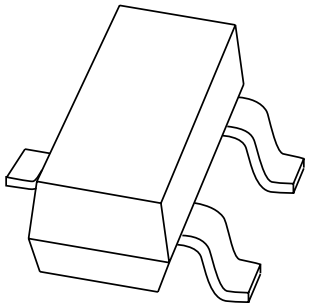
# DATA SHEET



# BSR12
## PNP switching transistor

Product specification

1999 Jul 23

Philips
Semiconductors

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# PNP switching transistor BSR12

## FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 15 V).

## APPLICATIONS

- High-speed, saturated switching applications for industrial service in thick and thin-film circuits.

## DESCRIPTION

PNP switching transistor in a SOT23 plastic package.

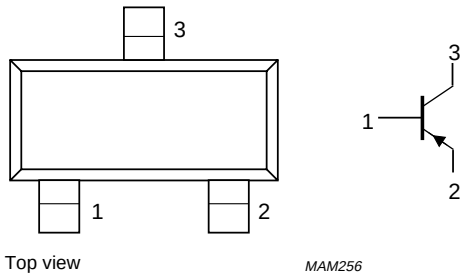



Fig.1 Simplified outline (SOT23) and symbol.

## PINNING

| PIN | DESCRIPTION |
|---|---|
| 1 | base |
| 2 | emitter |
| 3 | collector |

## MARKING

| TYPE NUMBER | MARKING CODE |
|---|---|
| BSR12 | B5p |

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CBO}$ | collector-base voltage | open emitter | – | –15 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | – | –15 | V |
| $I_{CM}$ | peak collector current | | – | –200 | mA |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | – | 250 | mW |
| $T_j$ | junction temperature | | – | 150 | °C |
| $h_{FE}$ | DC current gain | $I_C = -10$ mA; $V_{CE} = -1$ V | 30 | – | |
| | | $I_C = -50$ mA; $V_{CE} = -1$ V | 30 | 120 | |
| $f_T$ | transition frequency | f = 500 MHz; $I_C = -50$ mA; $V_{CE} = -10$ V | 1.5 | – | GHz |
| $t_{off}$ | turn-off time | $I_{Con} = -30$ mA; $I_{Bon} = -3$ mA; $I_{Boff} = 3$mA | – | 30 | ns |

## LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CBO}$ | collector-base voltage | open emitter | – | –15 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | – | –15 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | – | –3 | V |
| $I_C$ | collector current (DC) | | – | –100 | mA |
| $I_{CM}$ | peak collector current | | – | –200 | mA |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | – | 250 | mW |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | – | 150 | °C |

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}a}$ | thermal resistance from junction to ambient | note 1 | 500 | K/W |

**Note**

1. Transistor mounted on a ceramic substrate $8 \times 10 \times 0.7$ mm.

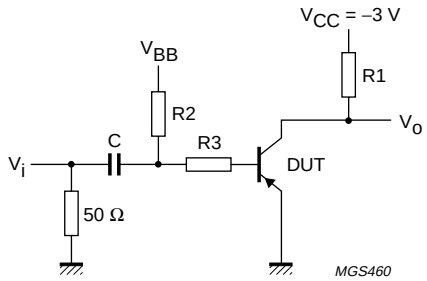
## CHARACTERISTICS

$T_{amb}$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | collector cut-off current | $I_E$ = 0; $V_{CB}$ = –10 V | – | – | –50 | nA |
| | | $I_E$ = 0; $V_{CB}$ = –10 V; $T_{amb}$ = 125 °C | – | – | –5 | µA |
| $I_{CES}$ | collector cut-off current | $V_{BE}$ = 0; $V_{CE}$ = –10 V | – | – | –50 | nA |
| $V_{(BR)CBO}$ | breakdown voltage | $I_E$ = 0; $I_C$ = –10 µA | –15 | – | – | V |
| $V_{(BR)CES}$ | breakdown voltage | $V_{BE}$ = 0; $I_C$ = –10 µA | –15 | – | – | V |
| $V_{(BR)EBO}$ | breakdown voltage | $I_C$ = 0; $I_E$ = –100 µA | –3 | – | – | V |
| $V_{CEOsust}$ | collector-emitter sustaining voltage | $I_B$ = 0; $I_C$ = –10 mA | –15 | – | – | V |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = –10 mA; $I_B$ = –1 mA; note 1 | – | – | –130 | mV |
| | | $I_C$ = –50 mA; $I_B$ = –5 mA; note 1 | – | –180 | –270 | mV |
| | | $I_C$ = –100 mA; $I_B$ = –10 mA; note 1 | – | – | –450 | mV |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = –10 mA; $I_B$ = –1 mA; note 1 | –725 | – | –920 | mV |
| | | $I_C$ = –50 mA; $I_B$ = –5 mA; note 1 | –800 | – | –1150 | mV |
| | | $I_C$ = –100 mA; $I_B$ = –10 mA; note 1 | –900 | – | –1500 | mV |
| $h_{FE}$ | DC current gain | $I_C$ = –1 mA; $V_{CE}$ = –1 V; note 1 | 30 | – | – | |
| | | $I_C$ = –10 mA; $V_{CE}$ = –1 V; note 1 | 30 | – | – | |
| | | $I_C$ = –50 mA; $V_{CE}$ = –1 V; note 1 | 30 | – | 120 | |
| | | $I_C$ = –50 mA; $V_{CE}$ = –1 V; $T_{amb}$ = 55 °C; note 1 | 30 | – | – | |
| | | $I_C$ = –100 mA; $V_{CE}$ = –1 V; note 1 | 20 | – | – | |
| $f_T$ | transition frequency | IC = –50 mA; $V_{CE}$ = –10 V; f = 500 MHz | 1.5 | – | – | GHz |
| $C_c$ | collector capacitance | $I_E$ = $I_e$ = 0; $V_{CB}$ = –5 V | – | – | 4.5 | pF |
| $C_e$ | emitter capacitance | $I_C$ = $I_c$ = 0; $V_{EB}$ = –0.5 V | – | – | 6 | pF |
| **Switching time** (see Fig.2) | | | | | | |
| $t_{on}$ | turn-on time | $V_i$ = –6.85 V; $V_{BB}$ = 0 V; $I_{Con}$ = –30 mA; $I_{Bon}$ = –3.0 mA | – | – | 20 | ns |
| $t_{off}$ | turn-off time | $V_i$ = 11.7 V; $V_{BB}$ = –9.85 V; $I_{Con}$ = –30 mA; $I_{Bon}$ = –3 mA; $I_{Boff}$ = 3 mA | – | – | 30 | ns |

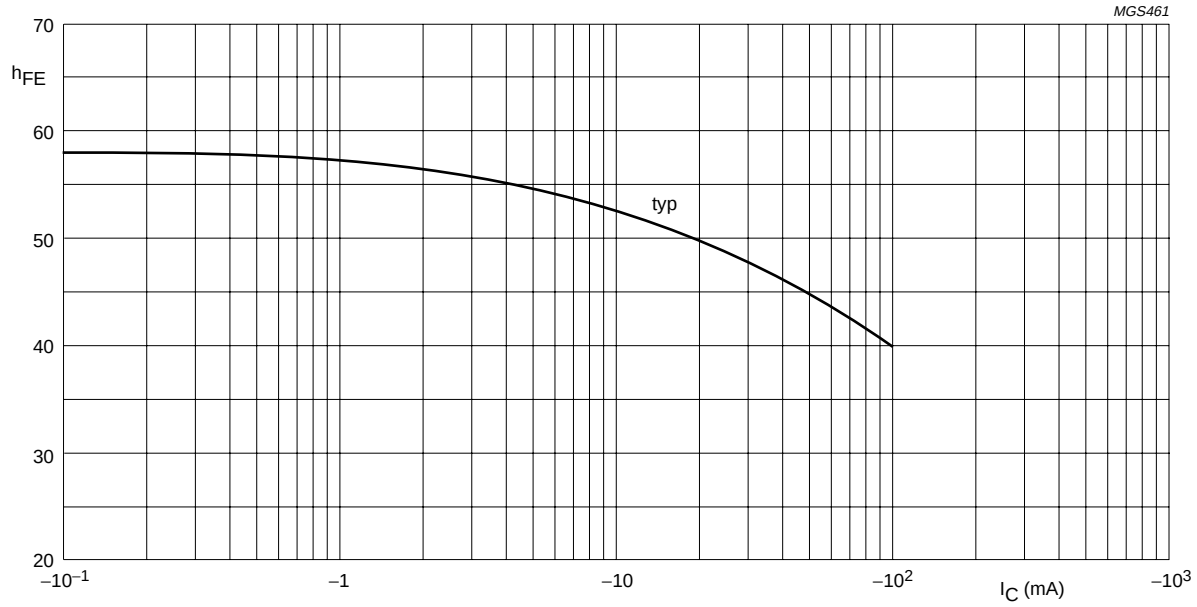
**Note**

1. Pulse test: $t_p$ = 300 µs; δ = 0.01.



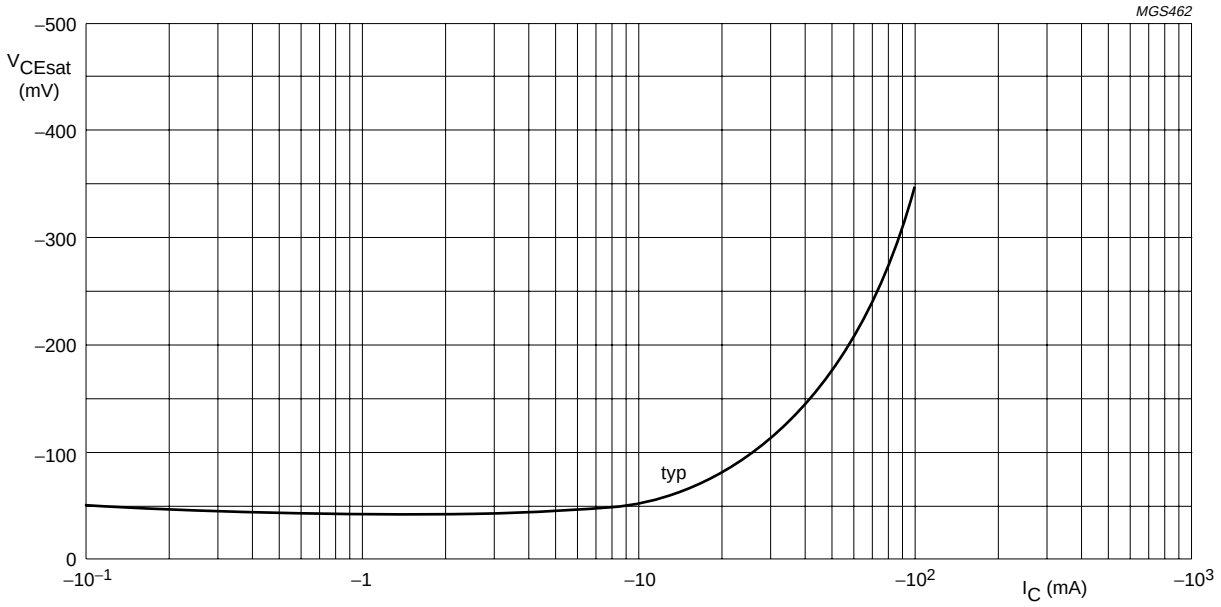

R1 = 94 Ω; R2 = 1 kΩ; R3 = 2 kΩ; C = 0.1 μF.
Pulse generator: Pulse duration $t_p$ = 400 ns. Rise time $t_r$ < 1 ns. Output impedance $Z_O$ = 50 Ω.
Sampling scope: Rise time $t_r$ < 1 ns. Input impedance $Z_i$ = 100 kΩ.

Fig.2 Test circuit for switching times.



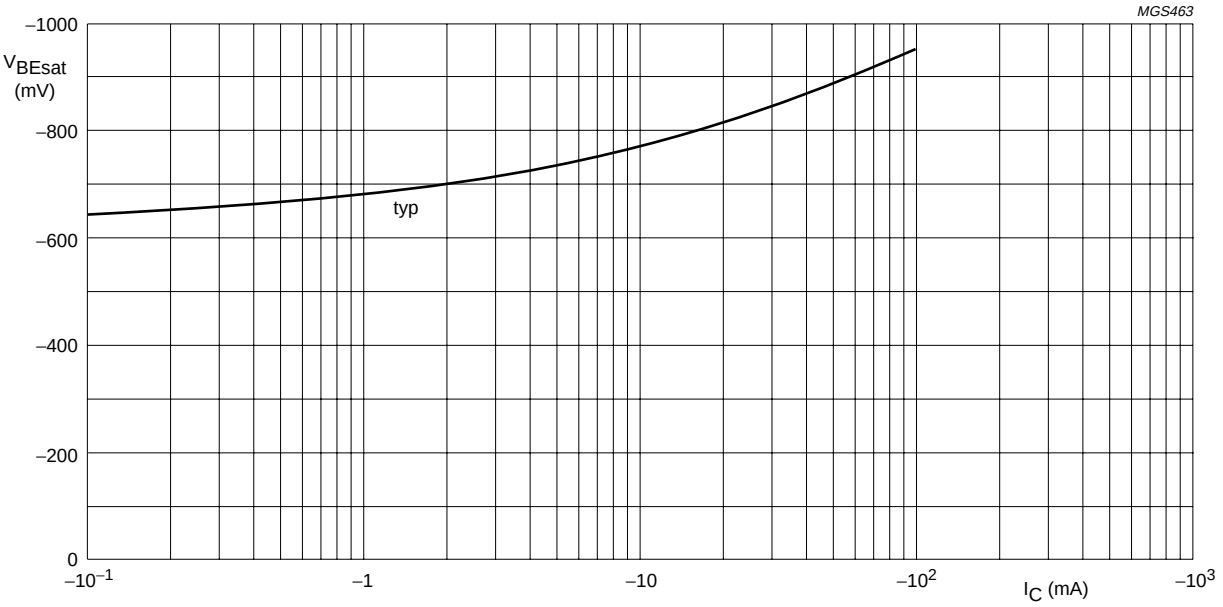

$V_{CE}$ = – 1 V; $T_{amb}$ = 25°C.

Fig.3 DC current gain; typical values.



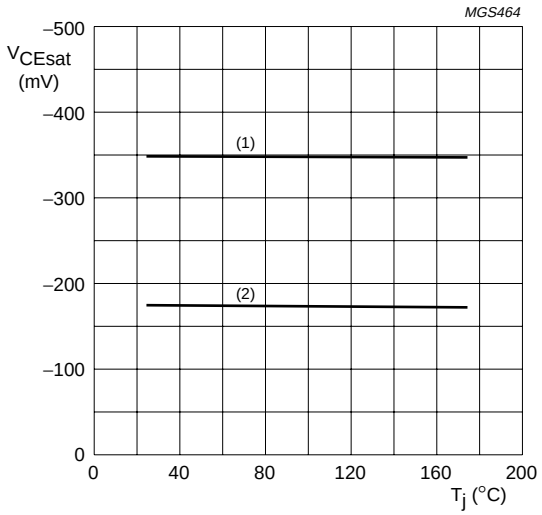

$I_C/I_B = 10.$

Fig.4 Collector-emitter saturation voltage as a function of collector current; typical values.




$I_C/I_B = 10.$

Fig.5 Base-emitter saturation voltage as a function of collector current; typical values.



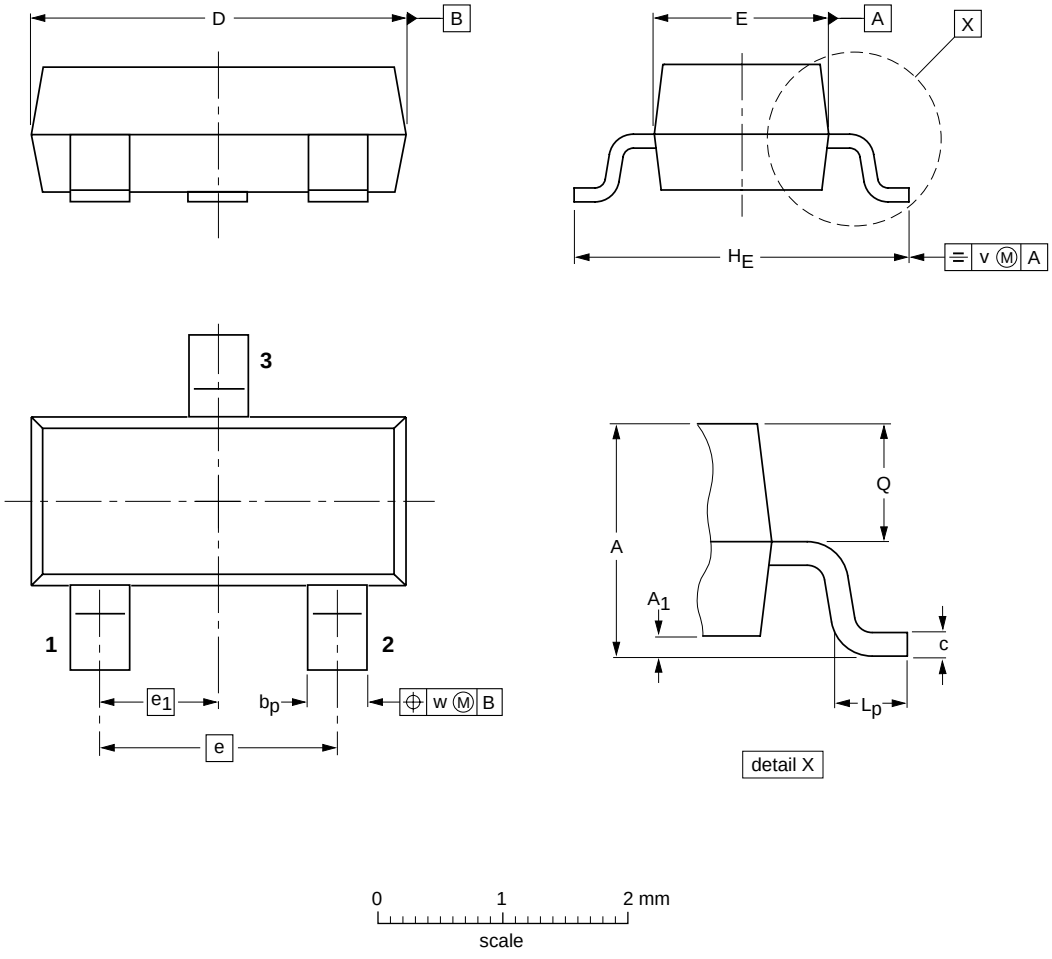

(1) $I_C$ = 100 mA; $I_B$ = 10 mA

(2) $I_C$ = 50 mA and $I_B$ = 5 mA.

Fig.6 Collector-emitter saturation voltage as a function of junction temperature; typical values.

**PACKAGE OUTLINE**

**Plastic surface mounted package; 3 leads** **SOT23**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max. | $b_p$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1 | 0.48<br>0.38 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 0.95 | 2.5<br>2.1 | 0.45<br>0.15 | 0.55<br>0.45 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT23 | | | | | | 97-02-28 |

## 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. | |
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**NOTES**

**NOTES**

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Printed in The Netherlands 125006/02/pp12 Date of release: 1999 Jul 23 Document order number: 9397 750 06129


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