DATA SHEET

BUT18F; BUT18AF
Silicon diffused power transistors

Product specification
Supersedes data of 1997 Aug 13

1999 Jun 11

Philips
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Silicon diffused power transistors BUT18F; BUT18AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT186 package with electrically isolated mounting base.

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

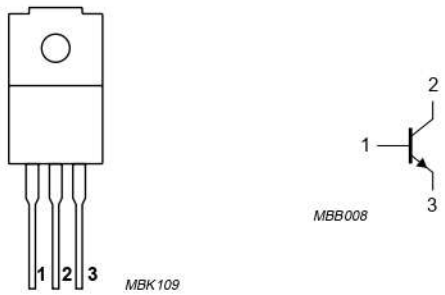


Fig.1 Simplified outline (SOT186) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	V_{BE} = 0		
	BUT18F		850	V
	BUT18AF		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT18F		400	V
	BUT18AF		450	V
V_{CEsat}	collector-emitter saturation voltage	see Fig.7	1.5	V
I_{Csat}	collector saturation current		4	A
I_C	collector current (DC)	see Fig.4	6	A
I_{CM}	collector current (peak value)	see Fig.4	12	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2	33	W
t_f	fall time	resistive load; see Figs 10 and 11	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	6.15	K/W
		note 2	3.65	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	V_{BE} = 0			
	BUT18F		−	850	V
	BUT18AF		−	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT18F		−	400	V
	BUT18AF		−	450	V
I_{Csat}	collector saturation current		−	4	A
I_C	collector current (DC)	see Fig.4	−	6	A
I_{CM}	collector current (peak value)	see Fig.4	−	12	A
I_B	base current (DC)		−	3	A
I_{BM}	base current (peak value)		−	6	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2; note 1	−	20	W
		$T_h \leq 25$ °C; see Fig.2; note 2	−	33	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		−	150	°C

Notes

1. **Without** heatsink compound.
2. **With** heatsink compound.

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 3 and 6				
	BUT18F		400	−	−	V
	BUT18AF		450	−	−	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 4 A; I_B = 800 mA; see Fig.7	−	−	1.5	V
V_{BEsat}	base-emitter saturation voltage	I_C = 4 A; I_B = 800 mA; see Fig.8	−	−	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 °C; note 1	−	−	2	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0	−	−	10	mA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 10 mA; see Fig.9	10	18	35	
		V_{CE} = 5 V; I_C = 1 A; see Fig.9	10	20	35	
Switching times resistive load (see Figs 10 and 11)						
t_{on}	turn-on time	I_{Con} = 4 A; $I_{Bon} = -I_{Boff}$ = 800 mA	−	−	1	µs
t_s	storage time	I_{Con} = 4 A; $I_{Bon} = -I_{Boff}$ = 800 mA	−	−	4	µs
t_f	fall time	I_{Con} = 4 A; $I_{Bon} = -I_{Boff}$ = 800 mA	−	−	0.8	µs
Switching times inductive load (see Figs 10 and 13)						
t_s	storage time	I_{Con} = 4 A; I_{Bon} = 800 mA	−	1.6	2.5	µs
t_f	fall time	I_{Con} = 4 A; I_{Bon} = 800 mA	−	150	400	ns

Note

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

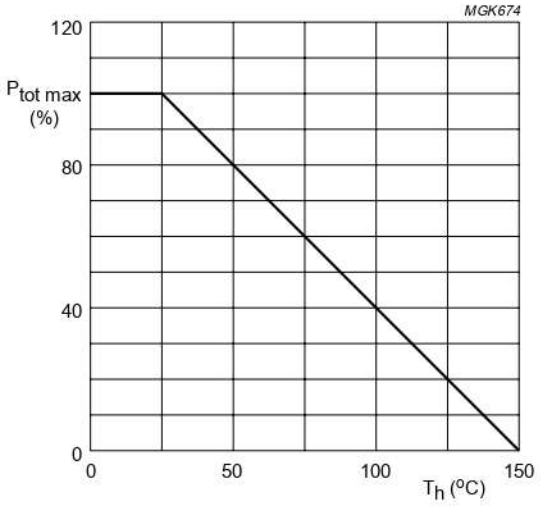


Fig.2 Power derating curve.

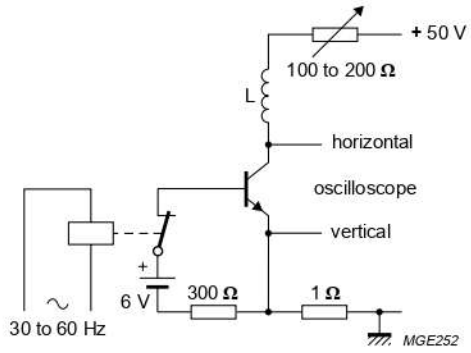
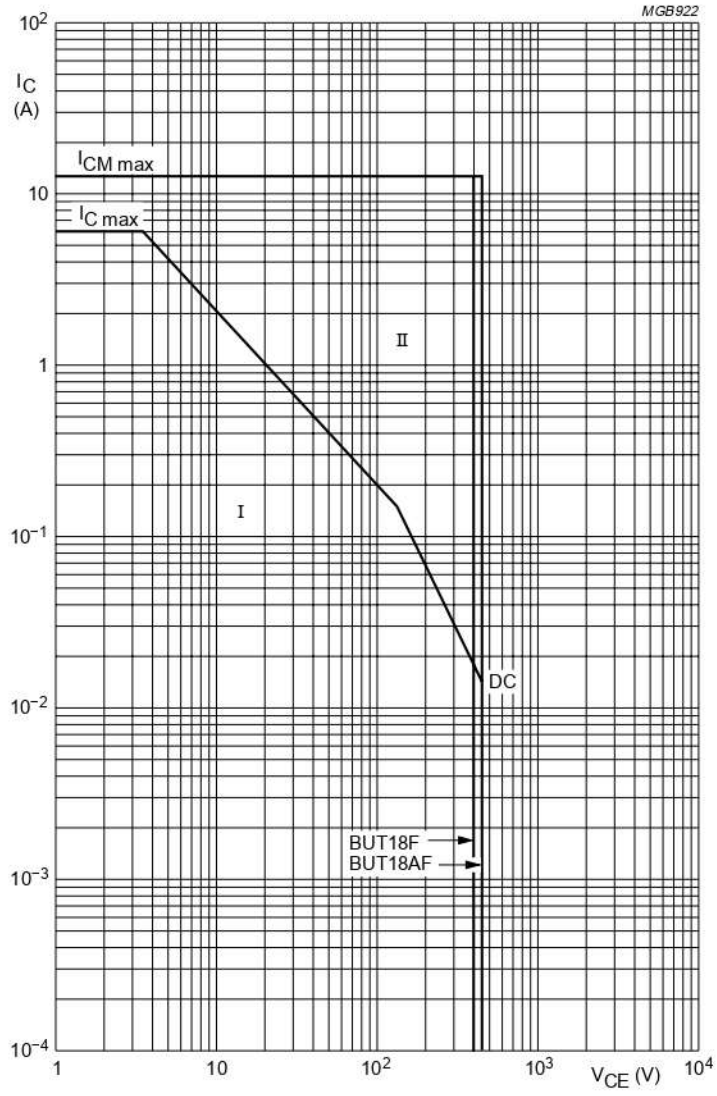


Fig.3 Test circuit for collector-emitter sustaining voltage.



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

T_{mb} < 25 °C

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.4 Forward bias SOAR.

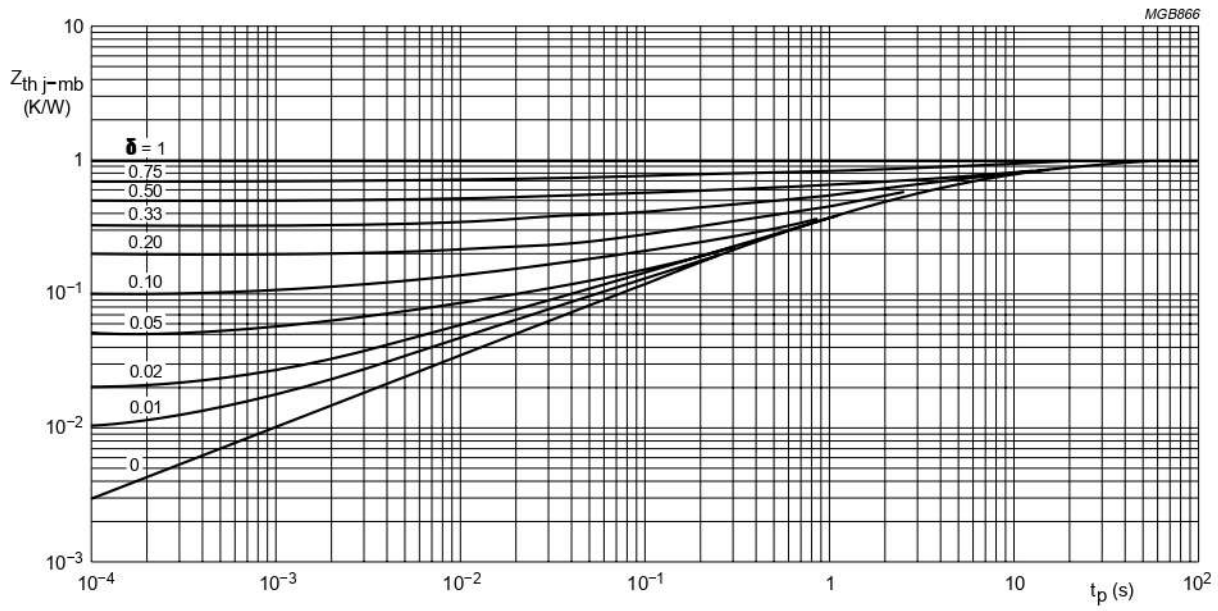


Fig.5 Transient thermal impedance.

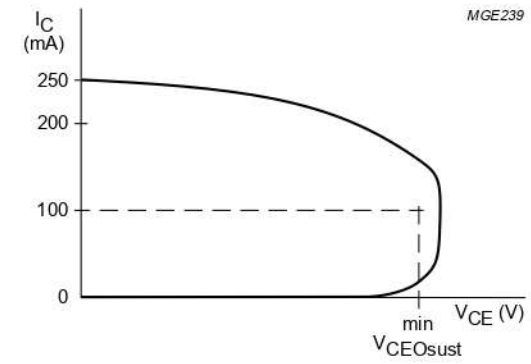
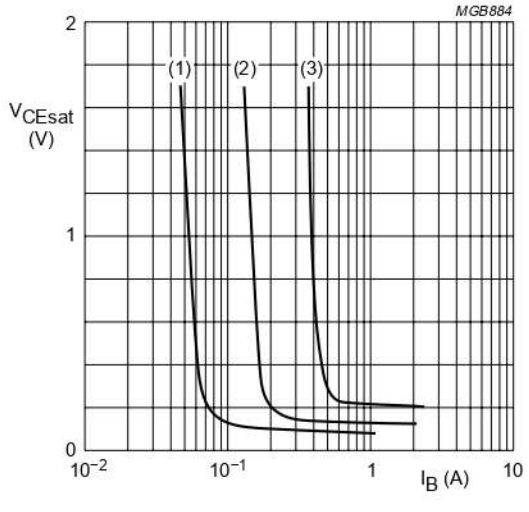
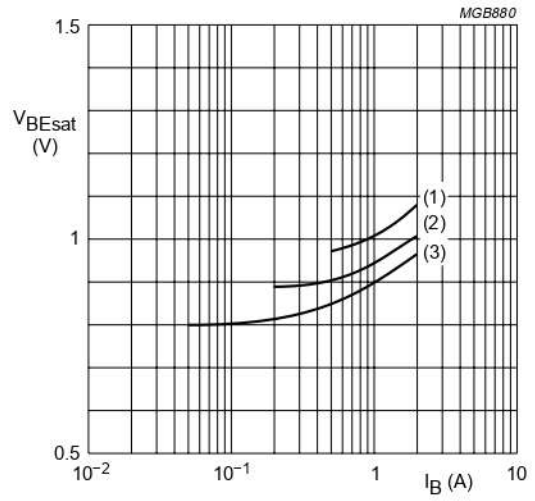


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



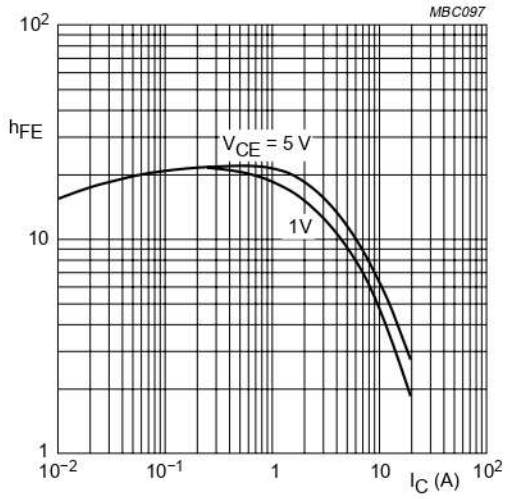
T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 2 A.
(3) I_C = 4 A.

Fig.7 Collector-emitter saturation voltage as a function of base current.



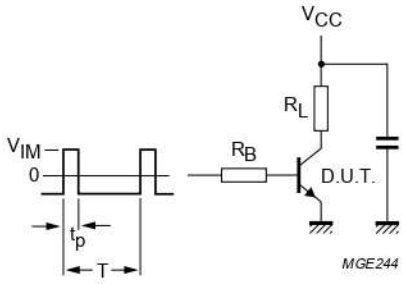
T_j = 25 °C.
(1) I_C = 4 A.
(2) I_C = 2 A.
(3) I_C = 1 A.

Fig.8 Base-emitter saturation voltage as a function of base current.



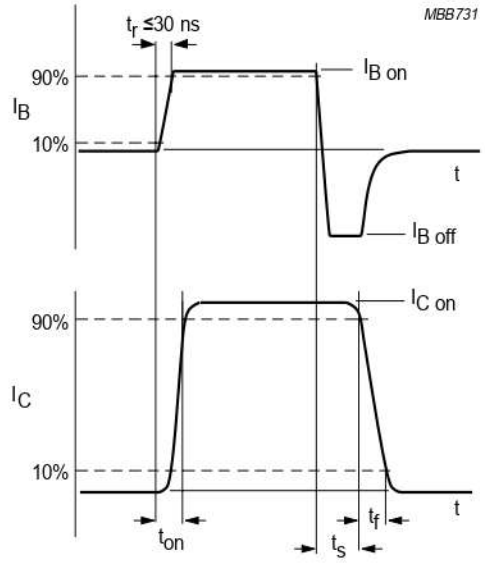
V_{CE} = 5 V; T_j = 25 °C.

Fig.9 DC current gain; typical values.



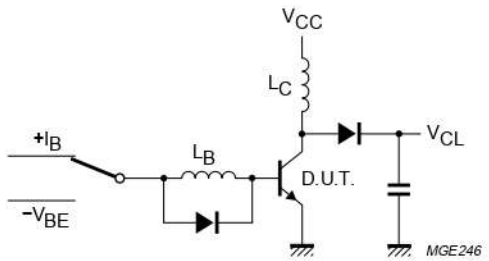
V_{CC} = 250 V; t_p = 20 μs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.10 Test circuit resistive load.



t_r ≤ 20 ns.

Fig.11 Switching times waveforms with resistive load.



V_{CL} = 300 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.12 Test circuit inductive load.

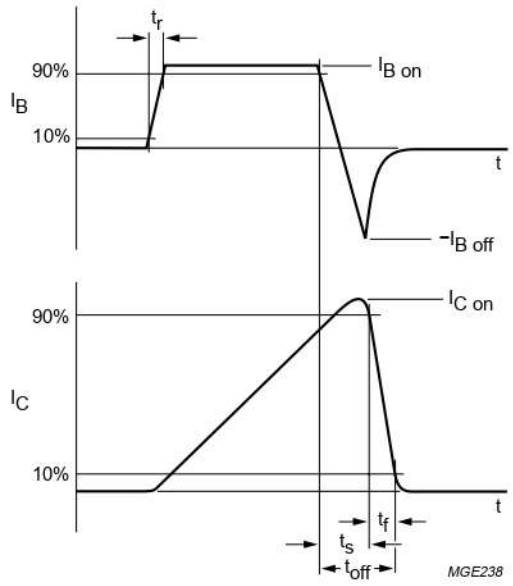
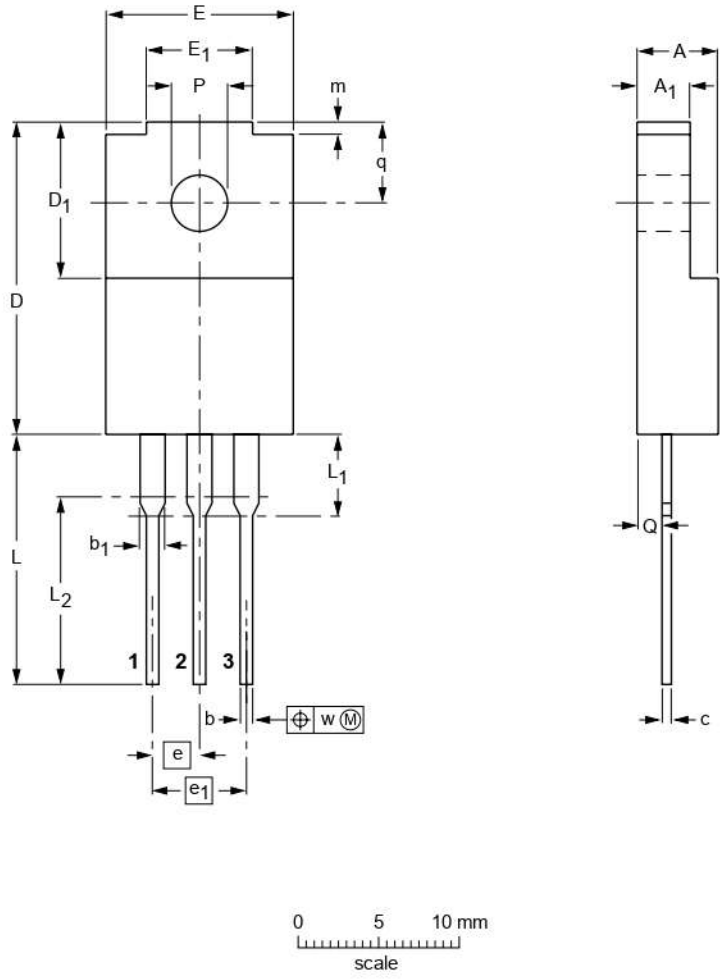


Fig.13 Switching time waveforms with inductive load.

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

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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