



# BFR520

## NPN 9 GHz wideband transistor

Rev. 4 — 13 September 2011

Product data sheet

## 1. Product profile

### 1.1 General description

The BFR520 is an NPN silicon planar epitaxial transistor in a SOT23 plastic package.

### 1.2 Features and benefits

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

### 1.3 Applications

- RF front end wideband applications in the GHz range
  - ◆ Analog and digital cellular telephones
  - ◆ Cordless telephones (CT1, CT2, DECT, etc.)
  - ◆ Radar detectors
  - ◆ Pagers and satellite TV tuners (SATV)
  - ◆ Repeater amplifiers in fiber-optic systems.

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CBO}$	collector-base voltage		-	-	20	V
$V_{CES}$	collector-emitter voltage	$R_{BE} = 0 \Omega$	-	-	15	V
$I_C$	collector current (DC)		-	-	70	mA
$P_{tot}$	total power dissipation	up to $T_{sp} = 97^\circ\text{C}$	<a href="#">1</a> -	-	300	mW
$h_{FE}$	DC current gain	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}$	60	120	250	
$C_{re}$	feedback capacitance	$I_C = I_c = 0 \text{ A}; V_{CB} = 6 \text{ V}; f = 1 \text{ MHz}$	-	0.4	-	pF
$f_T$	transition frequency	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}; f = 1 \text{ GHz}$	-	9	-	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}; T_{amb} = 25^\circ\text{C}$				
		$f = 900 \text{ MHz}$	-	15	-	dB
		$f = 2 \text{ GHz}$	-	9	-	dB



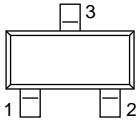
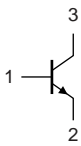
**Table 1. Quick reference data ...continued**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$ s_{21} ^2$	insertion power gain	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V};$ $T_{amb} = 25 \text{ }^\circ\text{C};$ $f = 900 \text{ MHz}$	13	14	-	dB
NF	noise figure	$\Gamma_s = \Gamma_{opt}; T_{amb} = 25 \text{ }^\circ\text{C}$				
		$I_C = 5 \text{ mA}; V_{CE} = 6 \text{ V};$ $f = 900 \text{ MHz}$	-	1.1	1.6	dB
		$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V};$ $f = 900 \text{ MHz}$	-	1.6	2.1	dB
		$I_C = 5 \text{ mA}; V_{CE} = 8 \text{ V};$ $f = 2 \text{ GHz}$	-	1.9	-	dB

[1]  $T_{sp}$  is the temperature at the soldering point of the collector tab.

## 2. Pinning information

**Table 2. Pinning**

Pin	Description	Simplified outline	Symbol
1	base		
2	emitter		
3	collector		

*sym021*

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
BFR520	-	plastic surface mounted package; 3 leads	SOT23

## 4. Marking

**Table 4. Marking**

Type number	Marking code <sup>[1]</sup>
BFR520	32*

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

## 5. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CBO}$	collector-base voltage	open emitter	-	20	V
$V_{CES}$	collector-emitter voltage	$R_{BE} = 0 \Omega$	-	15	V
$V_{EBO}$	emitter-base voltage	open collector	-	2.5	V
$I_C$	collector current (DC)		-	70	mA
$P_{tot}$	total power dissipation	up to $T_{sp} = 97 \text{ }^\circ\text{C}$ [1]	-	300	mW
$T_{stg}$	storage temperature		-65	150	$^\circ\text{C}$
$T_j$	junction temperature		-	175	$^\circ\text{C}$

[1]  $T_{sp}$  is the temperature at the soldering point of the collector tab.

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-s)}$	thermal resistance from junction to soldering point		[1] 260	K/W

[1]  $T_{sp}$  is the temperature at the soldering point of the collector tab.

## 7. Characteristics

**Table 7. Characteristics**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CBO}$	collector cut-off current	$I_E = 0 \text{ A}; V_{CB} = 6 \text{ V}$	-	-	50	nA
$h_{FE}$	DC current gain	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}$	60	120	250	
$C_e$	emitter capacitance	$I_C = i_c = 0 \text{ A}; V_{EB} = 0.5 \text{ V};$ $f = 1 \text{ MHz}$	-	1	-	pF
$C_c$	collector capacitance	$I_E = i_e = 0 \text{ A}; V_{CB} = 6 \text{ V};$ $f = 1 \text{ MHz}$	-	0.5	-	pF
$C_{re}$	feedback capacitance	$I_C = 0 \text{ A}; V_{CB} = 6 \text{ V};$ $f = 1 \text{ MHz}$	-	0.4	-	pF
$f_T$	transition frequency	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V};$ $f = 1 \text{ GHz}$	-	9	-	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V};$ $T_{amb} = 25 \text{ }^\circ\text{C}$	[1]			
		$f = 900 \text{ MHz}$	-	15	-	dB
		$f = 2 \text{ GHz}$	-	9	-	dB
$ s_{21} ^2$	insertion power gain	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V};$ $T_{amb} = 25 \text{ }^\circ\text{C}; f = 900 \text{ MHz}$	13	14	-	dB

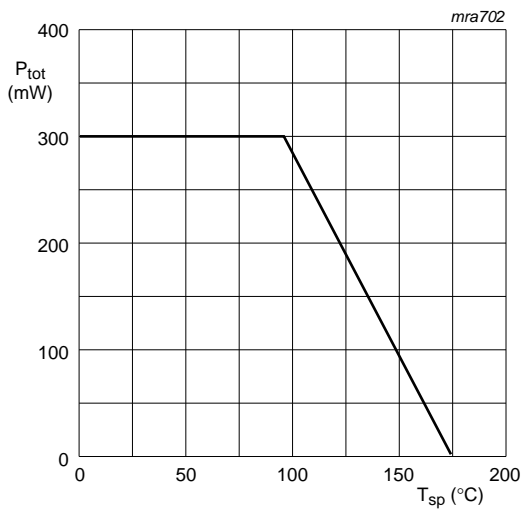
**Table 7. Characteristics ...continued**  
*T<sub>j</sub> = 25 °C unless otherwise specified.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
NF	noise figure	$\Gamma_s = \Gamma_{opt}; V_{CE} = 6 \text{ V};$ $T_{amb} = 25 \text{ °C}$				
		$I_C = 5 \text{ mA}; f = 900 \text{ MHz}$	-	1.1	1.6	dB
		$I_C = 20 \text{ mA}; f = 900 \text{ MHz}$	-	1.6	2.1	dB
		$I_C = 5 \text{ mA}; f = 2 \text{ GHz}$	-	1.9	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V};$ $R_L = 50 \text{ } \Omega; T_{amb} = 25 \text{ °C};$ $f = 900 \text{ MHz}$	-	17	-	dBm
I/O	third order intercept point		[2] -	26	-	dBm

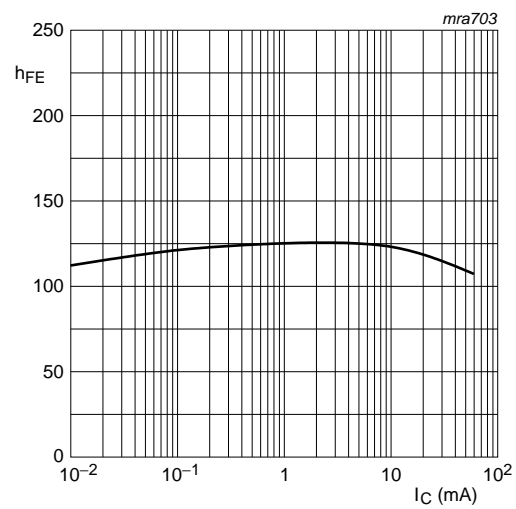
[1]  $G_{UM}$  is the maximum unilateral power gain, assuming  $s_{12}$  is zero and

$$G_{UM} = 10 \log \frac{|s_{21}|^2}{(1 - |s_{11}|^2)(1 - |s_{22}|^2)} \text{ dB.}$$

[2]  $I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}; R_L = 50 \text{ } \Omega; T_{amb} = 25 \text{ °C}; f_p = 900 \text{ MHz}; f_q = 902 \text{ MHz}$   
 Measured at  $f_{(2p-q)} = 898 \text{ MHz}$  and  $f_{(2q-p)} = 904 \text{ MHz}$ .

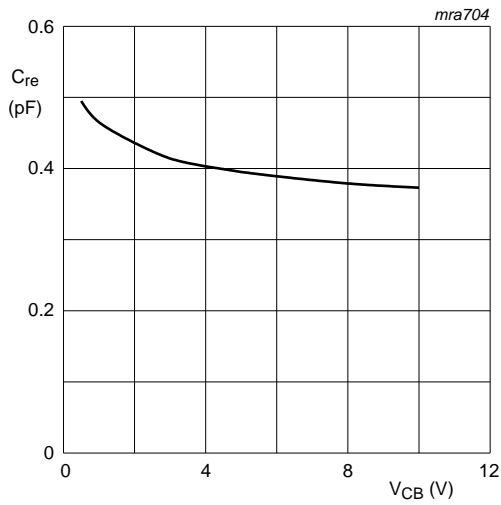


**Fig 1. Power derating curve.**



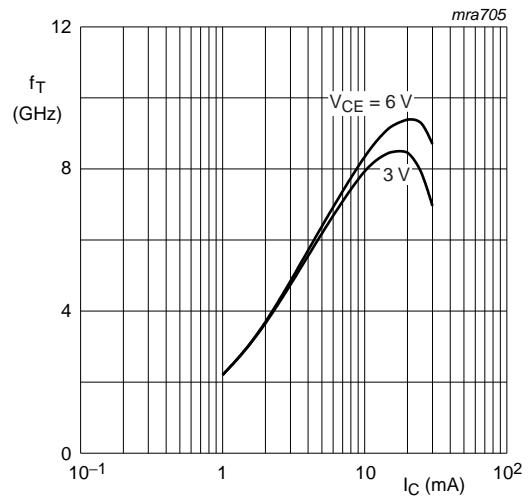
$V_{CE} = 6 \text{ V.}$

**Fig 2. DC current gain as a function of collector current.**



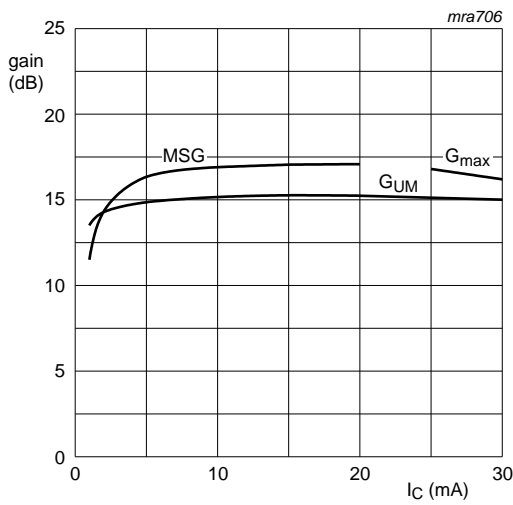
$I_C = 0 \text{ A}; f = 1 \text{ MHz}.$

**Fig 3. Feedback capacitance as a function of collector-base voltage.**



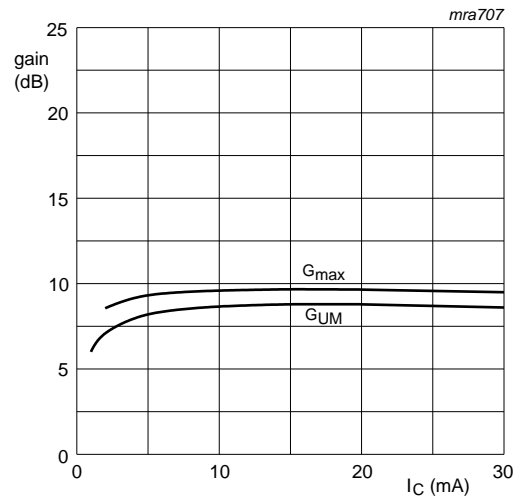
$T_{amb} = 25 \text{ }^\circ\text{C}; f = 1 \text{ GHz}.$

**Fig 4. Transition frequency as a function of collector current.**



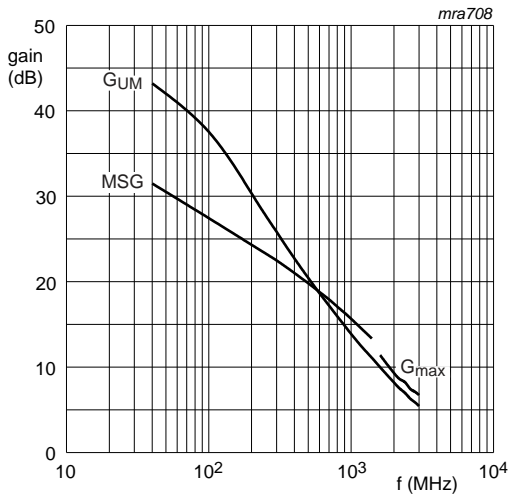
$V_{CE} = 6 \text{ V}; f = 900 \text{ MHz}.$

**Fig 5. Gain as a function of collector current;  $f = 900 \text{ MHz}.$**



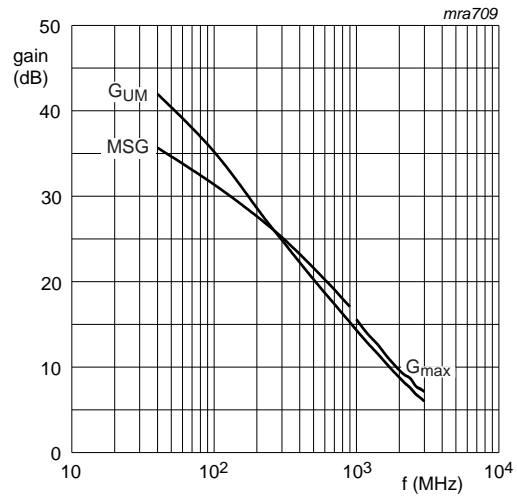
$V_{CE} = 6 \text{ V}; f = 2 \text{ GHz}.$

**Fig 6. Gain as a function of collector current;  $f = 2 \text{ GHz}.$**



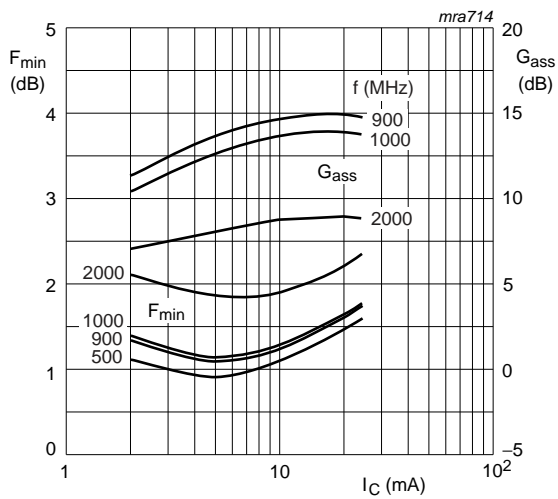
$V_{CE} = 6\text{ V}$ ;  $I_C = 5\text{ mA}$ .

**Fig 7. Gain as a function of frequency;  $I_C = 5\text{ mA}$ .**



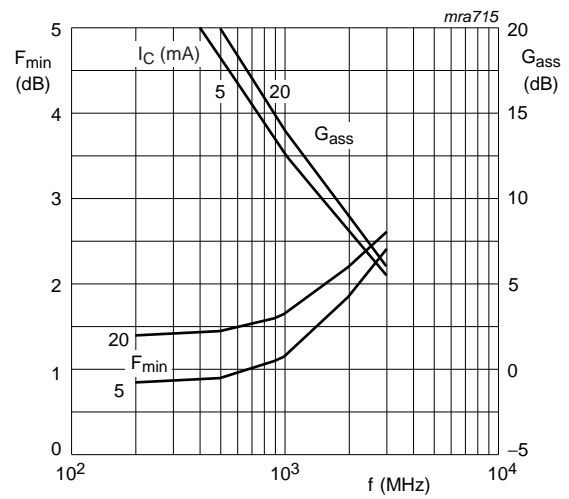
$V_{CE} = 6\text{ V}$ ;  $I_C = 20\text{ mA}$ .

**Fig 8. Gain as a function of frequency;  $I_C = 20\text{ mA}$ .**



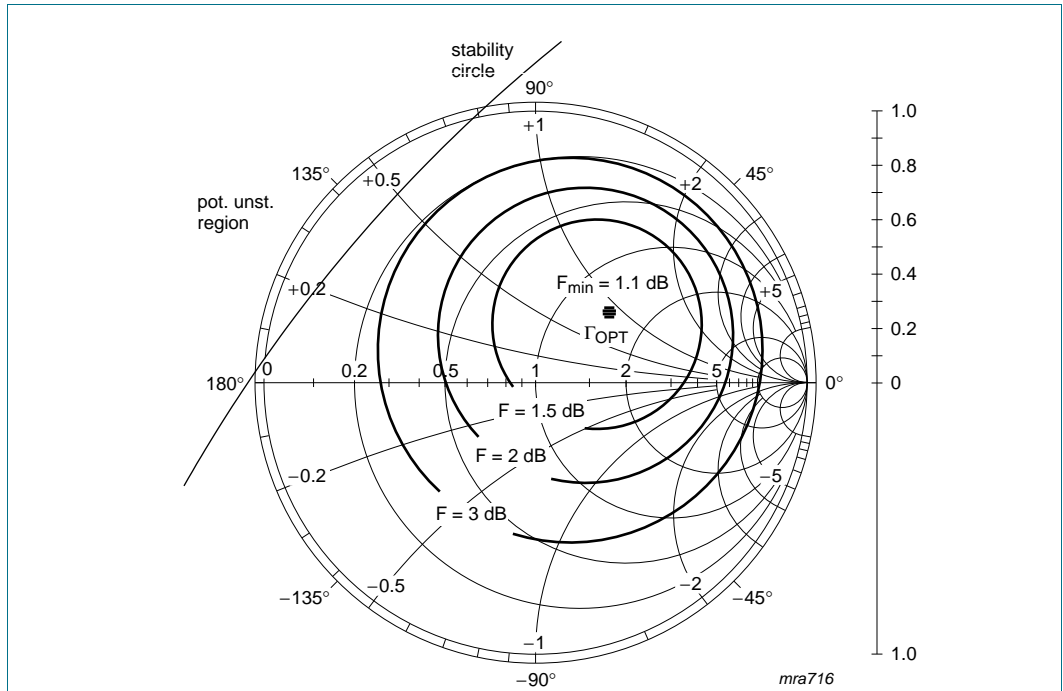
$V_{CE} = 6\text{ V}$ .

**Fig 9. Minimum noise figure and associated available gain as functions of collector current.**



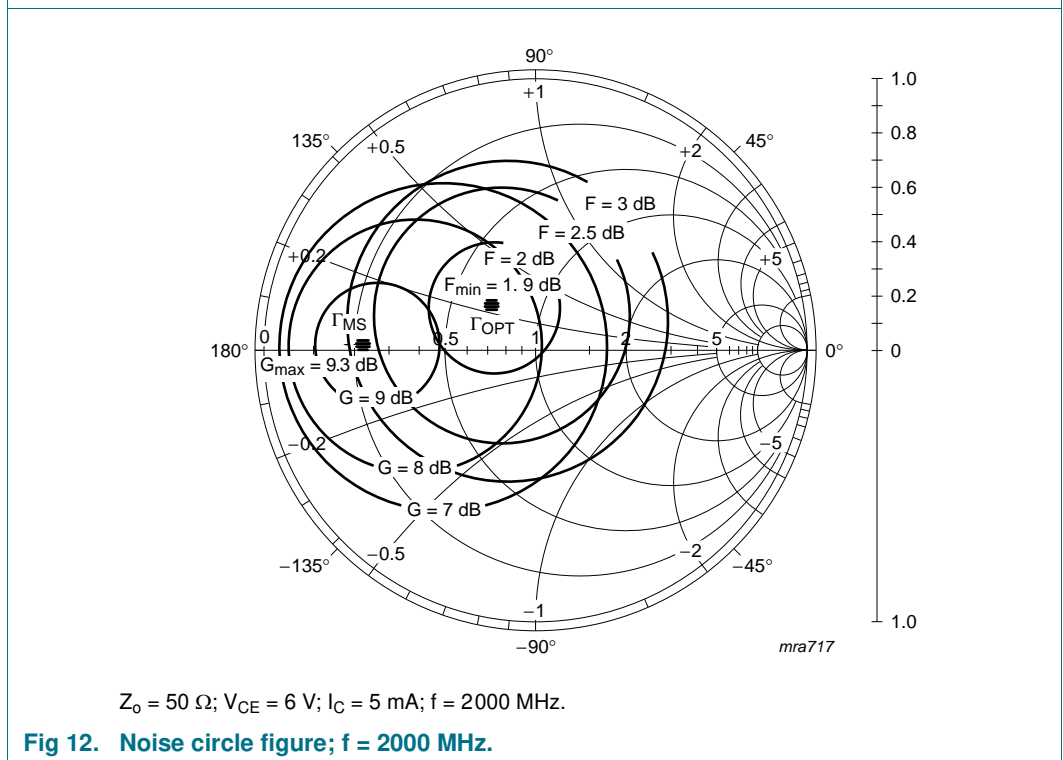
$V_{CE} = 6\text{ V}$ .

**Fig 10. Minimum noise figure and associated available gain as functions of frequency.**



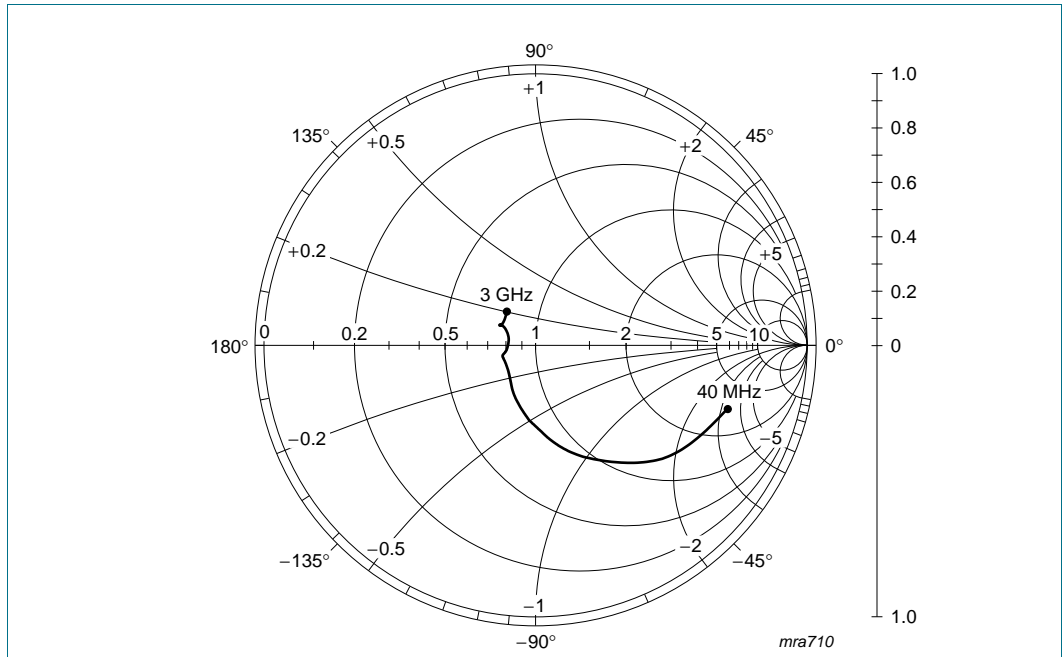
$Z_0 = 50 \Omega$ ;  $V_{CE} = 6 \text{ V}$ ;  $I_C = 5 \text{ mA}$ ;  $f = 900 \text{ MHz}$ .

**Fig 11. Noise circle figure;  $f = 900 \text{ MHz}$ .**



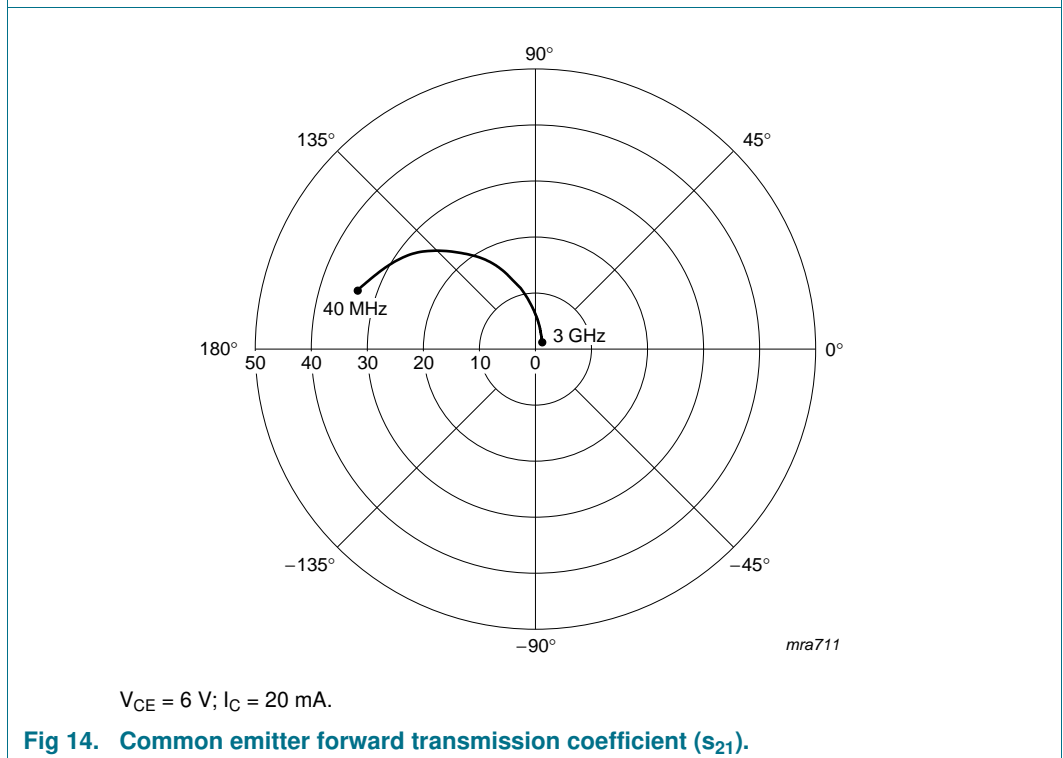
$Z_0 = 50 \Omega$ ;  $V_{CE} = 6 \text{ V}$ ;  $I_C = 5 \text{ mA}$ ;  $f = 2000 \text{ MHz}$ .

**Fig 12. Noise circle figure;  $f = 2000 \text{ MHz}$ .**



$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}; Z_0 = 50\ \Omega.$

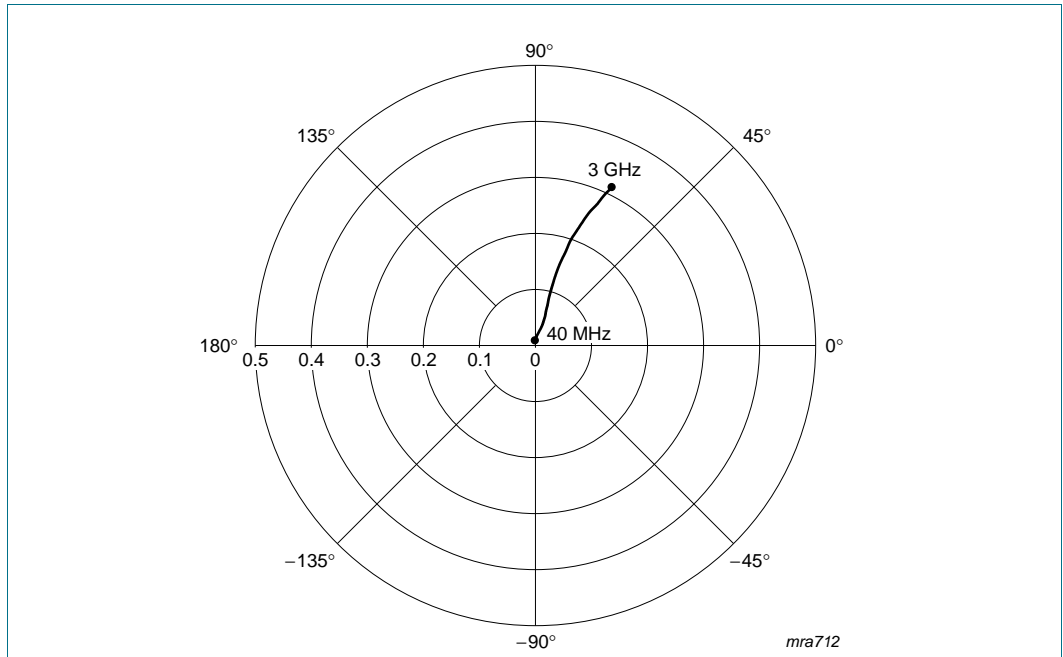
**Fig 13. Common emitter input reflection coefficient ( $s_{11}$ ).**



$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}.$

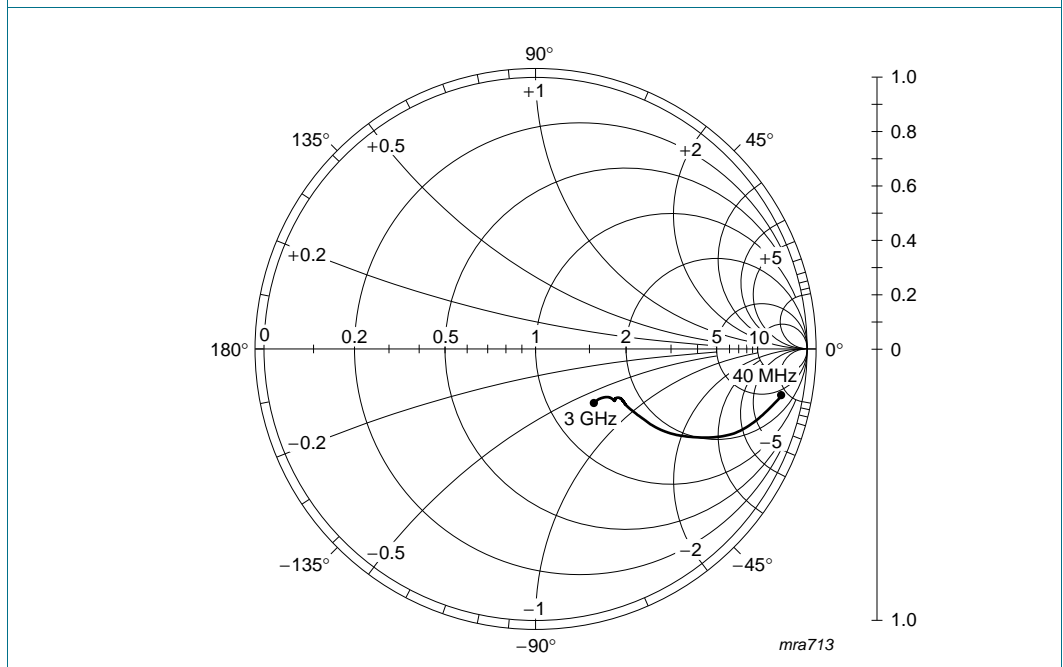
**Fig 14. Common emitter forward transmission coefficient ( $s_{21}$ ).**





$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}.$

**Fig 15. Common emitter reverse transmission coefficient ( $s_{12}$ ).**



$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}; Z_o = 50\ \Omega.$

**Fig 16. Common emitter output reflection coefficient ( $s_{22}$ ).**

**8. Package outline**

Plastic surface-mounted package; 3 leads

SOT23

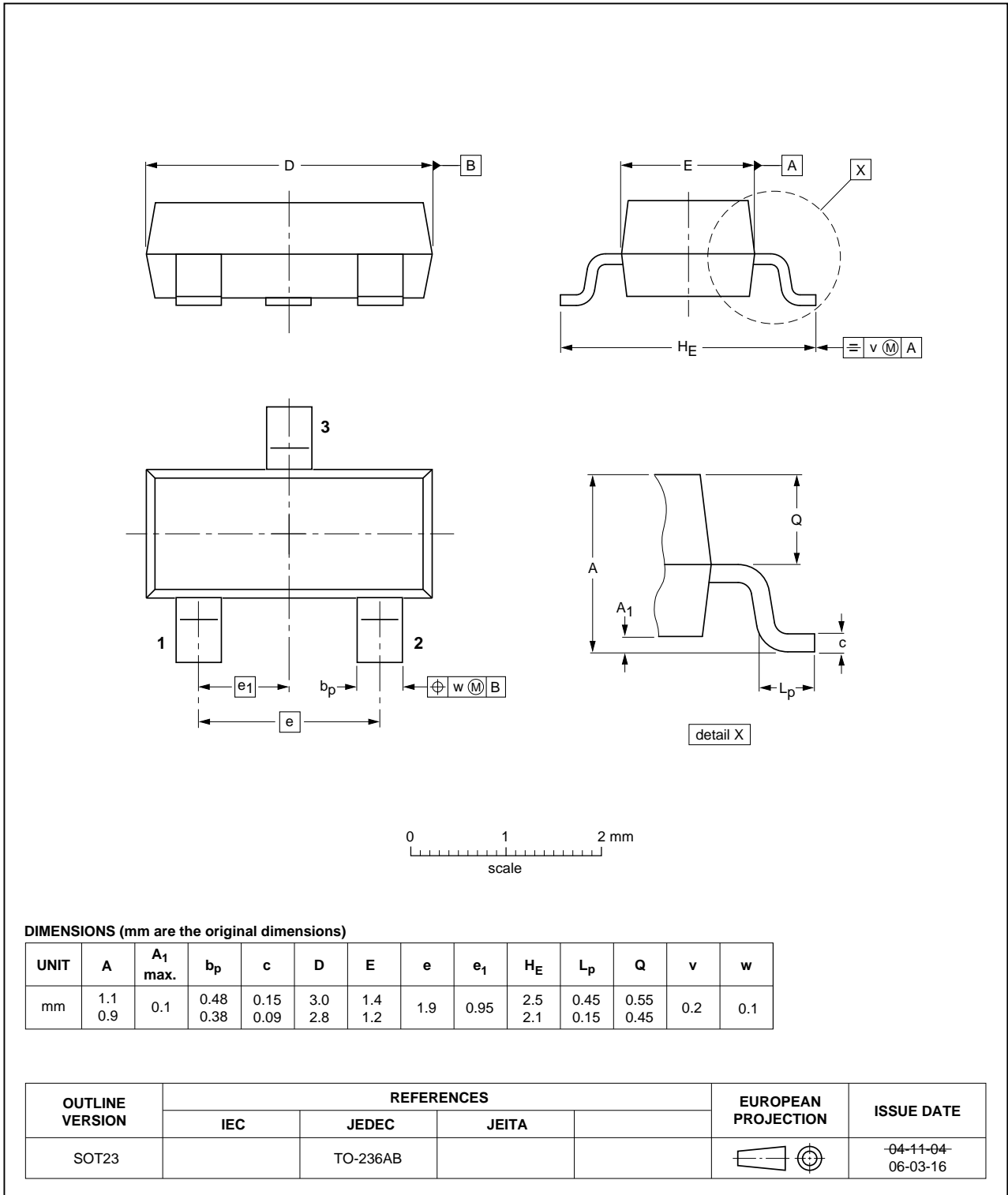


Fig 17. Package outline SOT23 (TO-236AB).

## 9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFR520 v.4	20110913	Product data sheet	-	BFR520 v.3
Modifications:		<ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li>Package outline drawings have been updated to the latest version.</li></ul>		
BFR520 v.3 (9397 750 13397)	20040901	Product data sheet	-	BFR520_CNV v.2
BFR520_CNV v.2	19971204	Product specification	-	-

## 10. Legal information

### 10.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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