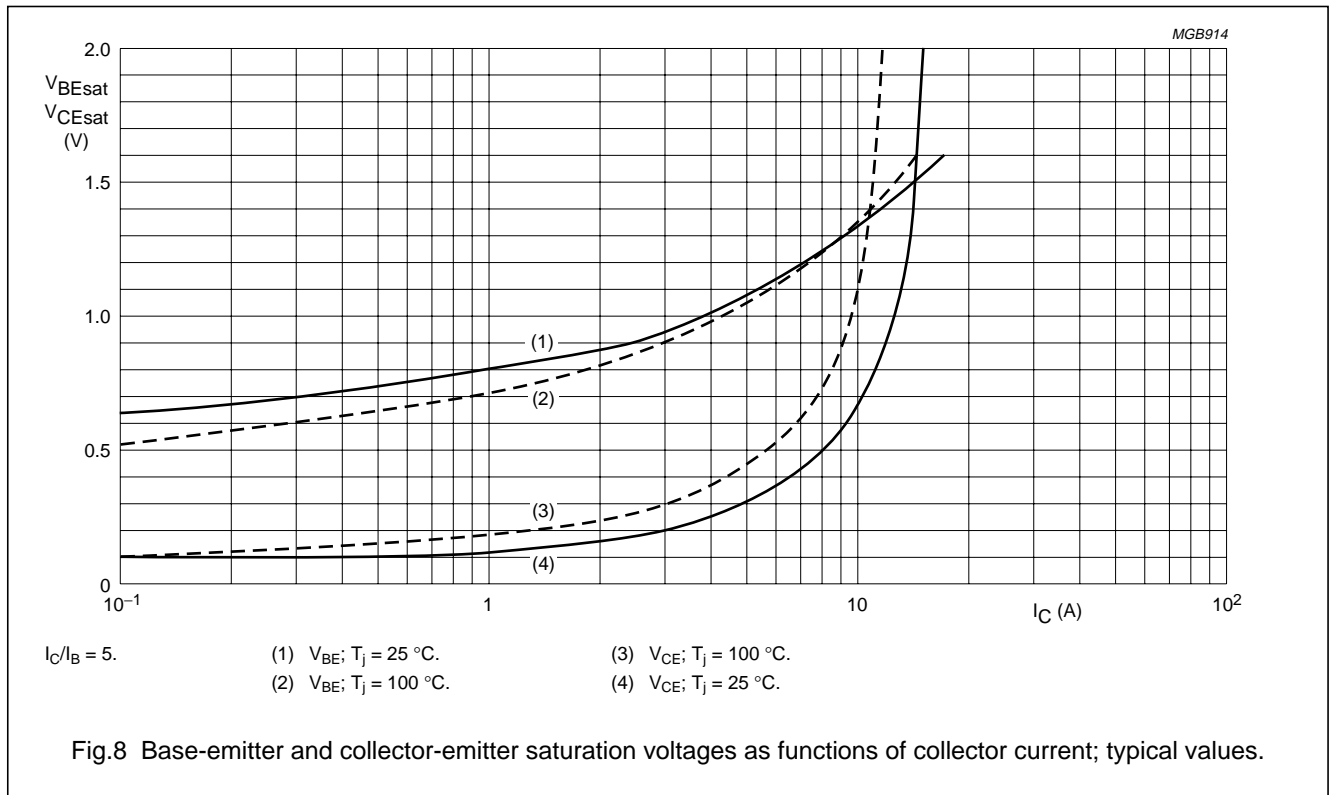
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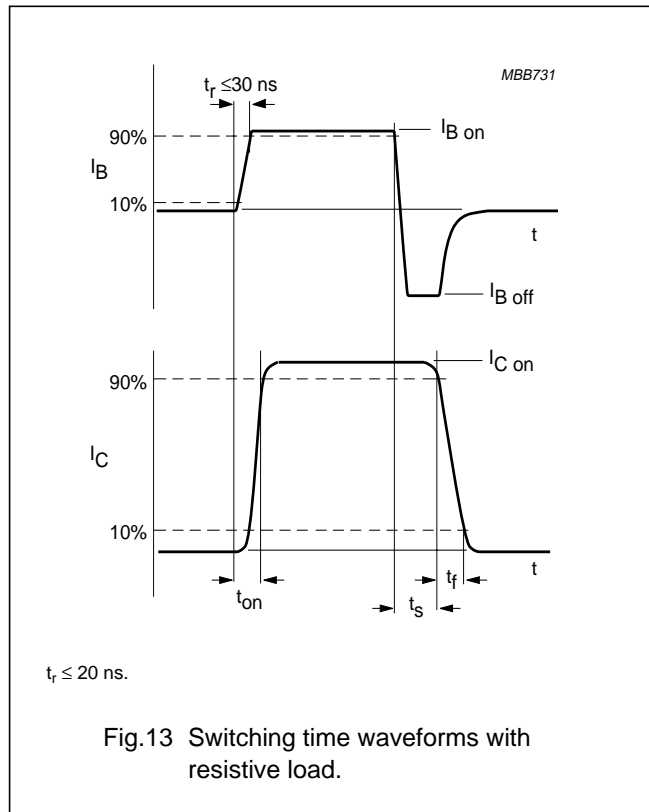
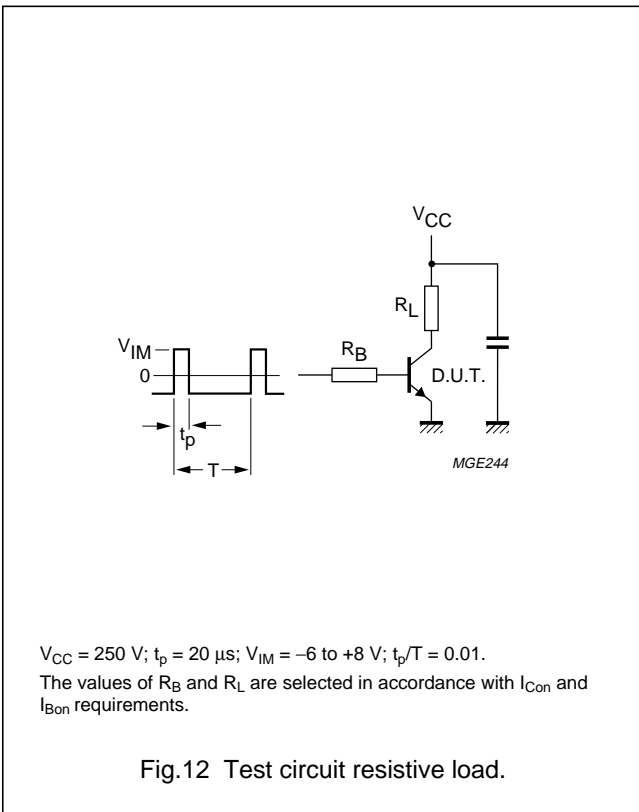
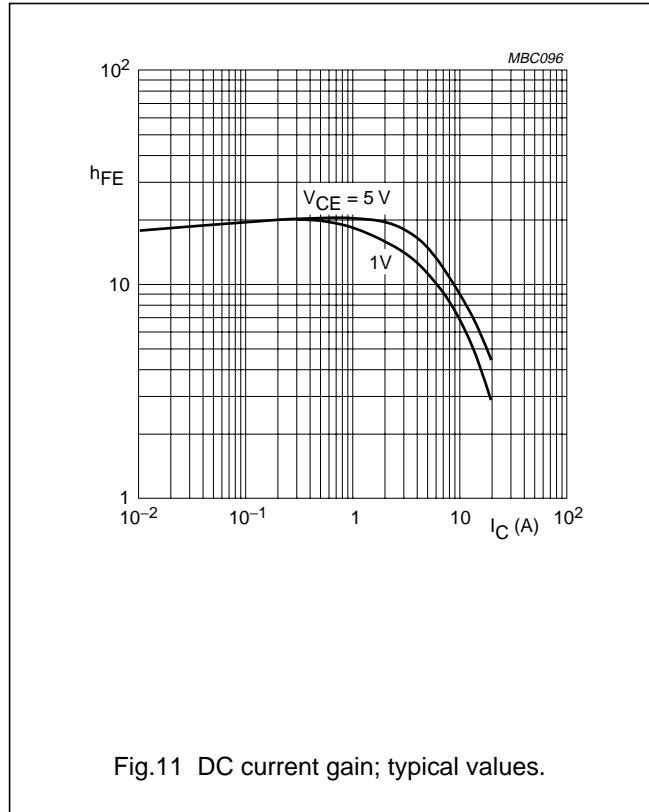
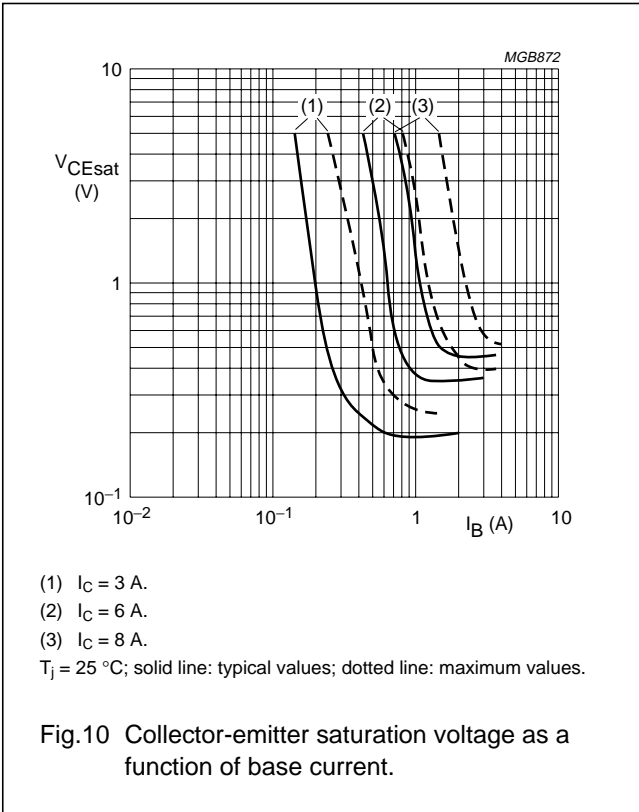
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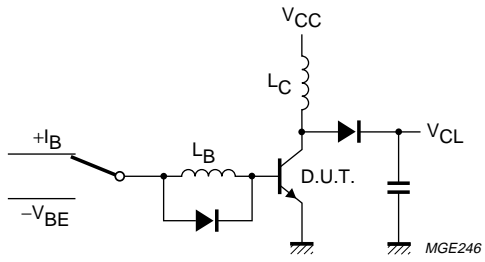
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V_{CL} = up to 1000 V; V_{CC} = 30 V; V_{BE} = -1 to -5 V; L_B = 1 μ H;
 L_C = 200 μ H.

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

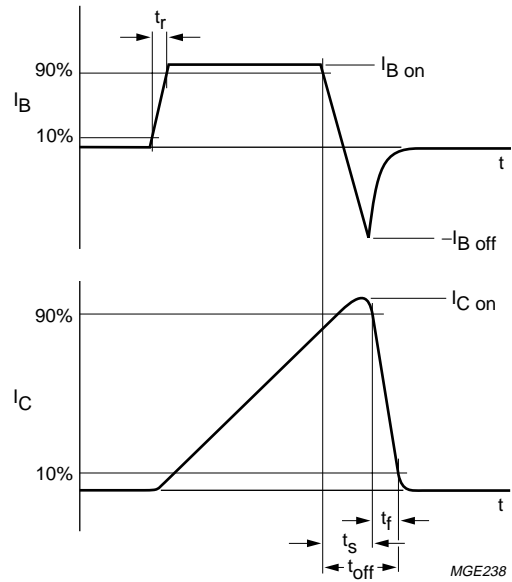


Fig.15 Switching time waveforms with inductive load.

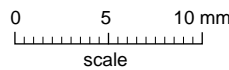
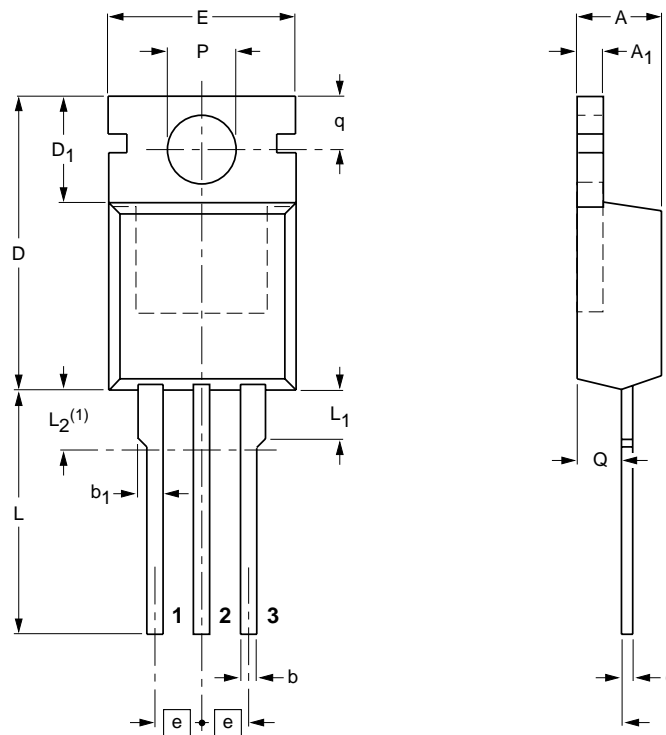
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PACKAGE OUTLINE

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

SOT78



DIMENSIONS (mm are the original dimensions)

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

Data sheet status	
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.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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Printed in The Netherlands

137067/00/01/pp11

Date of release: 1997 Aug 13

Document order number: 9397 750 02714

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