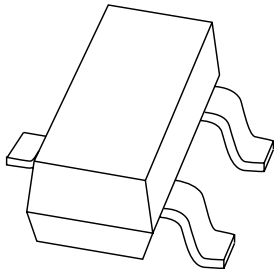


# DATA SHEET



## **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

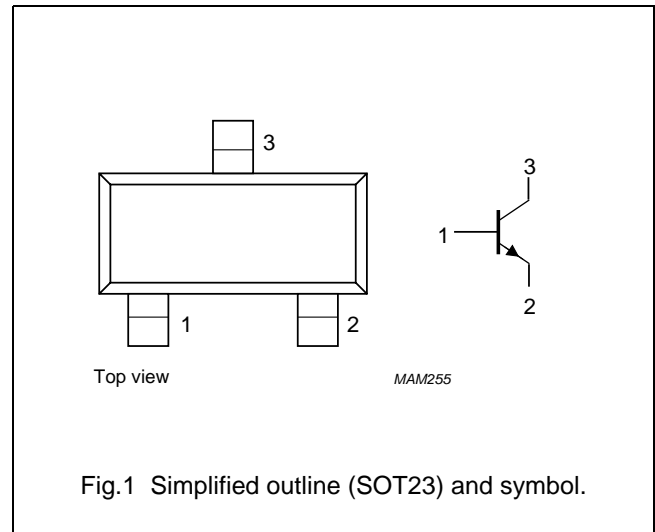
TYPE NUMBER	MARKING CODE <sup>(1)</sup>
BSR13	U7*
BSR14	U8*

### Note

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

### PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



### 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 <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

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	note 1	500	K/W

**Note**

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

**CHARACTERISTICS**T<sub>j</sub> = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I <sub>CBO</sub>	collector cut-off current				
	BSR13	I <sub>E</sub> = 0; V <sub>CB</sub> = 50 V	–	30	nA
		I <sub>E</sub> = 0; V <sub>CB</sub> = 50 V; T <sub>j</sub> = 150 °C	–	10	μA
	collector cut-off current				
	BSR14	I <sub>E</sub> = 0; V <sub>CB</sub> = 60 V	–	10	nA
		I <sub>E</sub> = 0; V <sub>CB</sub> = 60 V; T <sub>j</sub> = 150 °C	–	10	μA
I <sub>EBO</sub>	emitter cut-off current	I <sub>C</sub> = 0; V <sub>EB</sub> = 5 V			
	BSR13		–	30	nA
	BSR14		–	10	nA

## NPN switching transistors

## BSR13; BSR14

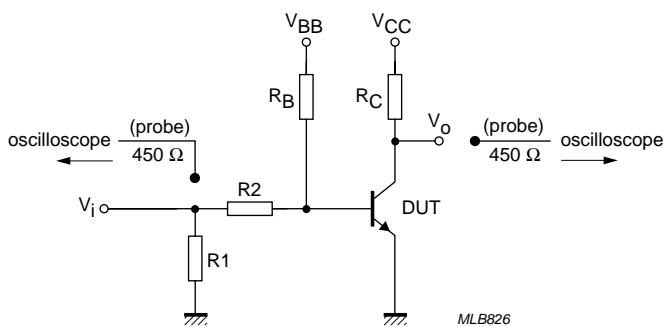
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$h_{FE}$	DC current gain	$I_C = 0.1 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$	35	–	
		$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$	50	–	
		$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$	75	–	
		$I_C = 150 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$	100	300	
		$I_C = 150 \text{ mA}; V_{CE} = 1 \text{ V}; \text{note 1}$	50	–	
$h_{FE}$	DC current gain	$I_C = 500 \text{ mA}; V_{CE} = 10 \text{ V}; \text{note 1}$			
	BSR13		30	–	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 150 \text{ mA}; I_B = 15 \text{ mA}$			
	BSR13		–	400	mV
	BSR14	–	300	mV	
	collector-emitter saturation voltage	$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}$			
BSR13	–		1.6	V	
BSR14	–	1	V		
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 150 \text{ mA}; I_B = 15 \text{ mA}$			
	BSR13		–	1.3	V
	BSR14	0.6	1.2	V	
	base-emitter saturation voltage	$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}$			
BSR13	–		2.6	V	
BSR14	–	2	V		
$C_c$	collector capacitance	$I_E = I_e = 0; V_{CB} = 10 \text{ V}; f = 1 \text{ MHz}$	–	8	pF
$f_T$	transition frequency	$I_C = 20 \text{ mA}; V_{CE} = 20 \text{ V}; f = 100 \text{ MHz}$			
	BSR13		250	–	MHz
BSR14	300	–	MHz		
<b>Switching times (between 10% and 90% levels); see Fig.2</b>					
$t_{on}$	turn-on time	$I_{Con} = 150 \text{ mA}; I_{Bon} = 15 \text{ mA}; I_{Boff} = -15 \text{ mA}$	–	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



$V_i = 9.5 \text{ V}$ ;  $T = 500 \text{ } \mu\text{s}$ ;  $t_p = 10 \text{ } \mu\text{s}$ ;  $t_r = t_f \leq 3 \text{ ns}$ .  
 $R_1 = 68 \text{ } \Omega$ ;  $R_2 = 325 \text{ } \Omega$ ;  $R_B = 325 \text{ } \Omega$ ;  $R_C = 160 \text{ } \Omega$ .  
 $V_{BB} = -3.5 \text{ V}$ ;  $V_{CC} = 29.5 \text{ V}$ .  
 Oscilloscope: input impedance  $Z_i = \geq 100 \text{ } \Omega$ .

Fig.2 Test circuit for switching times.

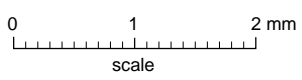
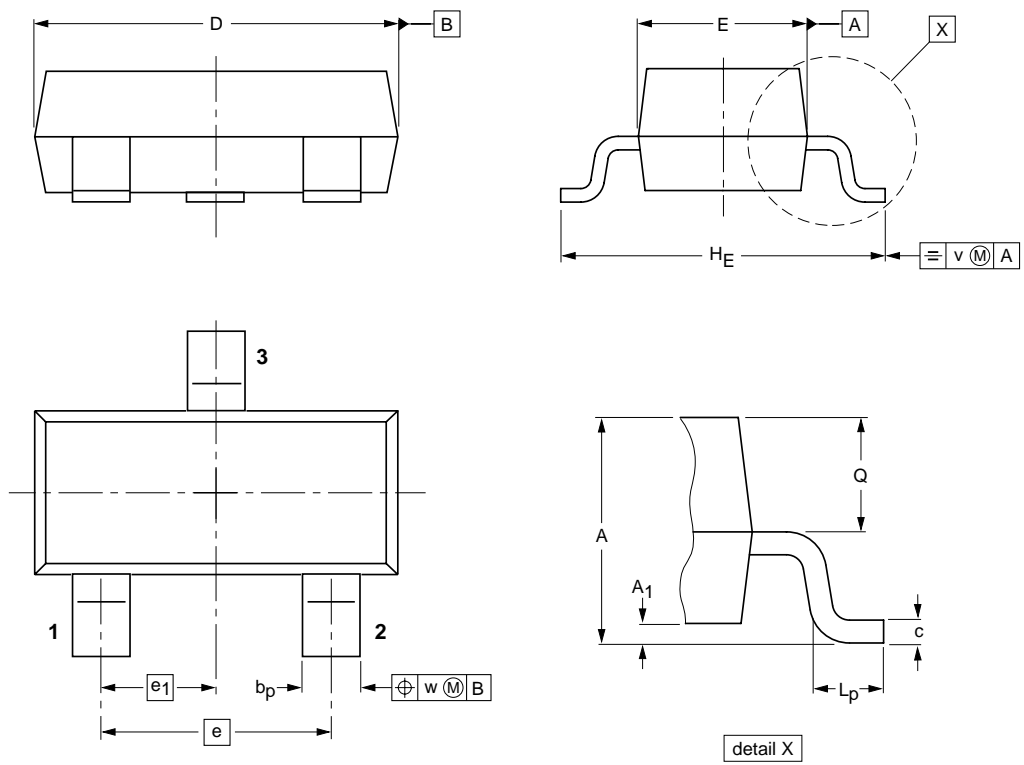
NPN switching transistors

BSR13; BSR14

PACKAGE OUTLINE

Plastic surface-mounted package; 3 leads

SOT23



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> 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 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				04-11-04 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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## **Customer notification**

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## **Contact information**

For additional information please visit: <http://www.nxp.com>

For sales offices addresses send e-mail to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331