



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 $T_{sp} = 97^\circ\text{C}$	1 -	-	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



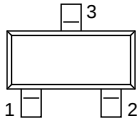
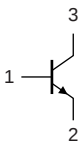
Table 1. Quick reference data ...continued

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 ^[1]
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 $T_{sp} = 97^\circ\text{C}$ [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

$T_j = 25^\circ\text{C}$ 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	$I_C = 20 \text{ mA}$; $V_{CE} = 6 \text{ V}$; $T_{amb} = 25^\circ\text{C}$ [1]				
		$f = 900 \text{ MHz}$	-	15	-	dB
		$f = 2 \text{ GHz}$	-	9	-	dB
$ s_{21} ^2$	insertion power gain	$I_C = 20 \text{ mA}$; $V_{CE} = 6 \text{ V}$; $T_{amb} = 25^\circ\text{C}$; $f = 900 \text{ MHz}$	13	14	-	dB

Table 7. Characteristics ...continued
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
NF	noise figure	$\Gamma_s = \Gamma_{opt}$; V _{CE} = 6 V; T _{amb} = 25 °C				
		I _C = 5 mA; f = 900 MHz	-	1.1	1.6	dB
		I _C = 20 mA; f = 900 MHz	-	1.6	2.1	dB
		I _C = 5 mA; f = 2 GHz	-	1.9	-	dB
P _{L(1dB)}	output power at 1 dB gain compression	I _C = 20 mA; V _{CE} = 6 V; R _L = 50 Ω; T _{amb} = 25 °C; f = 900 MHz	-	17	-	dBm
ITO	third order intercept point		[2] -	26	-	dBm

[1] G_{UM} is the maximum unilateral power gain, assuming s₁₂ 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 mA; V_{CE} = 6 V; R_L = 50 Ω; T_{amb} = 25 °C; f_p = 900 MHz; f_q = 902 MHz
Measured at f_(2p-q) = 898 MHz and f_(2q-p) = 904 MHz.

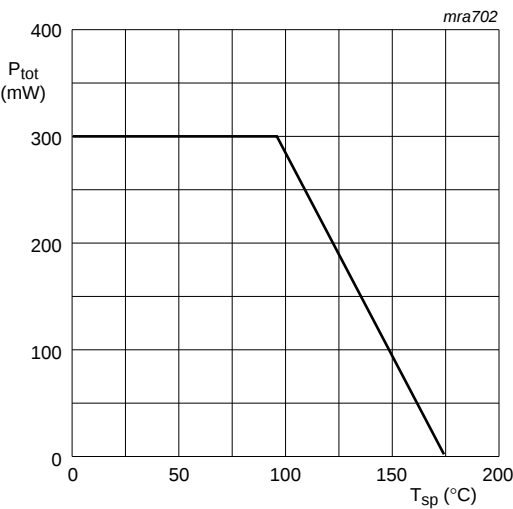
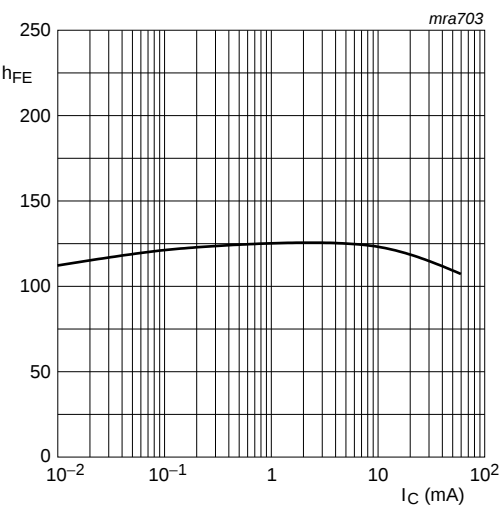
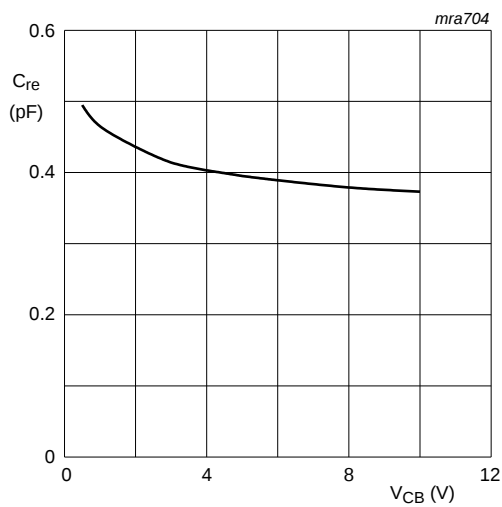


Fig 1. Power derating curve.



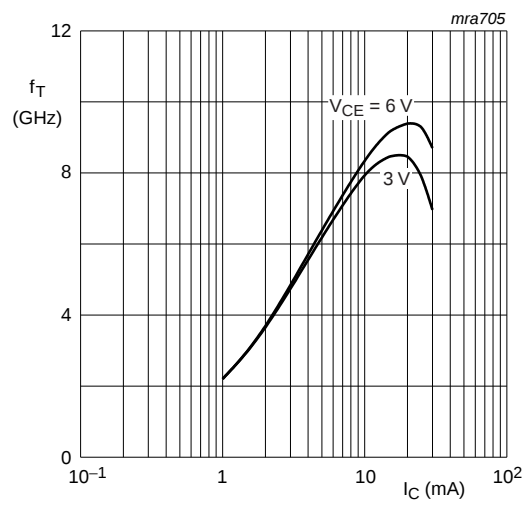
V_{CE} = 6 V.

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



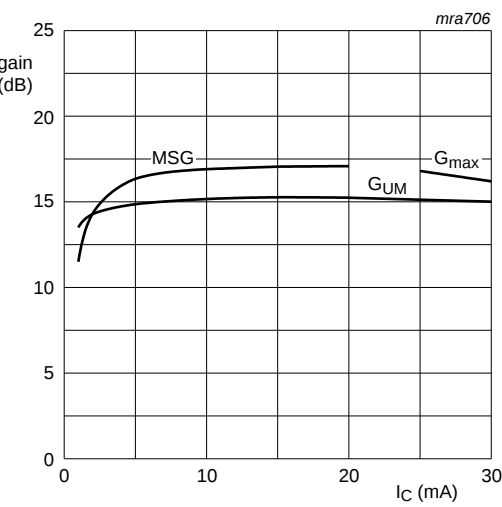
$I_C = 0$ A; $f = 1$ MHz.

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



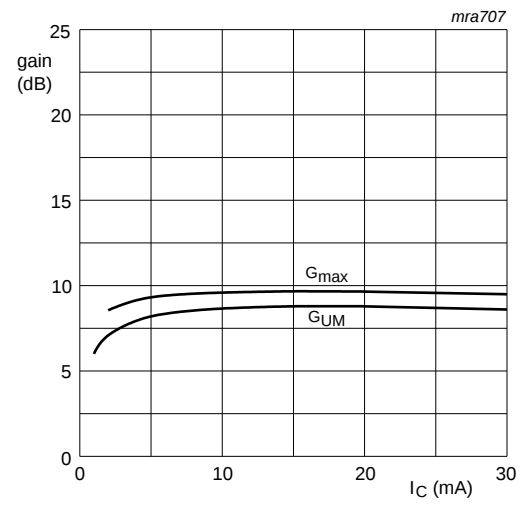
$T_{amb} = 25$ °C; $f = 1$ GHz.

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



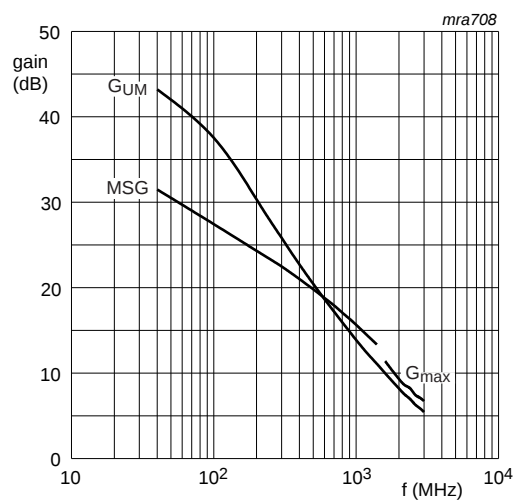
$V_{CE} = 6$ V; $f = 900$ MHz.

Fig 5. Gain as a function of collector current; $f = 900$ MHz.



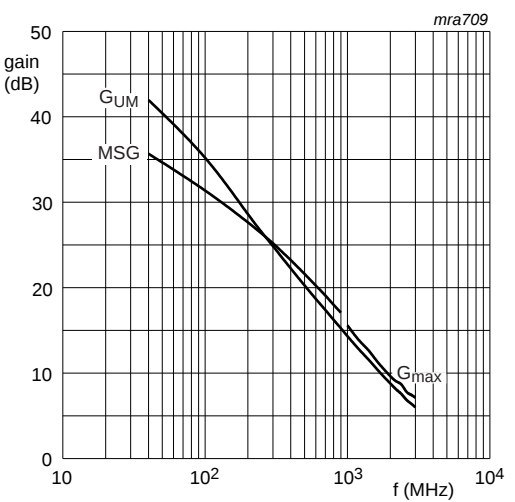
$V_{CE} = 6$ V; $f = 2$ GHz.

Fig 6. Gain as a function of collector current; $f = 2$ GHz.



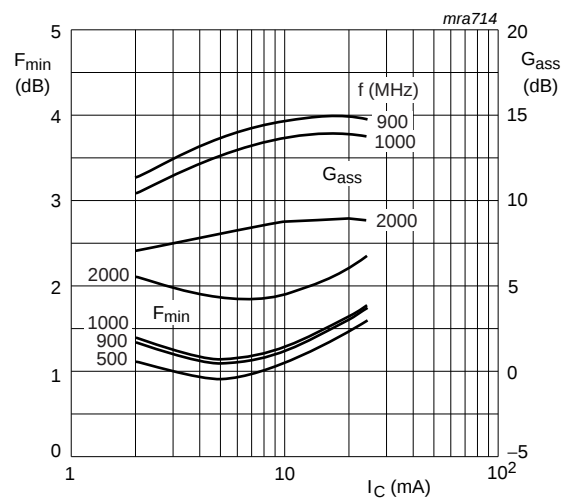
$V_{CE} = 6\text{ V}$; $I_C = 5\text{ mA}$.

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



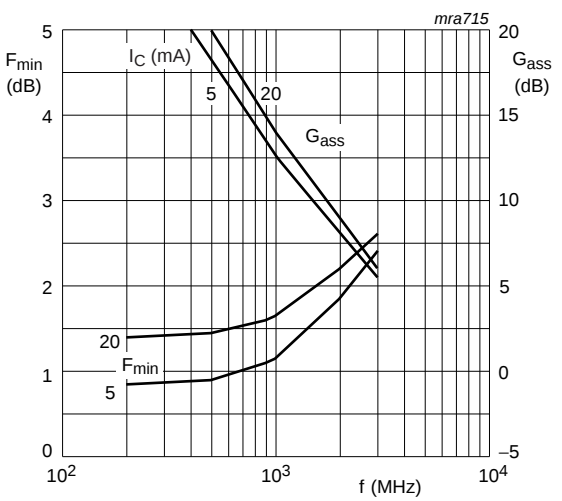
$V_{CE} = 6\text{ V}$; $I_C = 20\text{ mA}$.

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



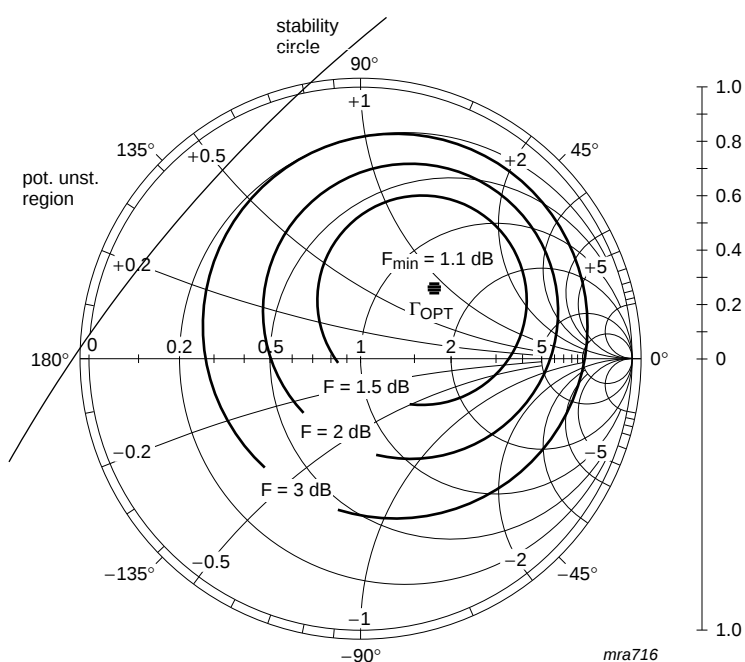
$V_{CE} = 6\text{ V}$.

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



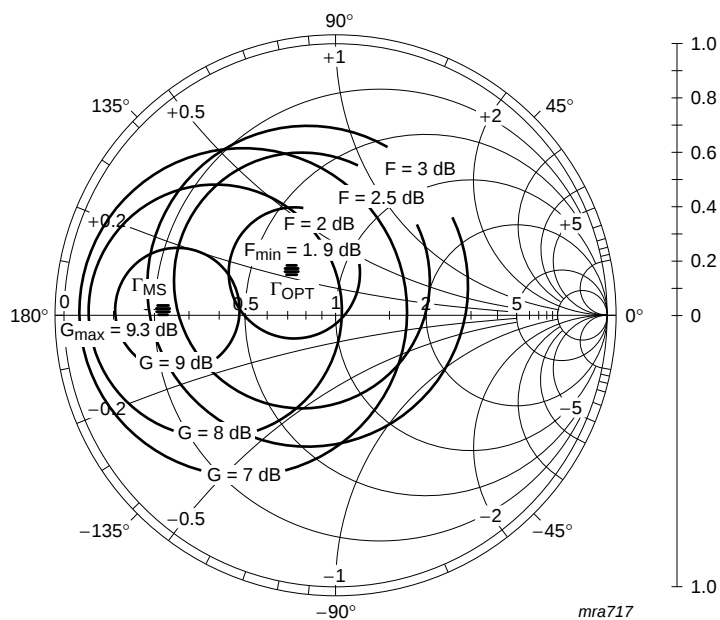
$V_{CE} = 6\text{ V}$.

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



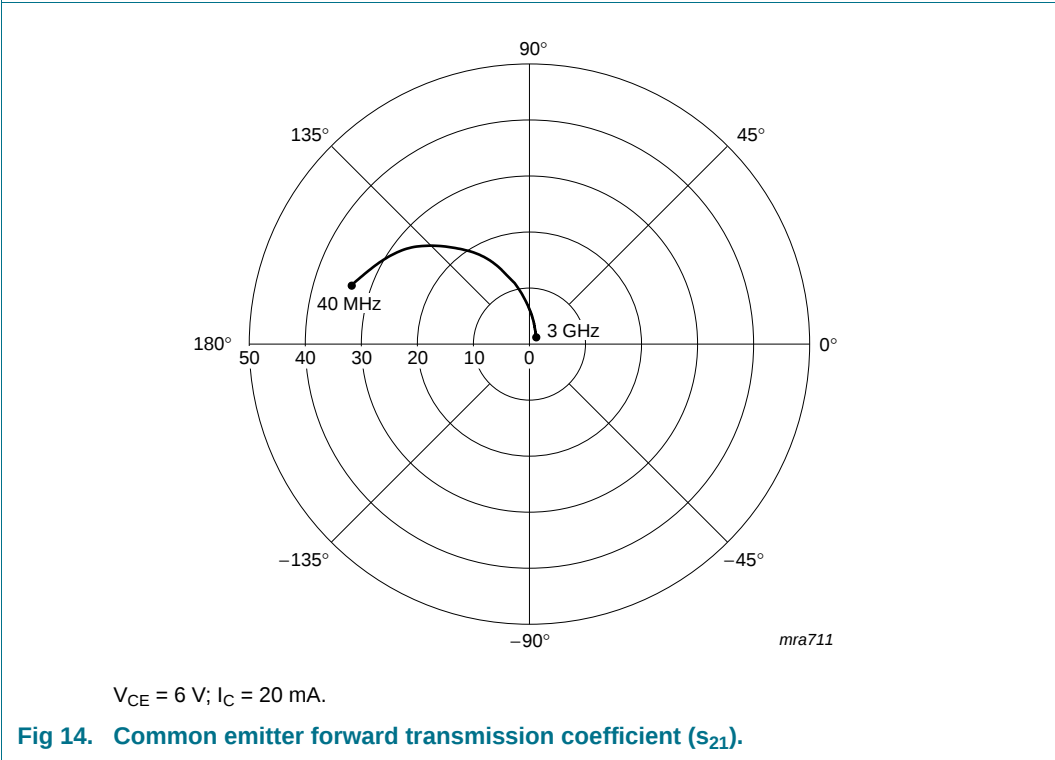
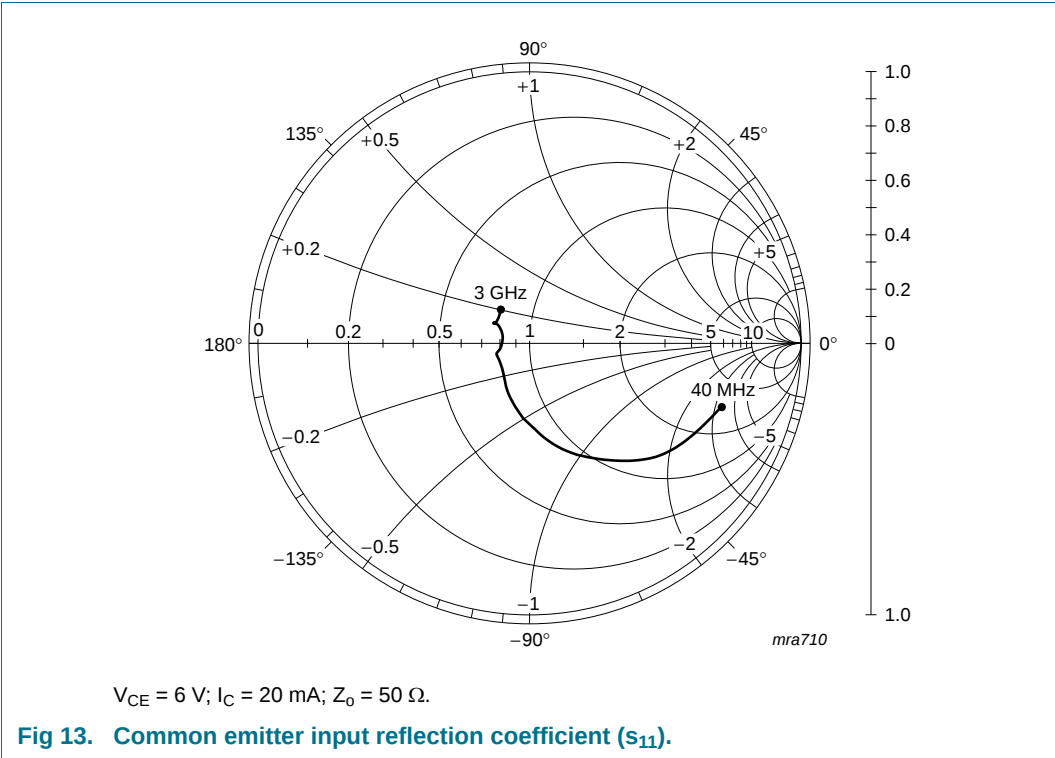
$Z_0 = 50 \Omega$; $V_{\text{CE}} = 6 \text{ V}$; $I_{\text{C}} = 5 \text{ mA}$; $f = 900 \text{ MHz}$.

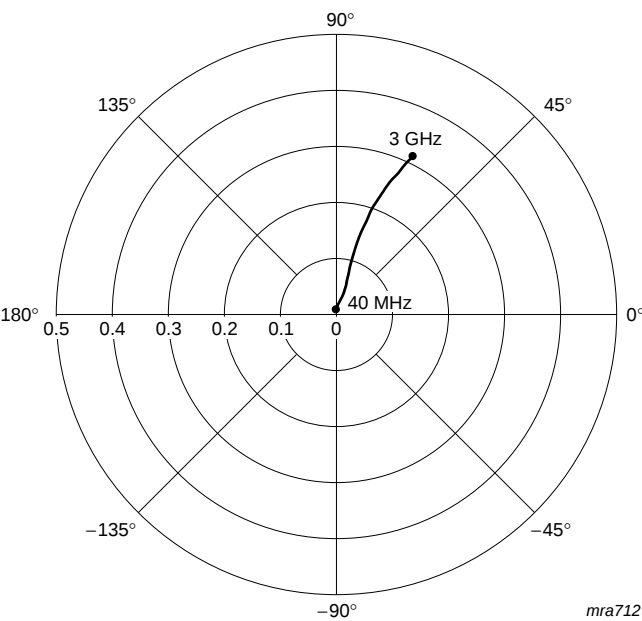
Fig 11. Noise circle figure; $f = 900 \text{ MHz}$.



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

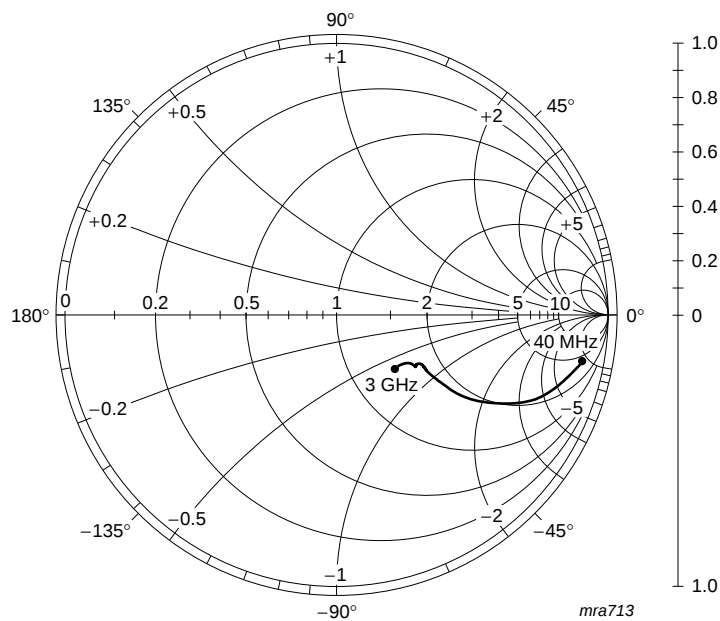
Fig 12. Noise circle figure; $f = 2000 \text{ MHz}$.





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

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 leadsSOT23

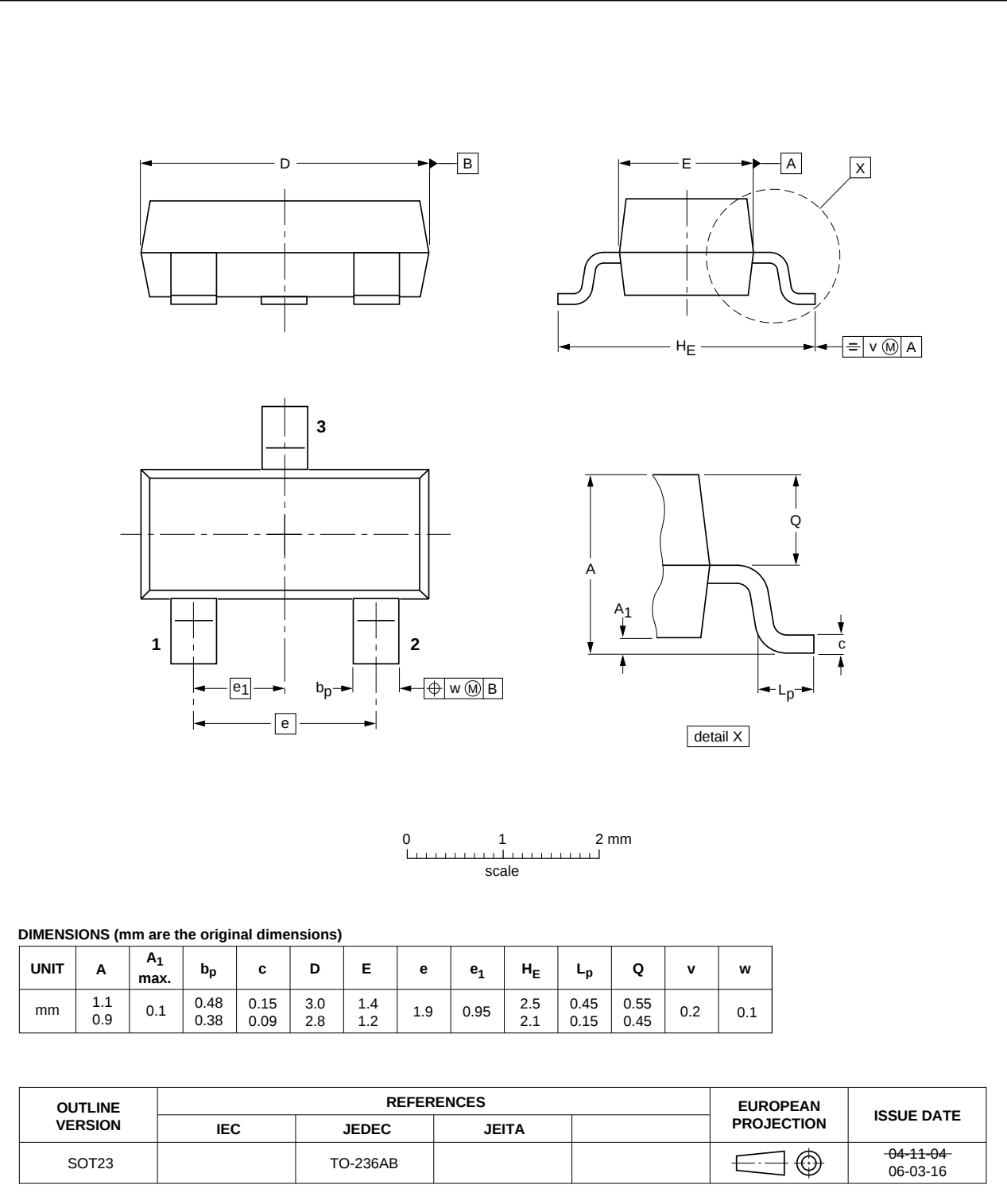


Fig 17. Package outline SOT23 (TO-236AB).

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:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Package outline drawings have been updated to the latest version.			
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 ^{[1][2]}	Product status ^[3]	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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12. Contents

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