# DATA SHEET

# BUT18; BUT18A
## Silicon diffused power transistors

Product specification
Supersedes data of 1997 Aug 13

1999 Jun 11

Philips
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# Silicon diffused power transistors — BUT18; BUT18A

## 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 |

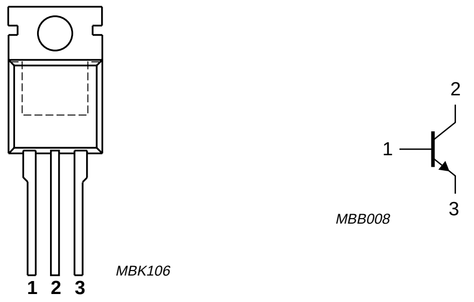



Fig.1 Simplified outline (TO-220AB) and symbol.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MAX. | UNIT |
|---|---|---|---|---|
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE} = 0$ | | |
| | BUT18 | | 850 | V |
| | BUT18A | | 1000 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | | |
| | BUT18 | | 400 | V |
| | BUT18A | | 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.2 | 6 | A |
| $I_{CM}$ | collector current (peak value) | see Fig.2 | 12 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} \leq 25$ °C; see Fig.4 | 110 | W |
| $t_f$ | fall time | resistive load; see Figs 10 and 11 | 0.8 | µs |

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{th\ j\text{-}mb}$ | thermal resistance from junction to mounting base | 1.15 | K/W |

## LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CESM}$ | collector-emitter peak voltage | $V_{BE} = 0$ | | | |
| | BUT18 | | – | 850 | V |
| | BUT18A | | – | 1000 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | | | |
| | BUT18 | | – | 400 | V |
| | BUT18A | | – | 450 | V |
| $I_{Csat}$ | collector saturation current | | – | 4 | A |
| $I_C$ | collector current (DC) | see Fig.2 | – | 6 | A |
| $I_{CM}$ | collector current (peak value) | see Fig.2 | – | 12 | A |
| $I_B$ | base current (DC) | | – | 3 | A |
| $I_{BM}$ | base current (peak value) | | – | 6 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} \leq 25$ °C; see Fig.4 | – | 110 | W |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | – | 150 | °C |

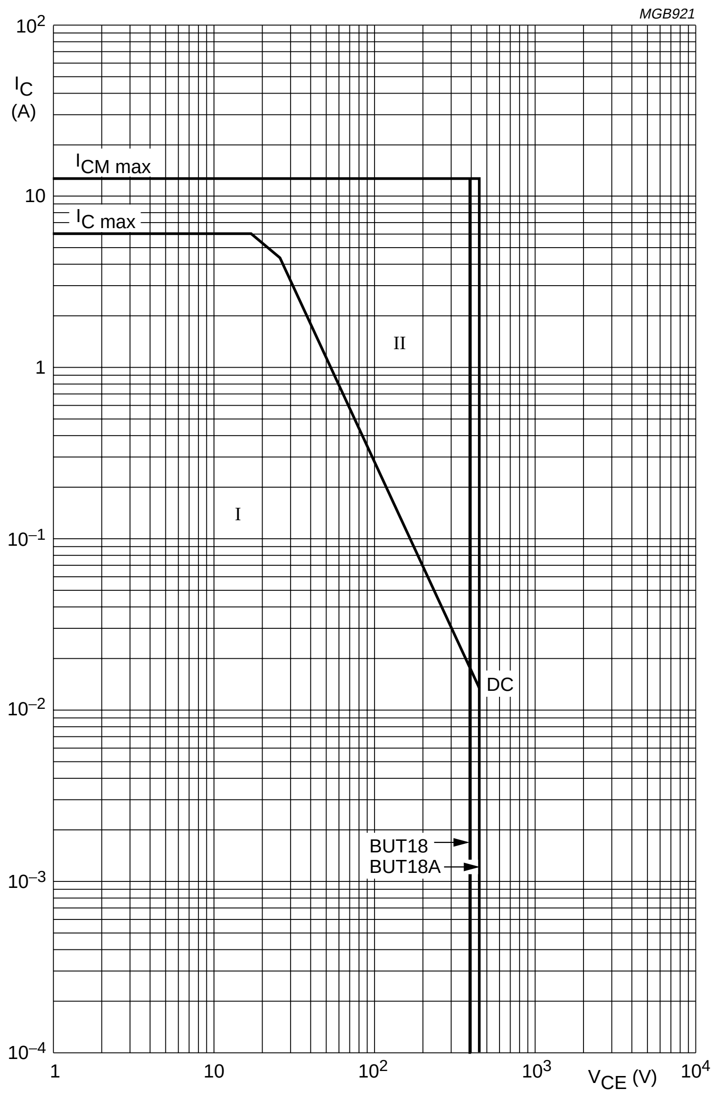
## CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{CEOsust}$ | collector-emitter sustaining voltage | $I_C = 0.1$ A; $I_{Boff} = 0$; L = 25 mH; see Figs 5 and 6 | | | | |
| | BUT18 | | 400 | – | – | V |
| | BUT18A | | 450 | – | – | V |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 4$ A; $I_B = 0.8$ A; see Fig.7 | – | – | 1.5 | V |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C = 4$ A; $I_B = 0.8$ A; 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 |
| $h_{FE}$ | 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; $V_{CL} = 250$ V | – | 1.6 | 2.5 | µs |
| $t_f$ | fall time | $I_{Con} = 4$ A; $I_{Bon} = 800$ mA; $V_{CL} = 250$ V | – | 150 | 400 | ns |

**Note**

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




$T_{mb}$ = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

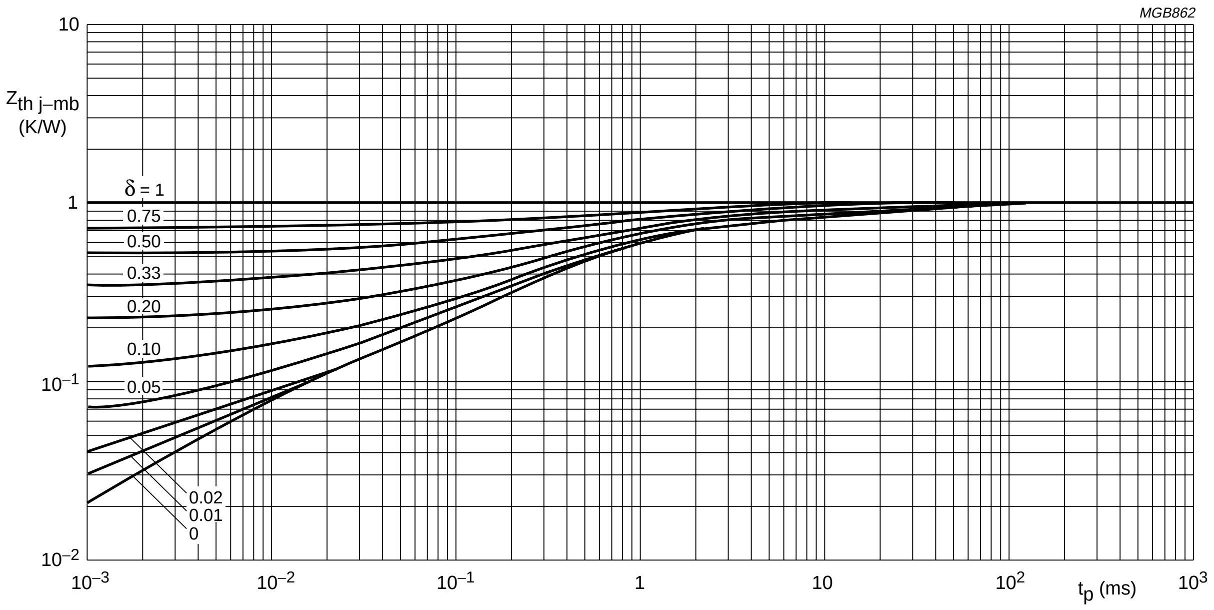



Fig.3 Transient thermal impedance.

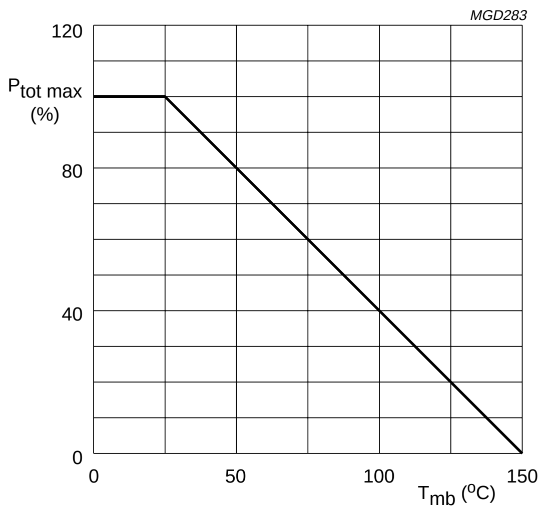



Fig.4 Power derating curve.

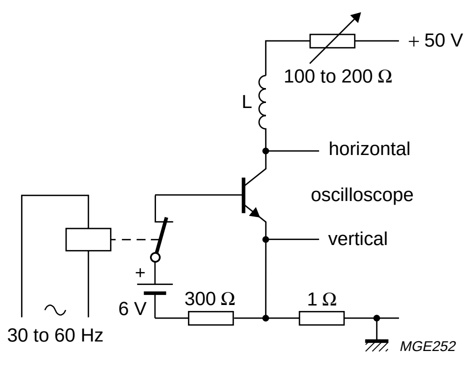



Fig.5 Test circuit for collector-emitter sustaining voltage.

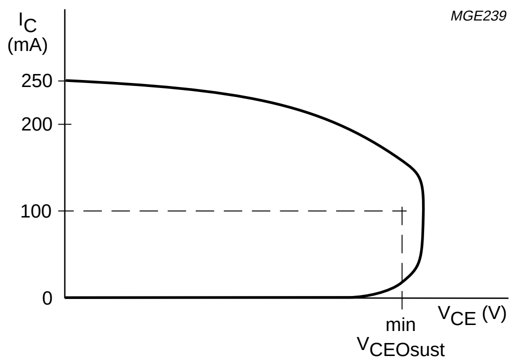
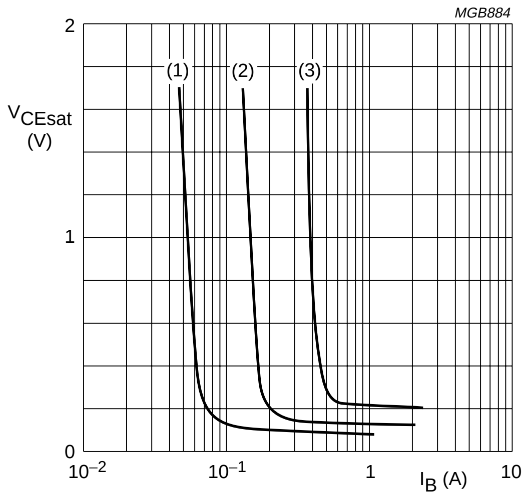
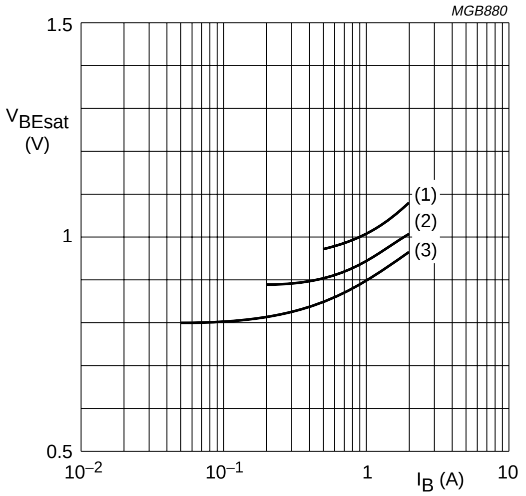



Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



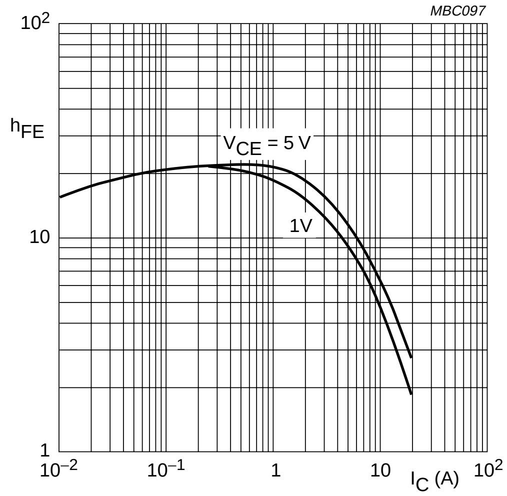

$T_j$ = 25 °C.
(1) $I_C$ = 1 A.
(2) $I_C$ = 2 A.
(3) $I_C$ = 4 A.

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



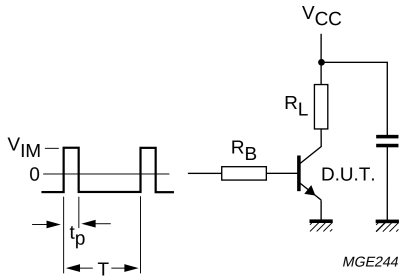

$T_j$ = 25 °C.
(1) $I_C$ = 4 A.
(2) $I_C$ = 2 A.
(3) $I_C$ = 1 A.

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



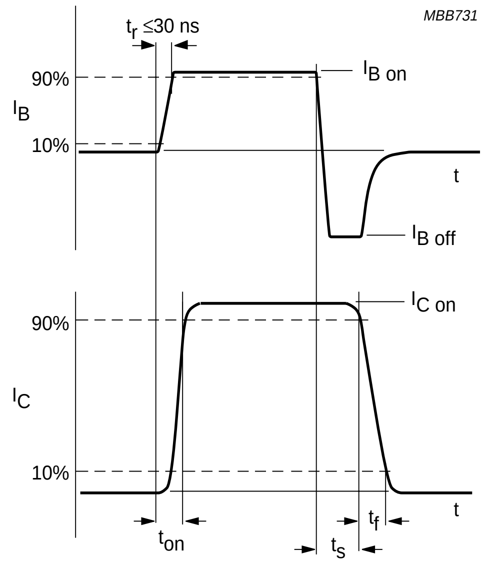

$V_{CE}$ = 5 V; $T_j$ = 25 °C.

Fig.9 DC current gain; typical values.



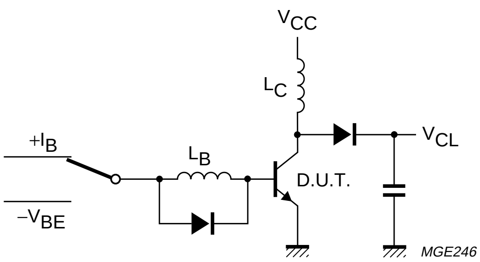

$V_{CC}$ = 250 V; $t_p$ = 20 µs; $V_{IM}$ = –6 to +8 V; $t_p$/T = 0.01.
The values of $R_B$ and $R_L$ are selected in accordance with $I_{Con}$ and $I_{Bon}$ requirements.

Fig.10 Test circuit resistive load.




$t_r$ ≤ 30 ns.

Fig.11 Switching time waveforms with resistive load.




$V_{CL}$ = up to 1000 V; $V_{CC}$ = 30 V; $V_{BE}$ = –5 V; $L_B$ = 1 µH (0 for reverse bias SOAR); $L_C$ = 200 µH.

Fig.12 Test circuit inductive load and reverse bias SOAR.

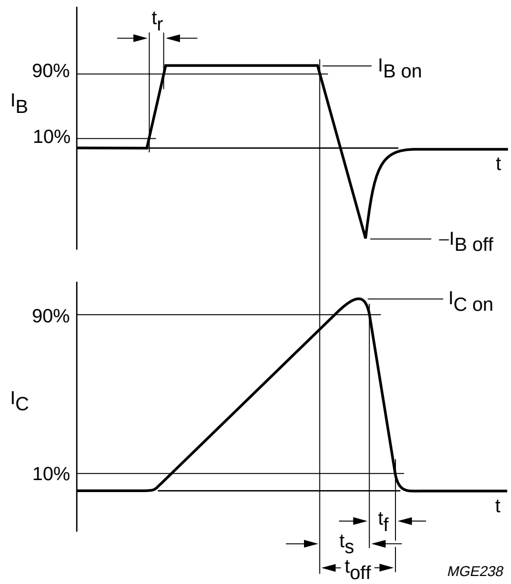
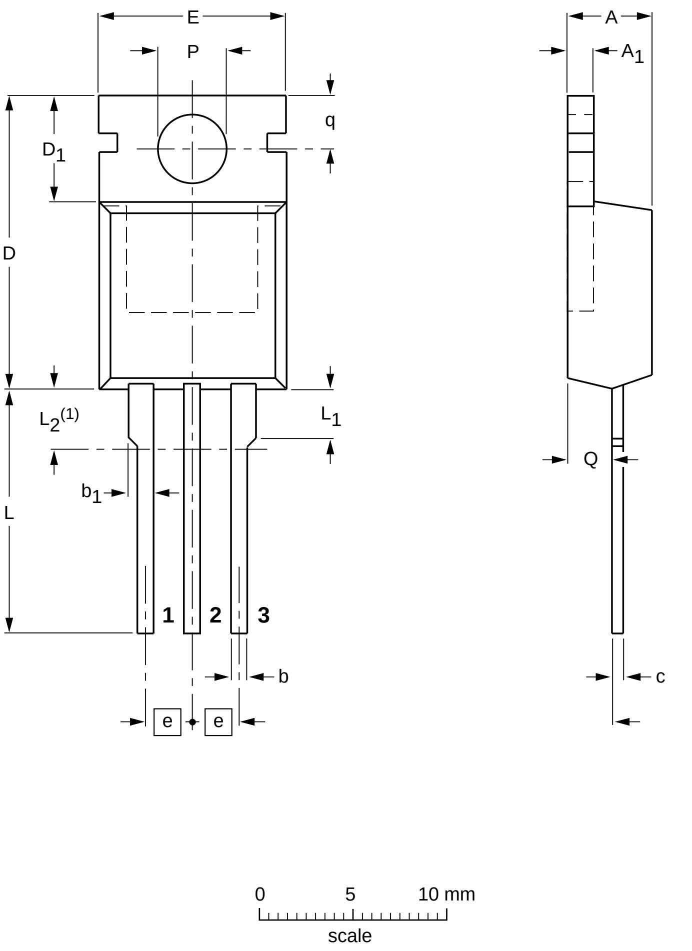



Fig.13 Switching times waveforms with inductive load.

## PACKAGE OUTLINE

**Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB** **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<br>4.1 | 1.39<br>1.27 | 0.9<br>0.7 | 1.3<br>1.0 | 0.7<br>0.4 | 15.8<br>15.2 | 6.4<br>5.9 | 10.3<br>9.7 | 2.54 | 15.0<br>13.5 | 3.30<br>2.79 | 3.0 | 3.8<br>3.6 | 3.0<br>2.7 | 2.6<br>2.2 |

**Note**

1. Terminals in this zone are not tinned.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT78 | | TO-220AB | | | | 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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## NOTES

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