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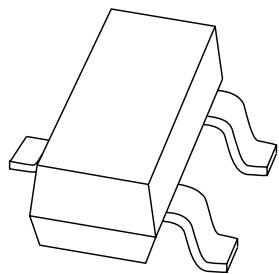
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Kind regards,

Team Nexperia

# DATA SHEET



## BSR13; BSR14 NPN switching transistors

Product data sheet  
Supersedes data of 1999 Apr 15

2004 Jan 13

**NPN switching transistors****BSR13; BSR14****FEATURES**

- High current (max. 800 mA)
- Low voltage (max. 40 V).

**APPLICATIONS**

- Switching and linear applications.

**DESCRIPTION**

NPN switching transistor in a SOT23 plastic package.  
 PNP complements: BSR15 and BSR16.

**MARKING**

| TYPE NUMBER | MARKING CODE <sup>(1)</sup> |
|-------------|-----------------------------|
| BSR13       | U7*                         |
| BSR14       | U8*                         |

**Note**

1. \* = p : Made in Hong Kong.
- \* = t : Made in Malaysia.
- \* = W : Made in China.

**PINNING**

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

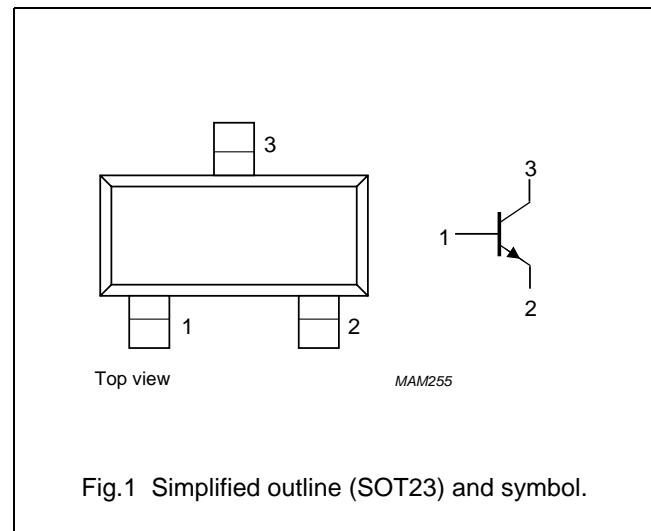


Fig.1 Simplified outline (SOT23) and symbol.

**ORDERING INFORMATION**

| TYPE NUMBER | PACKAGE |  |         |
|-------------|---------|--|---------|
|             | NAME    | DESCRIPTION                              | VERSION |
| BSR13       | –       | plastic surface mounted package; 3 leads | SOT23   |
| BSR14       |         |  |         |

## NPN switching transistors

BSR13; BSR14

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

| SYMBOL    | PARAMETER                                   | CONDITIONS                                 | MIN. | MAX. | UNIT               |
|-----------|---|--|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage<br>BSR13<br>BSR14    | open emitter                               | –    | 60   | V                  |
|           |   |  | –    | 75   | V                  |
| $V_{CEO}$ | collector-emitter voltage<br>BSR13<br>BSR14 | open base                                  | –    | 30   | V                  |
|           |   |  | –    | 40   | V                  |
| $V_{EBO}$ | emitter-base voltage<br>BSR13<br>BSR14      | open collector                             | –    | 5    | V                  |
|           |   |  | –    | 6    | V                  |
| $I_C$     | collector current (DC)                      |  | –    | 800  | mA                 |
| $I_{CM}$  | peak collector current                      |  | –    | 800  | mA                 |
| $I_{BM}$  | peak base current                           |  | –    | 200  | mA                 |
| $P_{tot}$ | total power dissipation                     | $T_{amb} \leq 25 \text{ }^{\circ}\text{C}$ | –    | 250  | mW                 |
| $T_{stg}$ | storage temperature                         |  | –65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature                        |  | –    | 150  | $^{\circ}\text{C}$ |
| $T_{amb}$ | operating ambient temperature               |  | –65  | +150 | $^{\circ}\text{C}$ |

## THERMAL CHARACTERISTICS

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

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## CHARACTERISTICS

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

| SYMBOL    | PARAMETER                                 | CONDITIONS   | MIN. | MAX. | UNIT          |
|-----------|---|--|------|------|---------------|
| $I_{CBO}$ | collector cut-off current<br>BSR13        | $I_E = 0; V_{CB} = 50 \text{ V}$                                     | –    | 30   | nA            |
|           |   | $I_E = 0; V_{CB} = 50 \text{ V}; T_j = 150 \text{ }^{\circ}\text{C}$ | –    | 10   | $\mu\text{A}$ |
| $I_{EBO}$ | collector cut-off current<br>BSR14        | $I_E = 0; V_{CB} = 60 \text{ V}$                                     | –    | 10   | nA            |
|           |   | $I_E = 0; V_{CB} = 60 \text{ V}; T_j = 150 \text{ }^{\circ}\text{C}$ | –    | 10   | $\mu\text{A}$ |
| $I_{EBO}$ | emitter cut-off current<br>BSR13<br>BSR14 | $I_C = 0; V_{EB} = 5 \text{ V}$                                      | –    | 30   | nA            |
|           |   |  | –    | 10   | nA            |

## NPN switching transistors

BSR13; BSR14

| SYMBOL      | PARAMETER  | CONDITIONS   | MIN.     | MAX.       | UNIT                       |
|-------------|--|--|----------|------------|----------------------------|
| $h_{FE}$    | DC current gain  | $I_C = 0.1 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$           | 35       | —          |                            |
|             |  | $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$             | 50       | —          |                            |
|             |  | $I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$            | 75       | —          |                            |
|             |  | $I_C = 150 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$           | 100      | 300        |                            |
|             |  | $I_C = 150 \text{ mA}; V_{CE} = 1 \text{ V}; \text{note 1}$            | 50       | —          |                            |
|             | DC current gain<br>BSR13<br>BSR14                      | $I_C = 500 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$           | 30<br>40 | —<br>—     |                            |
| $V_{CEsat}$ | collector-emitter saturation voltage<br>BSR13<br>BSR14 | $I_C = 150 \text{ mA}; I_B = 15 \text{ mA}$                            | —<br>—   | 400<br>300 | $\text{mV}$<br>$\text{mV}$ |
|             |  | $I_C = 500 \text{ mA}; I_B = 50 \text{ mA}$                            | —<br>—   | 1.6<br>1   | $\text{V}$<br>$\text{V}$   |
|             | base-emitter saturation voltage<br>BSR13<br>BSR14      | $I_C = 150 \text{ mA}; I_B = 15 \text{ mA}$                            | —<br>0.6 | 1.3<br>1.2 | $\text{V}$<br>$\text{V}$   |
|             |  | $I_C = 500 \text{ mA}; I_B = 50 \text{ mA}$                            | —<br>—   | 2.6<br>2   | $\text{V}$<br>$\text{V}$   |
| $C_c$       | collector capacitance                                  | $I_E = I_e = 0; V_{CB} = 10 \text{ V}; f = 1 \text{ MHz}$              | —        | 8          | $\text{pF}$                |
| $f_T$       | transition frequency<br>BSR13<br>BSR14                 | $I_C = 20 \text{ mA}; V_{CE} = 20 \text{ V};$<br>$f = 100 \text{ MHz}$ | 250      | —          | $\text{MHz}$               |
|             |  |  | 300      | —          | $\text{MHz}$               |

**Switching times (between 10% and 90% levels); see Fig.2**

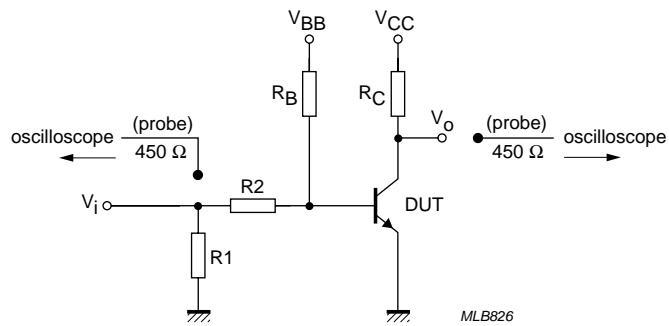
|           |               |   |   |     |    |
|-----------|---------------|---|---|-----|----|
| $t_{on}$  | turn-on time  | $I_{Con} = 150 \text{ mA}; I_{Bon} = 15 \text{ mA};$<br>$I_{Boff} = -15 \text{ mA}$ | — | 35  | ns |
| $t_d$     | delay time    |   | — | 15  | ns |
| $t_r$     | rise time     |   | — | 20  | ns |
| $t_{off}$ | turn-off time |   | — | 250 | ns |
| $t_s$     | storage time  |   | — | 200 | ns |
| $t_f$     | fall time     |   | — | 60  | ns |

**Note**

1. Pulse test:  $t_p \leq 300 \mu\text{s}$ ;  $\delta \leq 0.02$ .

## NPN switching transistors

BSR13; BSR14



$V_i = 9.5$  V;  $T = 500$   $\mu$ s;  $t_p = 10$   $\mu$ s;  $t_r = t_f \leq 3$  ns.

$R1 = 68 \Omega$ ;  $R2 = 325 \Omega$ ;  $R_B = 325 \Omega$ ;  $R_C = 160 \Omega$ .

$V_{BB} = -3.5$  V;  $V_{CC} = 29.5$  V.

Oscilloscope: input impedance  $Z_i = \geq 100 \Omega$ .

Fig.2 Test circuit for switching times.

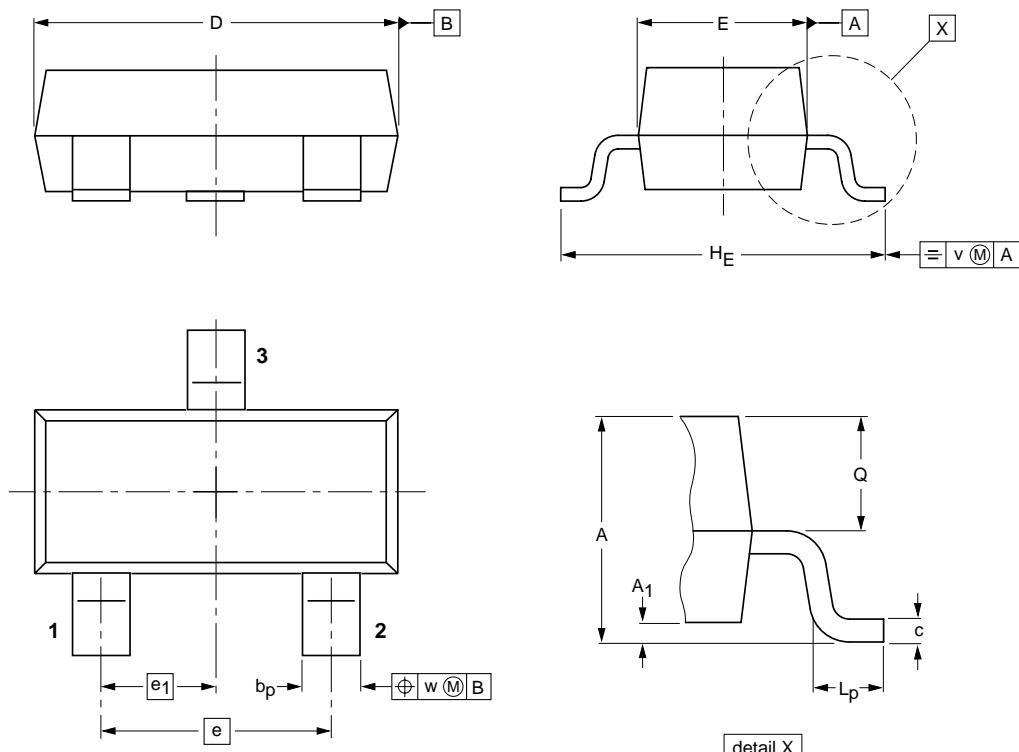
## NPN switching transistors

BSR13; BSR14

## PACKAGE OUTLINE

Plastic surface-mounted package; 3 leads

SOT23



## DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max. | b <sub>p</sub> | c            | D          | E          | e   | e <sub>1</sub> | H <sub>E</sub> | l <sub>p</sub> | 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<br>VERSION | REFERENCES |          |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE             |
|--------------------|------------|----------|-------|--|------------------------|------------------------|
|                    | IEC        | JEDEC    | JEITA |  |                        |                        |
| SOT23              |            | TO-236AB |       |  |                        | -04-11-04-<br>06-03-16 |

## NPN switching transistors

BSR13; BSR14

## DATA SHEET STATUS

| DOCUMENT STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)</sup> | DEFINITION  |
|--------------------------------|-------------------------------|---|
| Objective data sheet           | Development                   | This document contains data from the objective specification for product development. |
| Preliminary data sheet         | Qualification                 | This document contains data from the preliminary specification.                       |
| Product data sheet             | Production                    | This document contains the product specification.                                     |

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## **Contact information**

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