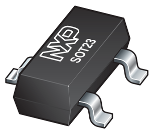


BFR505

NPN 9 GHz wideband transistor

Rev. 4 — 7 September 2011 **Product data sheet**

1. Product profile

1.1 General description

The BFR505 is an NPN silicon planar epitaxial transistor, intended for applications in the RF front end in wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, pagers and satellite TV tuners (SATV).

The transistor is encapsulated in a plastic SOT23 envelope.

1.2 Features and benefits

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

1.3 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CBO}	collector-base voltage	open emitter		-	-	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$		-	-	15	V
I_C	DC collector current			-	-	18	mA
P_{tot}	total power dissipation	up to $T_s = 135\ °C$	[1]	-	-	150	mW
h_{FE}	DC current gain	$I_C = 5$ mA; $V_{CE} = 6$ V		60	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$ A; $V_{CB} = 6$ V; f = 1 MHz		-	0.3	-	pF
f_T	transition frequency	$I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz		-	9	-	GHz
G_{UM}	maximum unilateral power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25\ °C$; f = 900 MHz		-	17	-	dB
		$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25\ °C$; f = 2 GHz		-	10	-	dB
$\|S_{21}\|^2$	insertion power gain	$I_C = 5$ mA; $V_{CE} = 6$ V; $T_{amb} = 25\ °C$; f = 900 MHz		13	14	-	dB

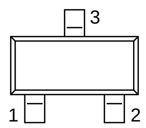
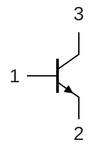
Table 1. Quick reference data *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	-	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	-	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 1.25 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	-	1.9	-	dB

[1] T_s is the temperature at the soldering point of the collector tab.

2. Pinning information

Table 2. Discrete pinning

Pin	Description	Simplified outline	Symbol
1	base		
2	emitter		
3	collector		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BFR505	-	plastic surface mounted package; 3 leads	SOT23

4. Marking

Table 4. Marking table

Type number	Marking code[1]
BFR505	31*

[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			-	2.5	V
I_C	DC collector current	continuous		-	18	mA
P_{tot}	total power dissipation	up to T_s = 135 °C	[1]	-	150	mW
T_{stg}	storage temperature			−65	+150	°C
T_j	junction temperature			-	175	°C

[1] T_s is the temperature at the soldering point of the collector tab.

6. Thermal characteristics

Table 6. Thermal characteristics

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

[1] T_s is the temperature at the soldering point of the collector tab.

7. Characteristics

Table 7. Characteristics

T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector cut-off current	I_E = 0 A; V_{CB} = 6 V		-	-	50	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V		60	120	250	
C_e	emitter capacitance	$I_C = i_c$ = 0 A; V_{EB} = 0.5 V; f = 1 MHz		-	0.4	-	pF
C_c	collector capacitance	$I_E = i_e$ = 0 A; V_{CB} = 6 V; f = 1 MHz		-	0.4	-	pF
C_{re}	feedback capacitance	$I_C = i_c$ = 0 A; V_{CB} = 6 V; f = 1 MHz		-	0.3	-	pF
f_T	transition frequency	I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz		-	9	-	GHz
G_{UM}	maximum unilateral power gain	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz	[1]	-	17	-	dB
		I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz		-	10	-	dB
$\lvert S_{21}\rvert^2$	insertion power gain	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz		13	14	-	dB

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz		-	1.2	1.7	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz		-	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz		-	1.9	-	dB
P_{L1}	output power at 1 dB gain compression	I_C = 5 mA; V_{CE} = 6 V; R_L = 50 Ω; T_{amb} = 25 °C; f = 900 MHz		-	4	-	dBm
ITO	third order intercept point		[2]	-	10	-	dBm

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

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

[2] I_C = 5 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.

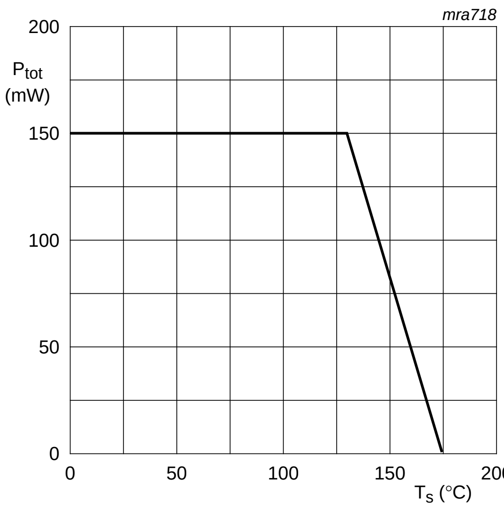
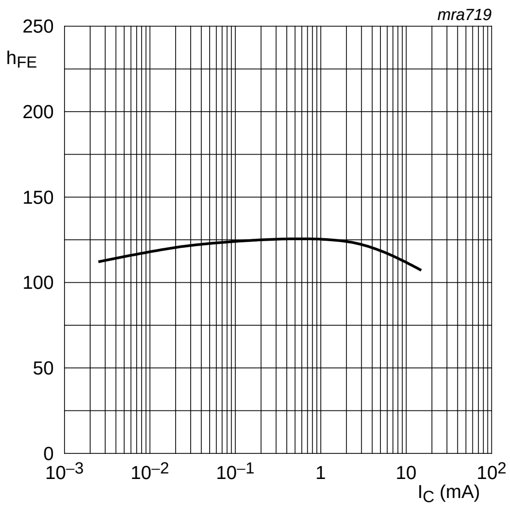
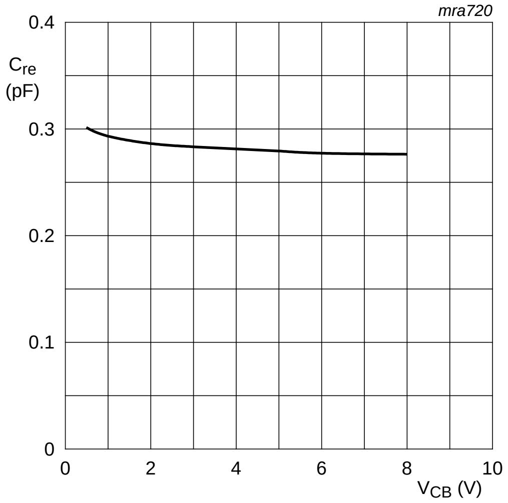


Fig 1. Power derating curve.



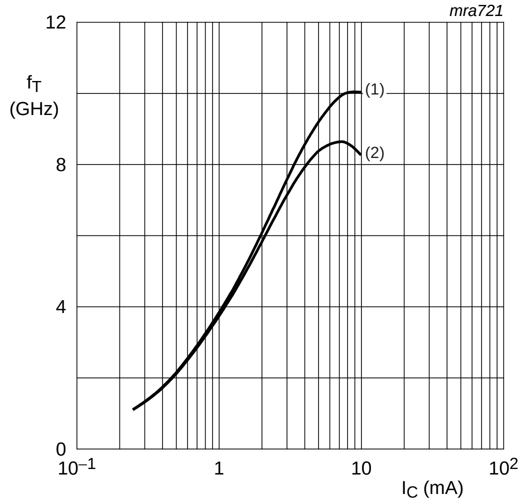
V_{CE} = 6 V.

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.

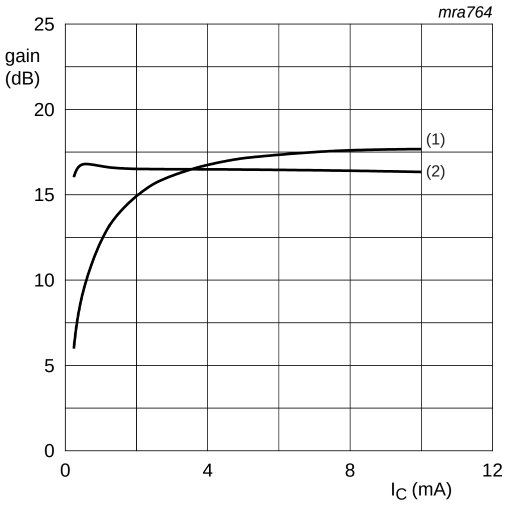


T_{amb} = 25 °C; f = 1 GHz.

(1) V_{CE} = 6 V.

(2) V_{CE} = 3 V.

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

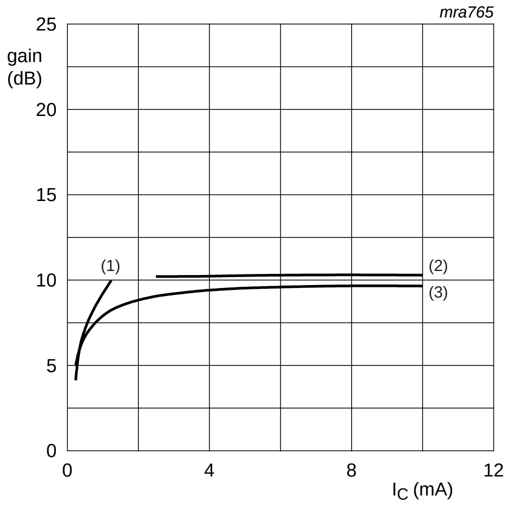


V_{CE} = 6 V; f = 900 MHz.

(1) MSG.

(2) G_{UM}.

Fig 5. Gain as a function of collector current.



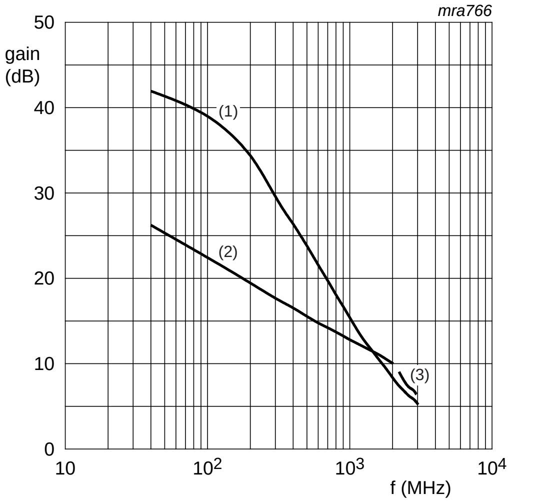
V_{CE} = 6 V; f = 2 GHz.

(1) MSG.

(2) G_{max}.

(3) G_{UM}.

Fig 6. Gain as a function of collector current.



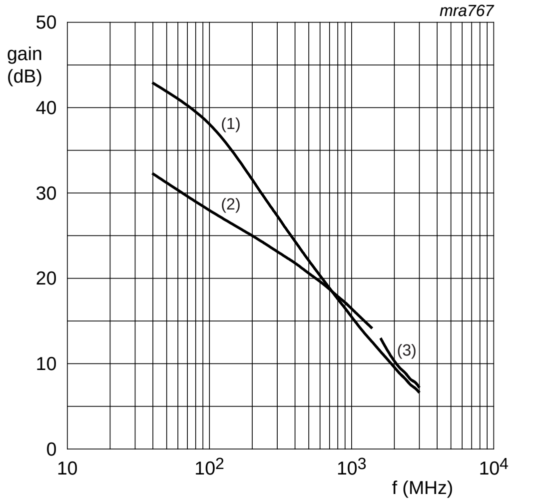
V_{CE} = 6 V; I_C = 1.25 mA.

(1) G_{UM}.

(2) MSG.

(3) G_{max}.

Fig 7. Gain as a function of frequency.



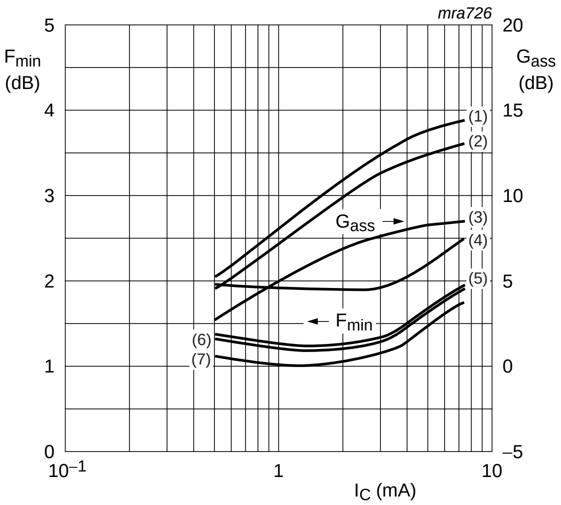
V_{CE} = 6 V; I_C = 5 mA.

(1) G_{UM}.

(2) MSG.

(3) G_{max}.

Fig 8. Gain as a function of frequency.



V_{CE} = 6 V.

(1) f = 900 MHz.

(2) f = 1000 MHz.

(3) f = 2000 MHz.

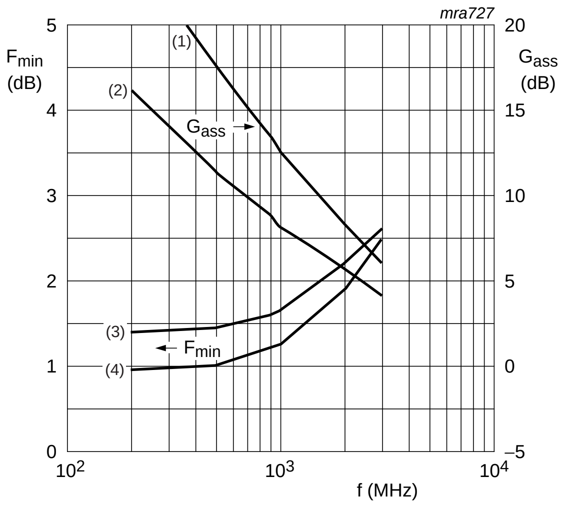
(4) f = 2000 MHz.

(5) f = 1000 MHz.

(6) f = 900 MHz.

(7) f = 500 MHz.

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



V_{CE} = 6 V.

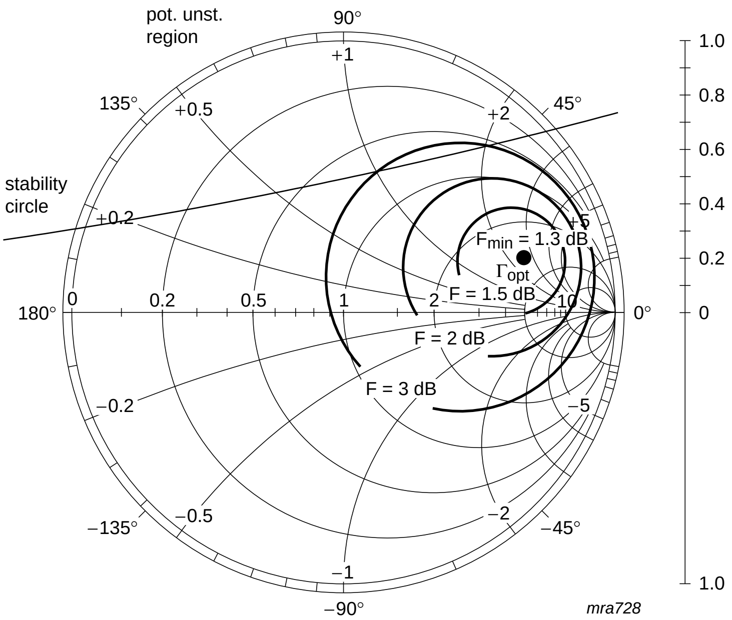
(1) I_C = 5 mA.

(2) I_C = 1.25 mA.

(3) I_C = 5 mA.

(4) I_C = 1.25 mA.

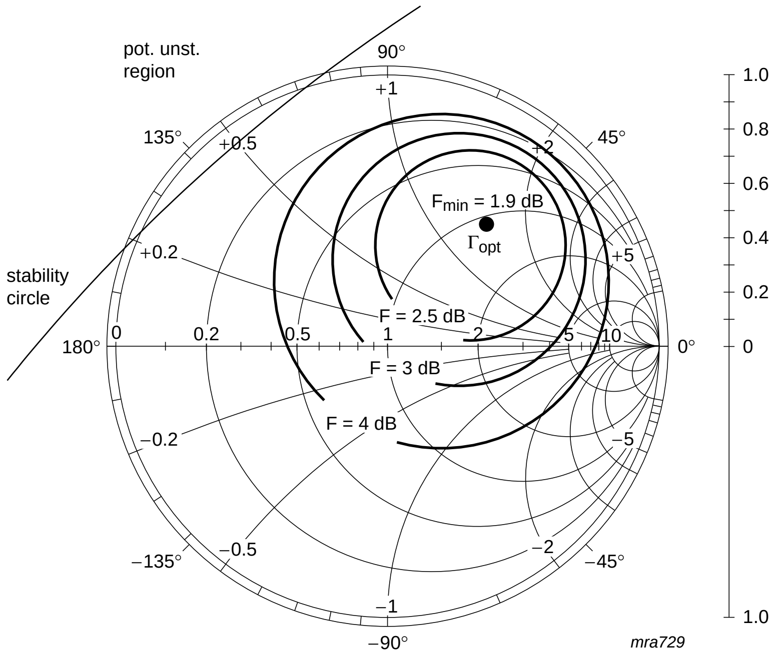
Fig 10. Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.

V_{CE} = 6 V; I_C = 5 mA; f = 900 MHz.

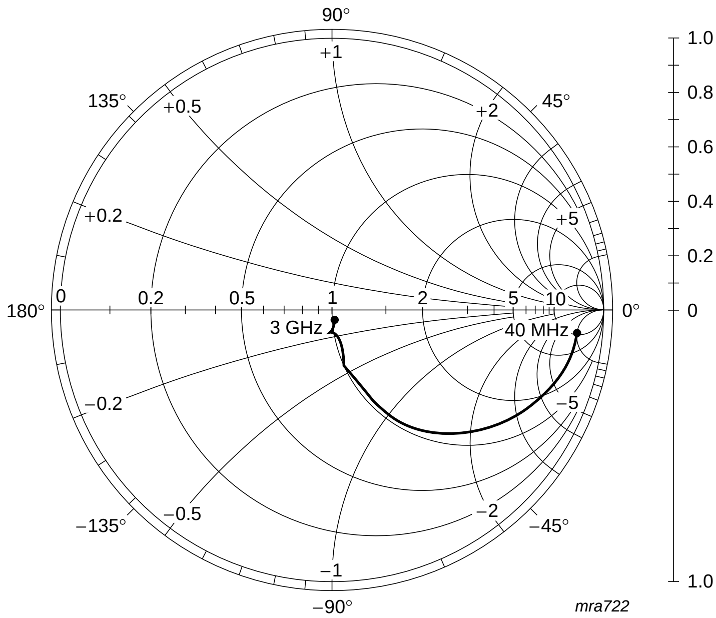
Fig 11. Noise circle figure.



Z_o = 50 Ω.

V_{CE} = 6 V; I_C = 5 mA; f = 2000 MHz.

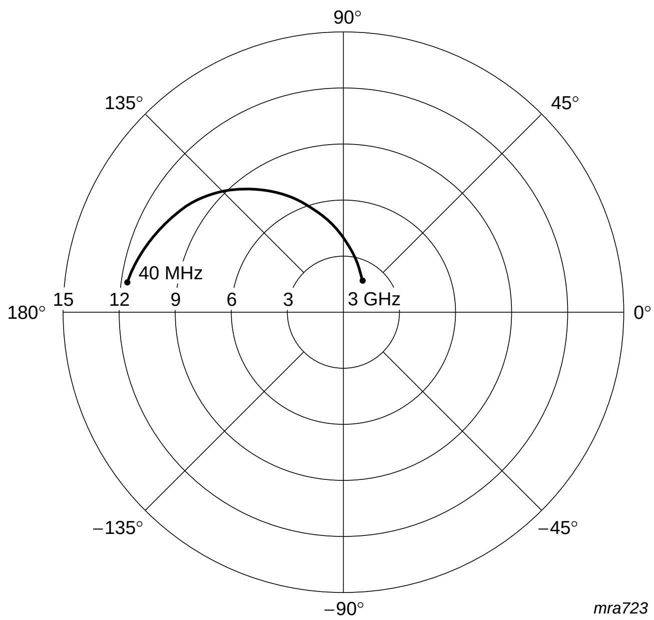
Fig 12. Noise circle figure.



Z_o = 50 Ω.

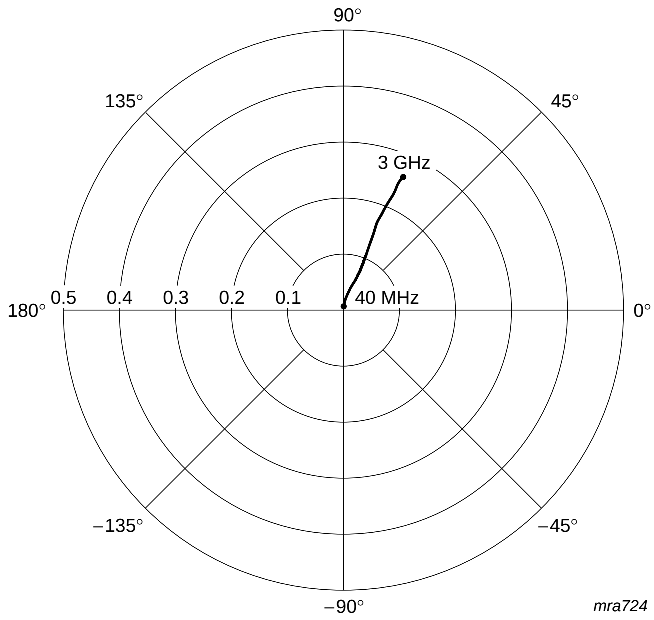
V_{CE} = 6 V; I_C = 5 mA.

Fig 13. Common emitter input reflection coefficient (S_{11}).



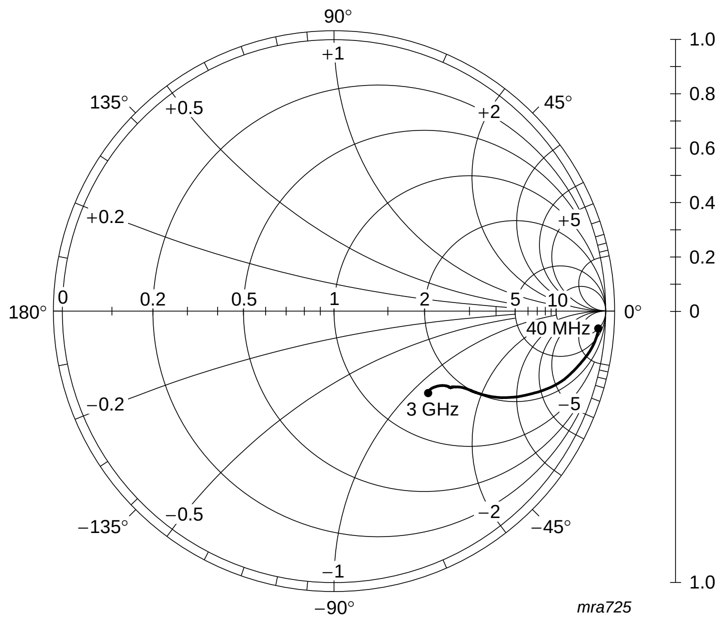
V_{CE} = 6 V; I_C = 5 mA.

Fig 14. Common emitter forward transmission coefficient (S_{21}).



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

Fig 15. Common emitter reverse transmission coefficient (S_{12}).



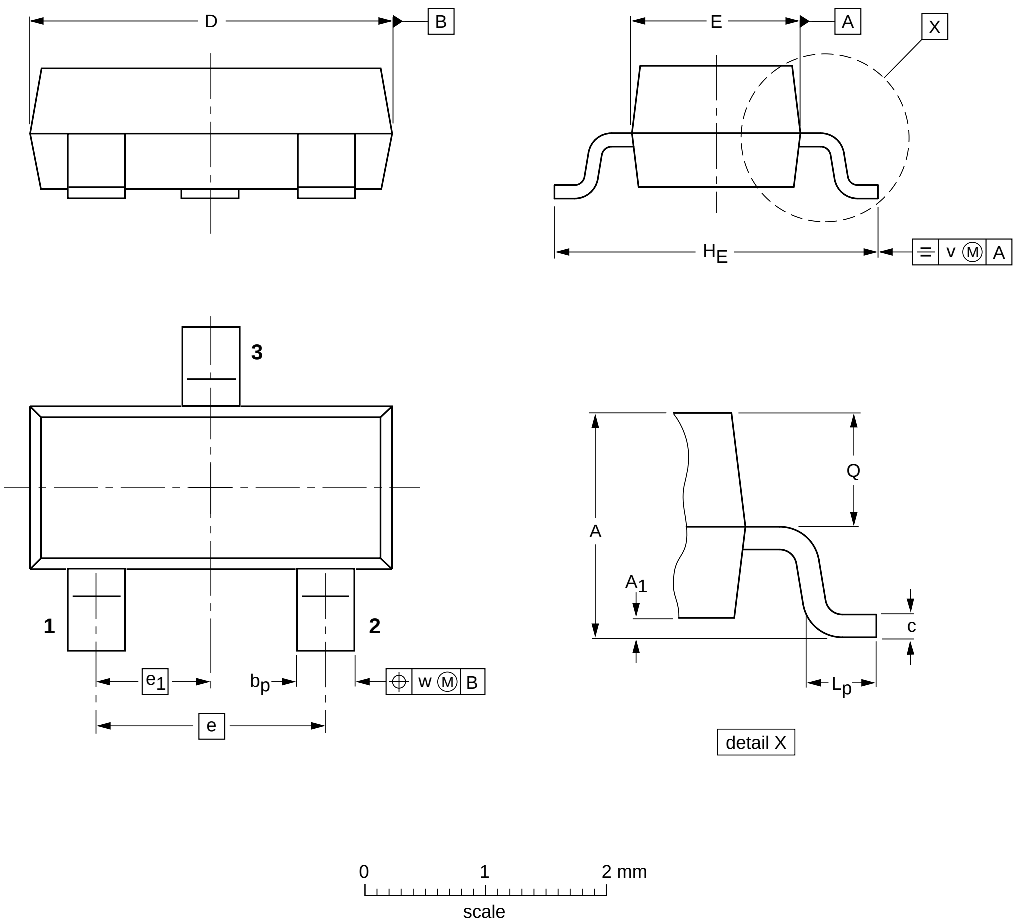
Z_o = 50 Ω.

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

Fig 16. Common emitter output reflection coefficient (S_{22}).

8. Package outline

Plastic surface-mounted package; 3 leads **SOT23**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max.	b_p	c	D	E	e	e_1	H_E	L_p	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

Fig 17. Package outline.

9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFR505 v.4	20110907	Product data sheet	-	BFR505 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.			
BFR505 v.3 (9397 750 13396)	20040720	Product data sheet	-	BFR505_CNV v.2
BFR505_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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

12. Contents

Date of release: 7 September 2011
Document identifier: BFR505