

DATA SHEET

BUT12F; BUT12AF Silicon diffused power transistors

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

1997 Aug 13

Silicon diffused power transistors

BUT12F; BUT12AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT186 plastic package.

APPLICATIONS

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

PINNING

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

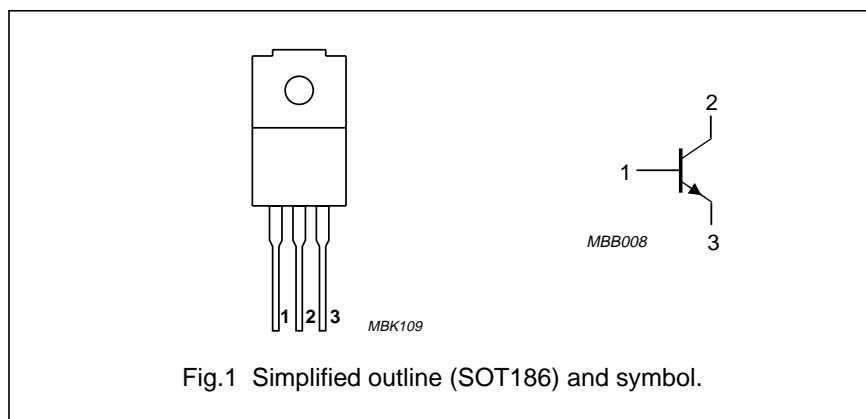


Fig.1 Simplified outline (SOT186) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	850 1000	V V
	BUT12F BUT12AF			
V_{CEO}	collector-emitter voltage	open base	400 450	V V
	BUT12F BUT12AF			
V_{CEsat}	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
I_{Csat}	collector saturation current		6 5	A A
	BUT12F BUT12AF			
I_C	collector current (DC)	see Figs 2 and 4	8	A
I_{CM}	collector current (peak value)	see Fig.2	20	A
P_{tot}	total power dissipation	$T_h \leq 25\text{ }^\circ\text{C}$; see Fig.3	23	W
t_f	fall time	resistive load; see Figs 11 and 12	0.8	μs

Silicon diffused power transistors

BUT12F; BUT12AF

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R _{th j-h}	thermal resistance from junction to external heatsink	note 1	5.5	K/W
		note 2	3.9	K/W
R _{th j-a}	thermal resistance from junction to ambient		55	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 _{CESM}	collector-emitter peak voltage BUT12F BUT12AF	V _{BE} = 0	–	850	V
			–	1000	V
V _{CEO}	collector-emitter voltage BUT12F BUT12AF	open base	–	400	V
			–	450	V
I _{Csat}	collector saturation current BUT12F BUT12AF		–	6	A
			–	5	A
I _C	collector current (DC)	see Figs 2 and 4	–	8	A
I _{CM}	collector current (peak value)	see Fig.2	–	20	A
I _B	base current (DC)		–	4	A
I _{BM}	base current (peak value)		–	6	A
P _{tot}	total power dissipation	T _h ≤ 25 °C; see Fig.3; note 1	–	23	W
T _{stg}	storage temperature		–65	+150	°C
T _j	junction temperature		–	150	°C

Note

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

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V _{isolM}	isolation voltage from all terminals to external heatsink (peak value)	–	1500	V
C _{isol}	isolation capacitance from collector to external heatsink	–	12	pF

Silicon diffused power transistors

BUT12F; BUT12AF

CHARACTERISTICS

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

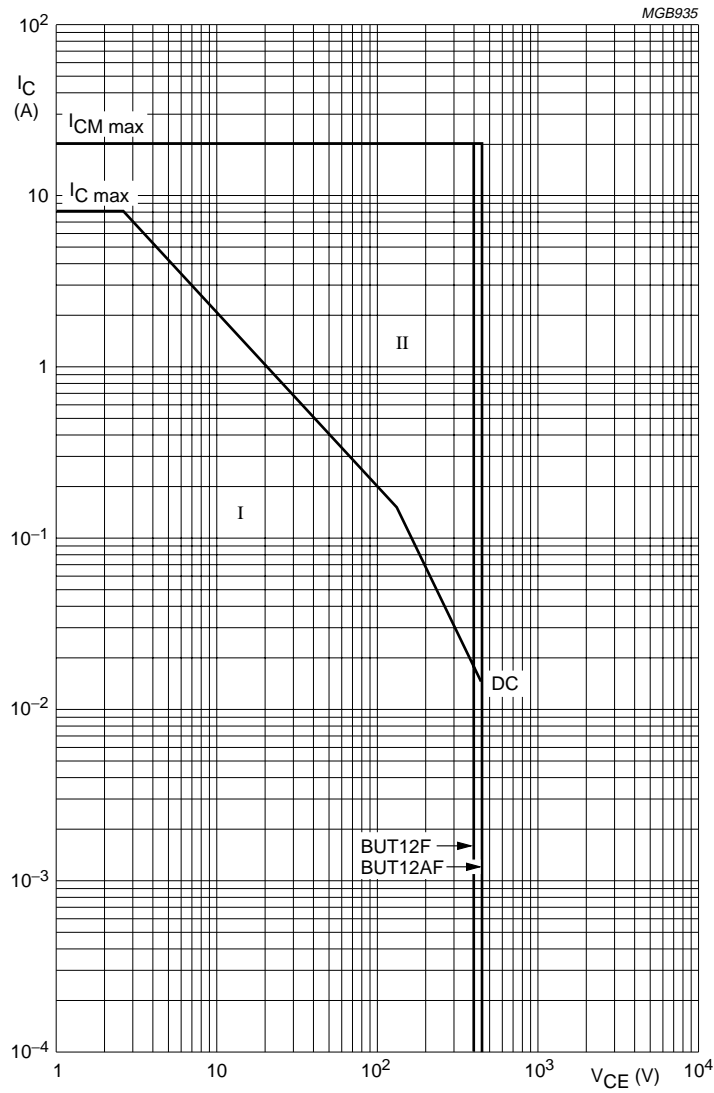
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage BUT12F BUT12AF	$I_C = 100\text{ mA}$; $I_{Boff} = 0$; $L = 25\text{ mH}$; see Figs 5 and 6	400	–	–	V
			450	–	–	V
V_{CEsat}	collector-emitter saturation voltage BUT12F BUT12AF	$I_C = 6\text{ A}$; $I_B = 1.2\text{ A}$; see Figs 7 and 9	–	–	1.5	V
		$I_C = 5\text{ A}$; $I_B = 1\text{ A}$; see Figs 7 and 9	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage BUT12F BUT12AF	$I_C = 6\text{ A}$; $I_B = 1.2\text{ A}$; see Fig.7	–	–	1.5	V
		$I_C = 5\text{ A}$; $I_B = 1\text{ A}$; see Fig.7	–	–	1.5	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	–	–	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.10	10	18	35	
		$V_{CE} = 5\text{ V}$; $I_C = 1\text{ A}$; see Fig.10	10	20	35	
Switching times resistive load (see Fig.12)						
t_{on}	turn-on time BUT12F BUT12AF	$I_{Con} = 6\text{ A}$; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	1	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	1	μs
t_s	storage time BUT12F BUT12AF	$I_{Con} = 6\text{ A}$; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	4	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	4	μs
t_f	fall time BUT12F BUT12AF	$I_{Con} = 6\text{ A}$; $I_{Bon} = -I_{Boff} = 1.2\text{ A}$	–	–	0.8	μs
		$I_{Con} = 5\text{ A}$; $I_{Bon} = -I_{Boff} = 1\text{ A}$	–	–	0.8	μs
Switching times inductive load (see Fig.14)						
t_s	storage time BUT12F BUT12AF	$I_{Con} = 6\text{ A}$; $I_{Bon} = 1.2\text{ A}$; $V_{CL} = 250\text{ V}$; $T_c = 100\text{ °C}$	–	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 BUT12F BUT12AF	$I_{Con} = 6\text{ A}$; $I_{Bon} = 1.2\text{ A}$; $V_{CL} = 250\text{ V}$; $T_c = 100\text{ °C}$	–	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).

Silicon diffused power transistors

BUT12F; BUT12AF



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

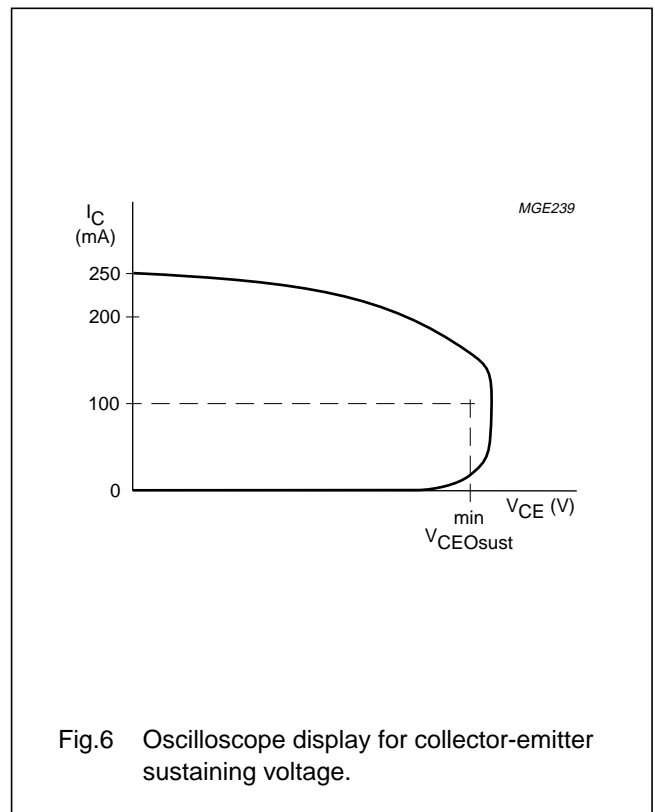
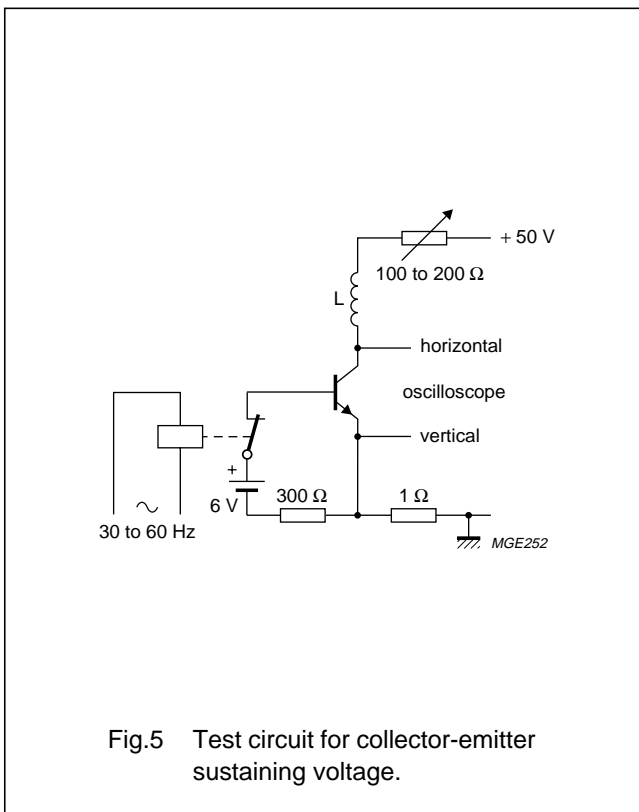
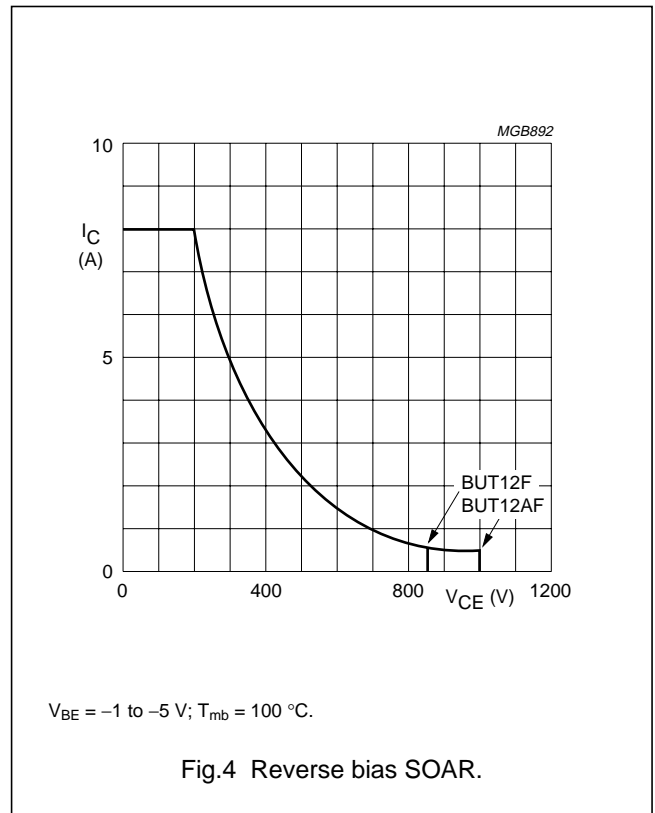
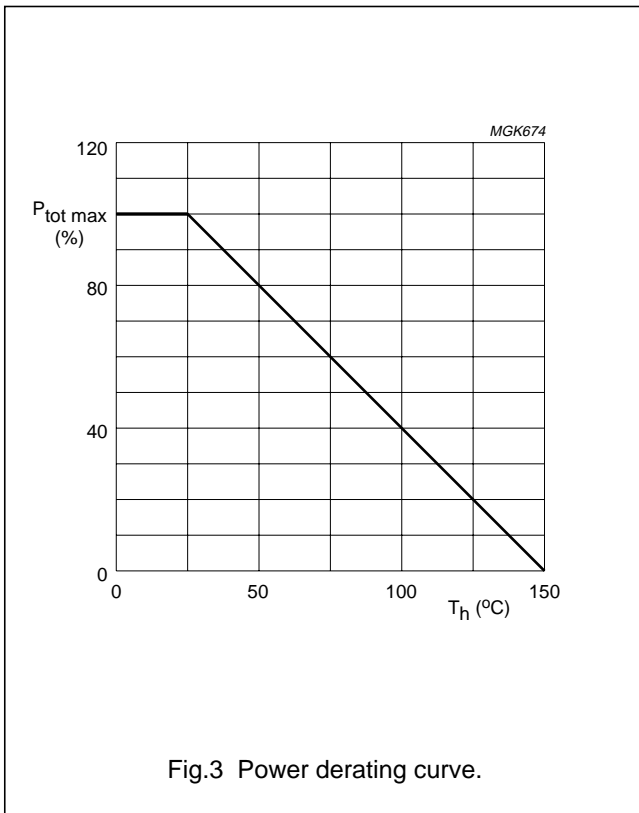
I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

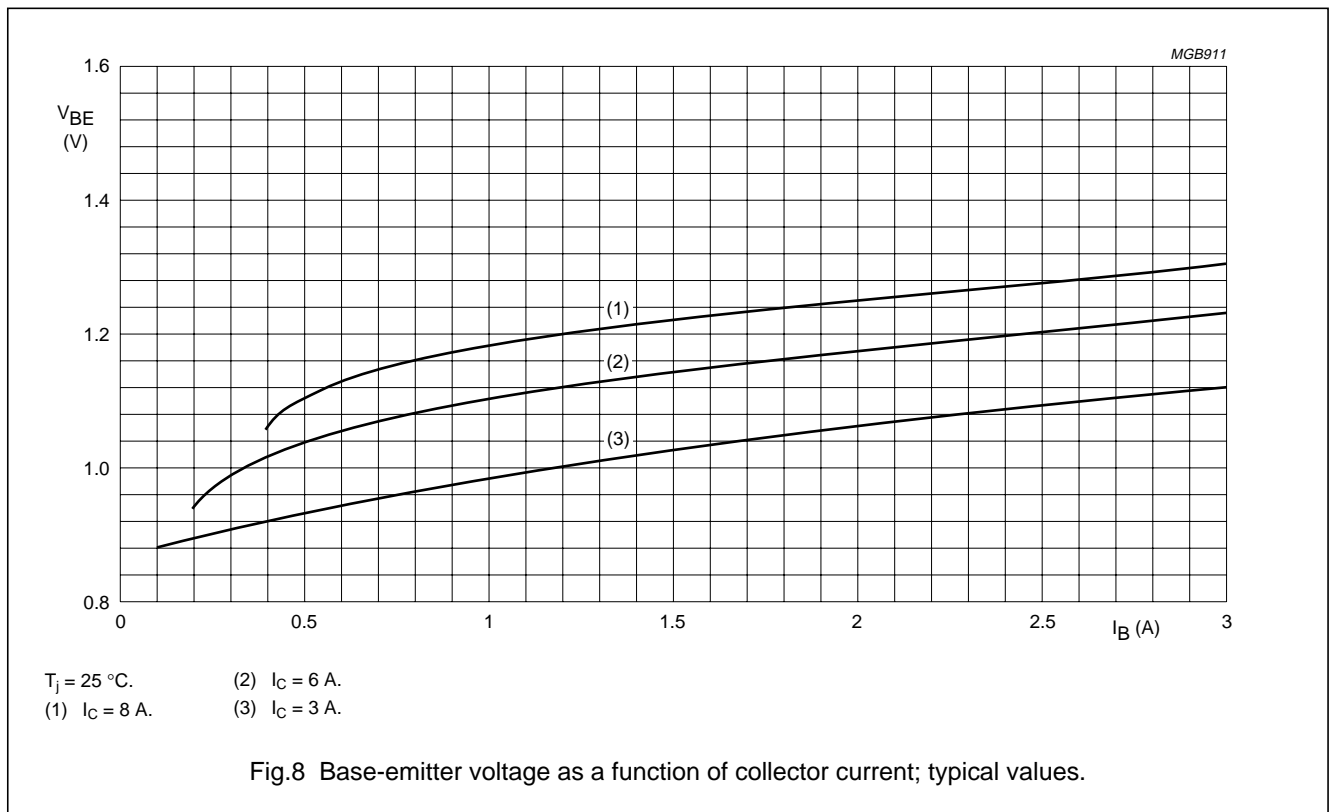
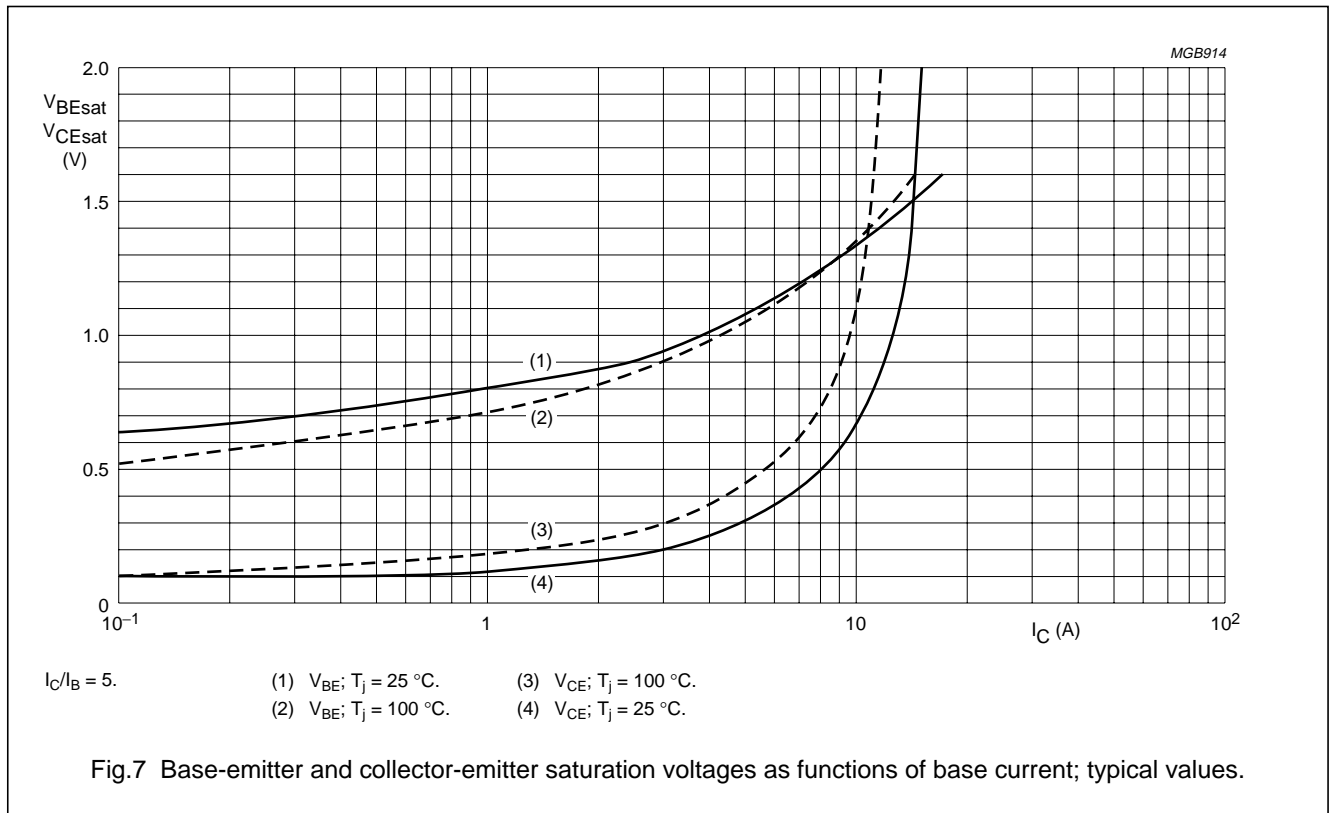
Silicon diffused power transistors

BUT12F; BUT12AF



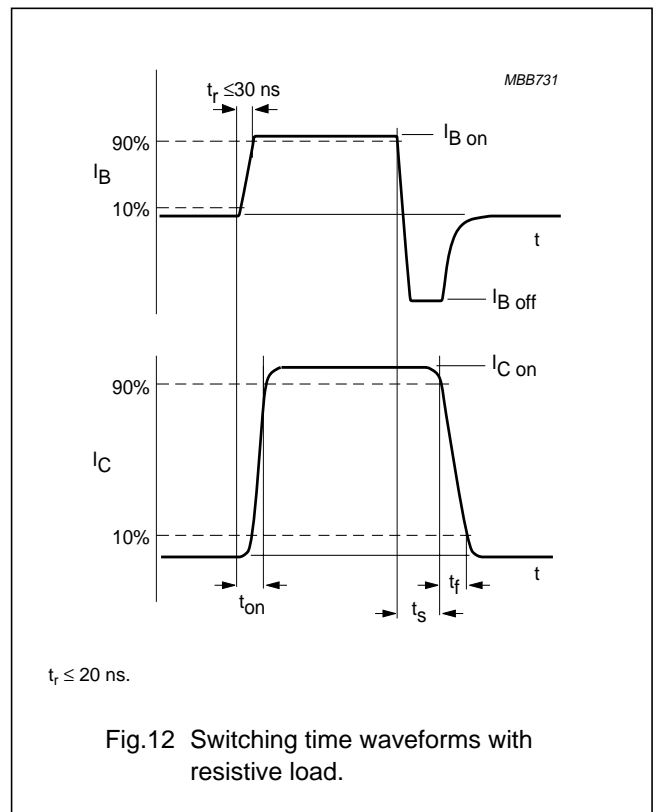
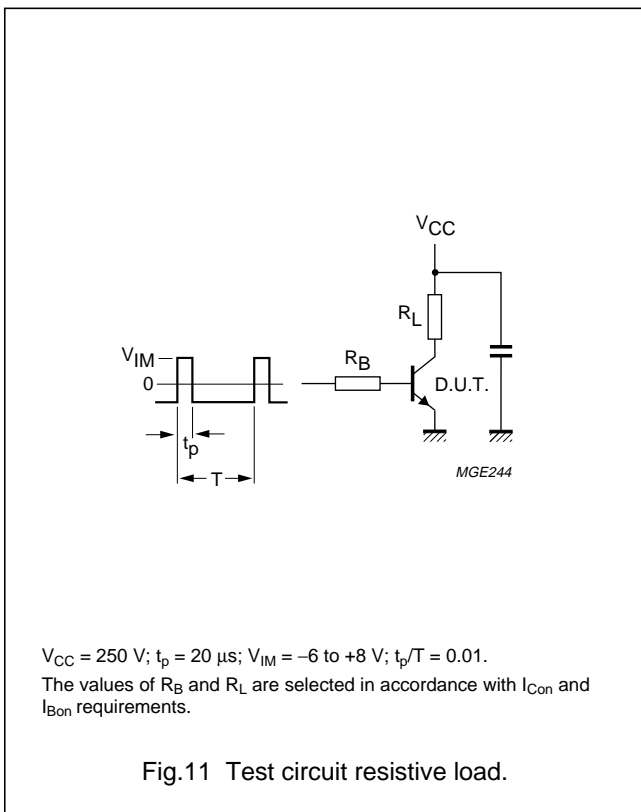
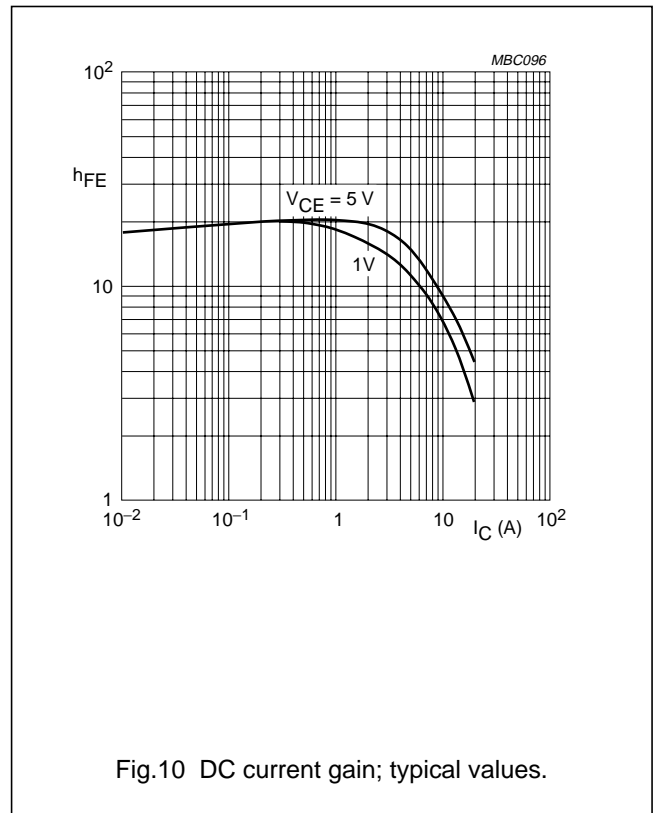
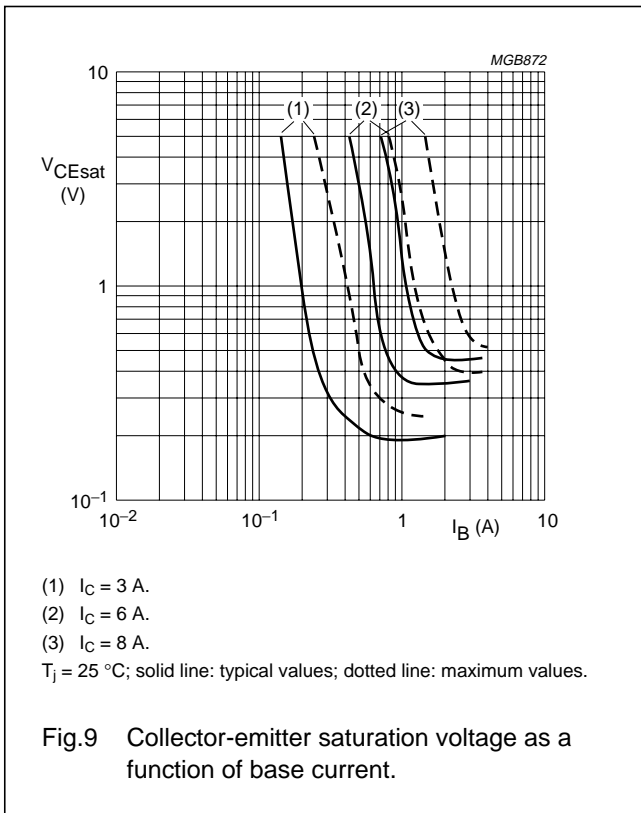
Silicon diffused power transistors

BUT12F; BUT12AF



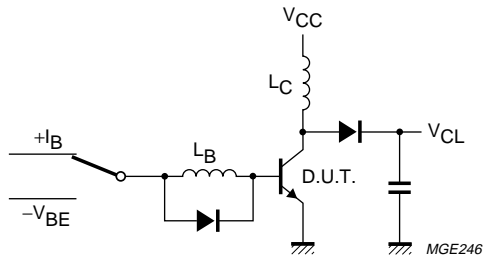
Silicon diffused power transistors

BUT12F; BUT12AF



Silicon diffused power transistors

BUT12F; BUT12AF



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.13 Test circuit inductive load and reverse bias SOAR.

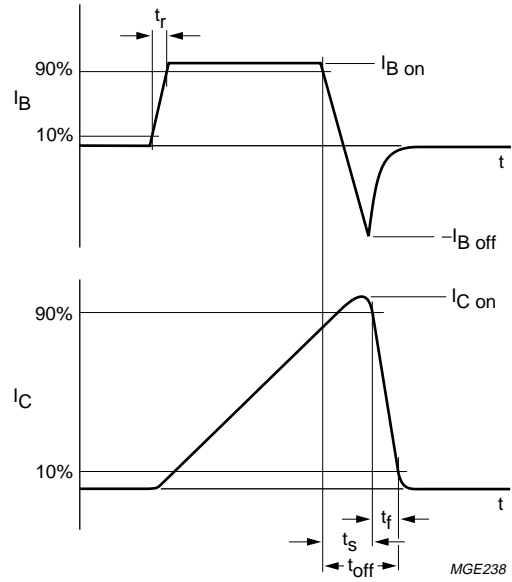


Fig.14 Switching times waveforms with inductive load.

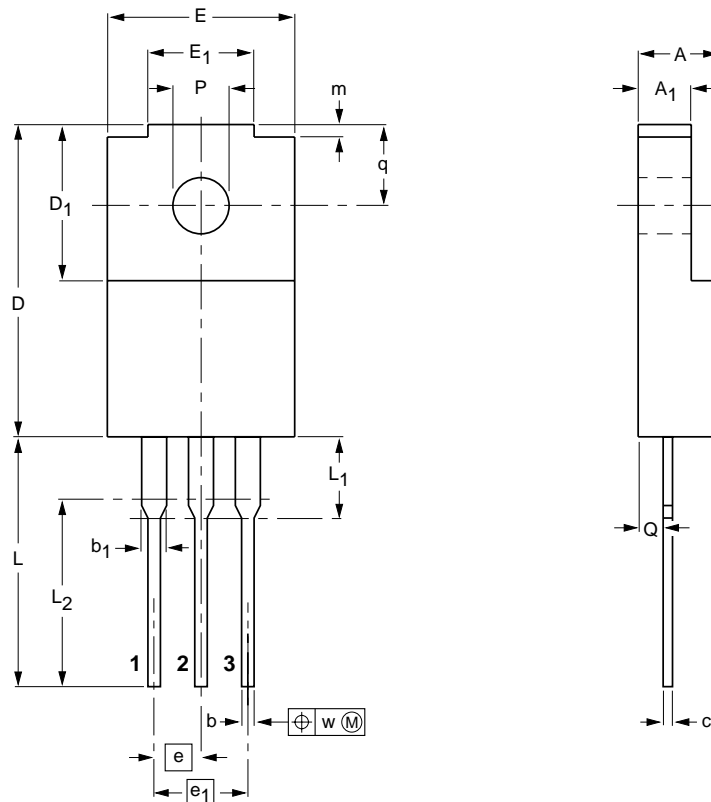
Silicon diffused power transistors

BUT12F; BUT12AF

PACKAGE OUTLINE

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

SOT186



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	b	b ₁	c	D	D ₁	E	E ₁	e	e ₁	L	L ₁ ⁽¹⁾	L ₂	m	P	Q	q	w
mm	4.4 4.0	2.9 2.5	0.9 0.7	1.5 1.3	0.55 0.38	17.0 16.4	7.9 7.5	10.2 9.6	5.7 5.3	2.54	5.08	14.3 13.5	4.8 4.0	10	0.9 0.5	3.2 3.0	1.4 1.2	4.4 4.0	0.4

Note

1. Terminal dimensions within this zone are uncontrolled. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT186		TO-220				97-06-11

Silicon diffused power transistors

BUT12F; BUT12AF

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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