

# 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

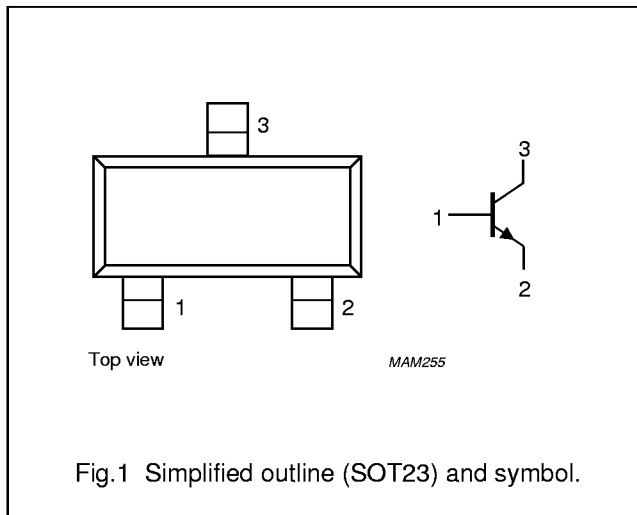
| TYPE NUMBER | MARKING CODE <sup>(1)</sup> |
|-------------|-----------------------------|
| BSR13       | U7*                         |
| BSR14       | U8*                         |

### Note

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

### PINNING

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



### LIMITING VALUES

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

| SYMBOL           | PARAMETER                     | CONDITIONS               | MIN. | MAX. | UNIT |
|------------------|-------------------------------|--------------------------|------|------|------|
| V <sub>CBO</sub> | collector-base voltage        | open emitter             |      |      |      |
|                  | BSR13                         |                          | –    | 60   | V    |
|                  | BSR14                         |                          | –    | 75   | V    |
| V <sub>CEO</sub> | collector-emitter voltage     | open base                |      |      |      |
|                  | BSR13                         |                          | –    | 30   | V    |
|                  | BSR14                         |                          | –    | 40   | V    |
| V <sub>EBO</sub> | emitter-base voltage          | open collector           |      |      |      |
|                  | BSR13                         |                          | –    | 5    | V    |
|                  | BSR14                         |                          | –    | 6    | V    |
| I <sub>C</sub>   | collector current (DC)        |                          | –    | 800  | mA   |
| I <sub>CM</sub>  | peak collector current        |                          | –    | 800  | mA   |
| I <sub>BM</sub>  | peak base current             |                          | –    | 200  | mA   |
| P <sub>tot</sub> | total power dissipation       | T <sub>amb</sub> ≤ 25 °C | –    | 250  | mW   |
| T <sub>stg</sub> | storage temperature           |                          | –65  | +150 | °C   |
| T <sub>j</sub>   | junction temperature          |                          | –    | 150  | °C   |
| T <sub>amb</sub> | operating ambient temperature |                          | –65  | +150 | °C   |

## NPN switching transistors

## BSR13; BSR14

## 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

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

| SYMBOL      | PARAMETER  | CONDITIONS  | MIN.   | MAX.                                      | UNIT                |            |
|-------------|--|---|--|---|---------------------|------------|
| $I_{CBO}$   | collector cut-off current<br>BSR13                     | $I_E = 0; V_{CB} = 50\text{ V}$<br>$I_E = 0; V_{CB} = 50\text{ V}; T_j = 150\text{ °C}$ | –<br>–   | 30<br>10                                  | nA<br>$\mu\text{A}$ |            |
|             | collector cut-off current<br>BSR14                     | $I_E = 0; V_{CB} = 60\text{ V}$<br>$I_E = 0; V_{CB} = 60\text{ V}; T_j = 150\text{ °C}$ | –<br>–   | 10<br>10                                  | nA<br>$\mu\text{A}$ |            |
| $I_{EBO}$   | emitter cut-off current<br>BSR13                       | $I_C = 0; V_{EB} = 5\text{ V}$  | –  | 30  | nA                  |            |
|             | BSR14  |   | –  | 10  | nA                  |            |
| $h_{FE}$    | 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                                | mV<br>mV            |            |
|             |  |   | collector-emitter saturation voltage<br>BSR13<br>BSR14     | $I_C = 500\text{ mA}; I_B = 50\text{ mA}$ | –<br>–              | 1.6<br>1   |
|             | 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 |
|             |  |   | base-emitter saturation voltage<br>BSR13<br>BSR14          | $I_C = 500\text{ mA}; I_B = 50\text{ mA}$ | –<br>–              | 2.6<br>2   |

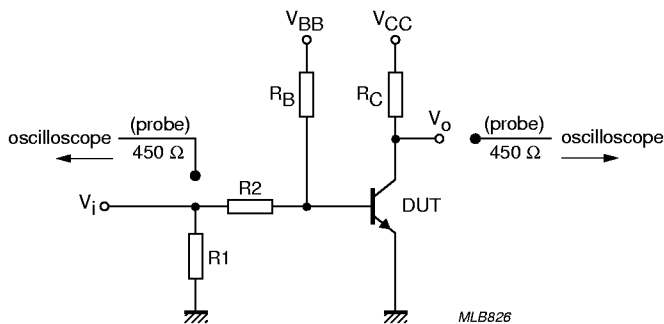
NPN switching transistors

BSR13; BSR14

| SYMBOL   | PARAMETER             | CONDITIONS  | MIN. | MAX. | UNIT |
|--|-----------------------|---|------|------|------|
| $C_c$  | collector capacitance | $I_E = I_e = 0; V_{CB} = 10 \text{ V}; f = 1 \text{ MHz}$         | –    | 8    | pF   |
| $f_T$  | transition frequency  | $I_C = 20 \text{ mA}; V_{CE} = 20 \text{ V}; f = 100 \text{ MHz}$ | 250  | –    | MHz  |
|  | BSR13                 |   | 300  | –    | MHz  |
|  | BSR14                 |   |      |      |      |
| <b>Switching times (between 10% and 90% levels); see Fig.2</b> |                       |   |      |      |      |
| $t_{on}$   | turn-on time          | $I_{Con} = 150 \text{ mA}; I_{Bon} = 15 \text{ mA};$              | –    | 35   | ns   |
| $t_d$  | delay time            | $I_{Boff} = -15 \text{ mA}$                                       | –    | 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:  $t_p \leq 300 \mu\text{s}; \delta \leq 0.02$ .



$V_i = 9.5 \text{ V}; T = 500 \mu\text{s}; t_p = 10 \mu\text{s}; t_r = t_f \leq 3 \text{ ns}.$   
 $R1 = 68 \Omega; R2 = 325 \Omega; R_B = 325 \Omega; R_C = 160 \Omega.$   
 $V_{BB} = -3.5 \text{ V}; V_{CC} = 29.5 \text{ V}.$   
 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

