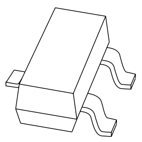

BFR505

NPN 9 GHz wideband transistor

Rev. 03 — 20 July 2004 | 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

- 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

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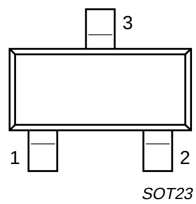
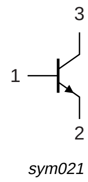
Table 1: Quick reference data *...continued*

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
$\|S_{21}\|^2$	insertion power gain	I_C = 5 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 900 MHz		13	14	-	dB

Table 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.

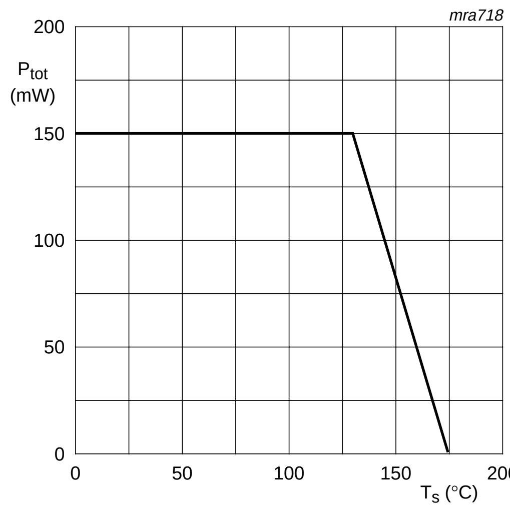
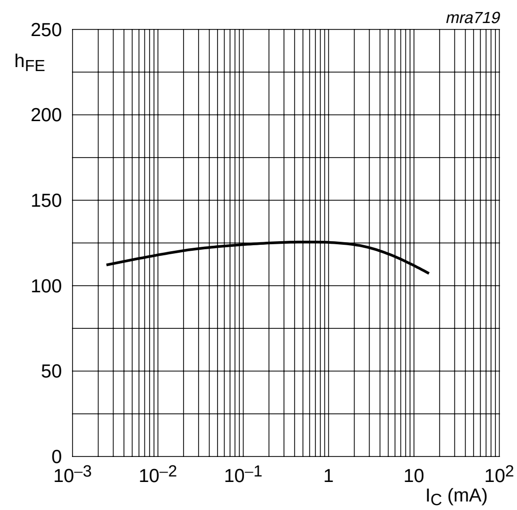
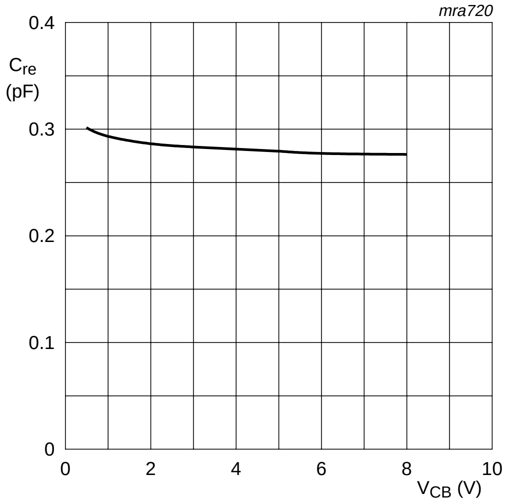


Fig 1. Power derating curve.



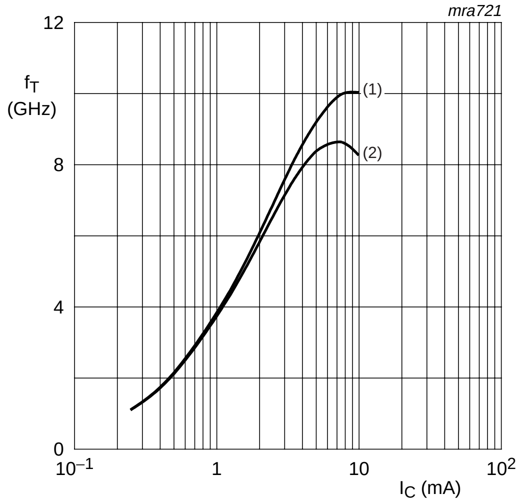
V_{CE} = 6 V.

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.

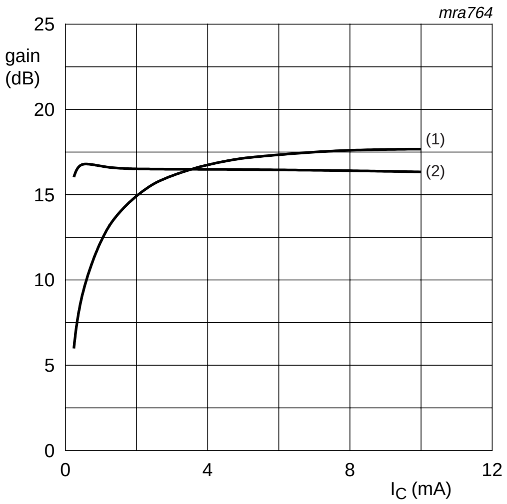


T_{amb} = 25 °C; f = 1 GHz.

(1) V_{CE} = 6 V.

(2) V_{CE} = 3 V.

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

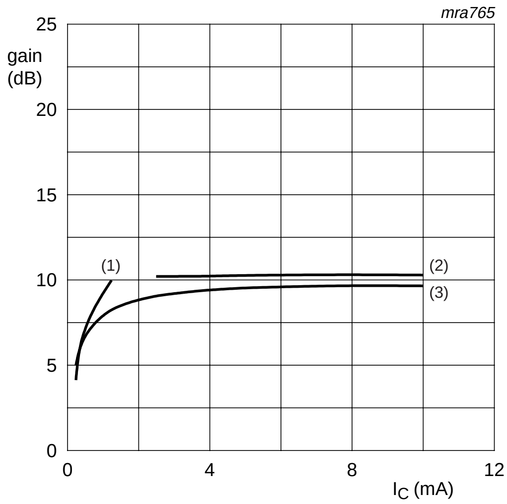


V_{CE} = 6 V; f = 900 MHz.

(1) MSG.

(2) G_{UM}.

Fig 5. Gain as a function of collector current.



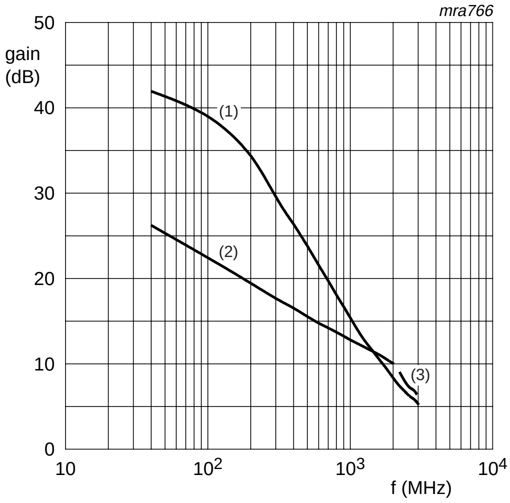
V_{CE} = 6 V; f = 2 GHz.

(1) MSG.

(2) G_{max}.

(3) G_{UM}.

Fig 6. Gain as a function of collector current.



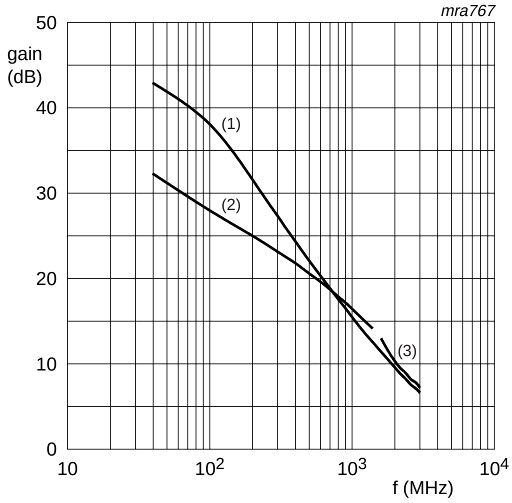
V_{CE} = 6 V; I_C = 1.25 mA.

(1) G_{UM}.

(2) MSG.

(3) G_{max}.

Fig 7. Gain as a function of frequency.



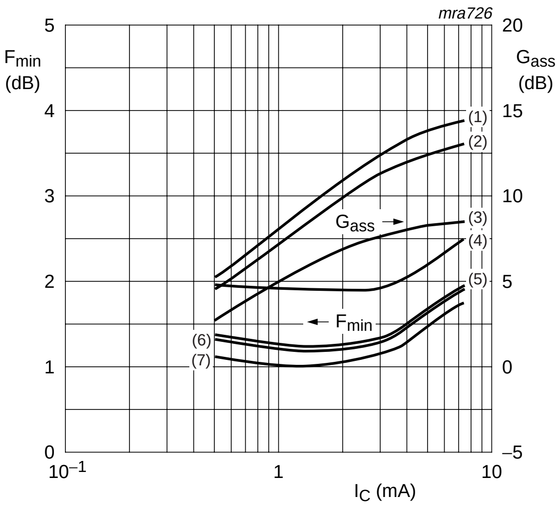
V_{CE} = 6 V; I_C = 5 mA.

(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.

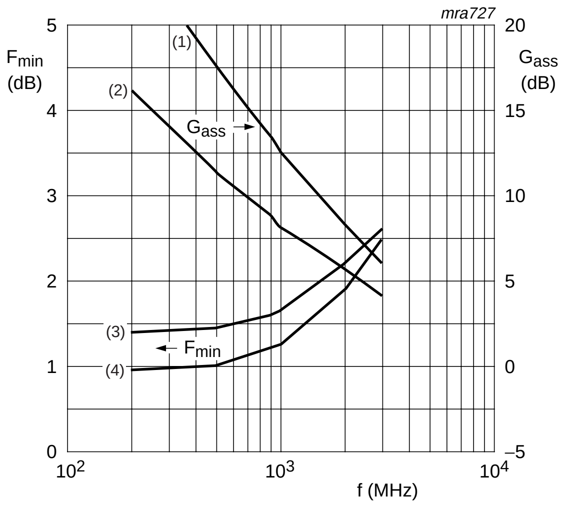
(4) f = 2000 MHz.

(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.

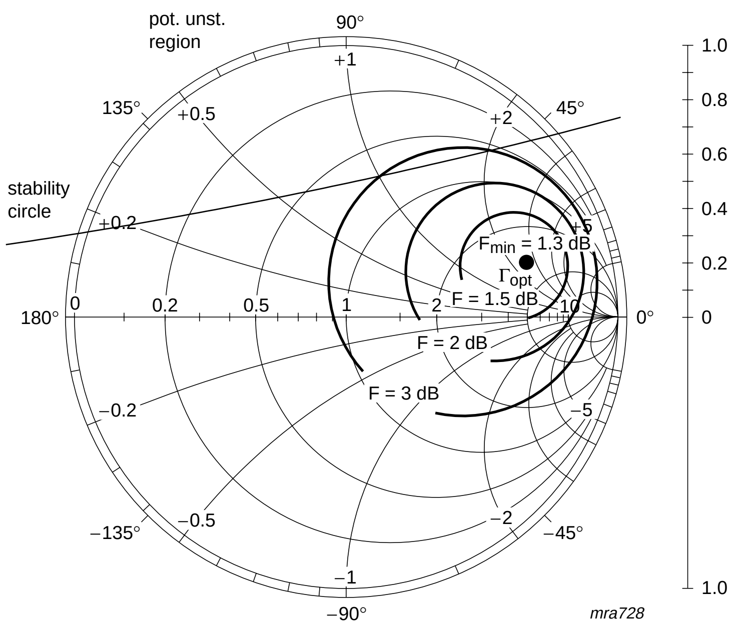
(1) I_C = 5 mA.

(2) I_C = 1.25 mA.

(3) I_C = 5 mA.

(4) I_C = 1.25 mA.

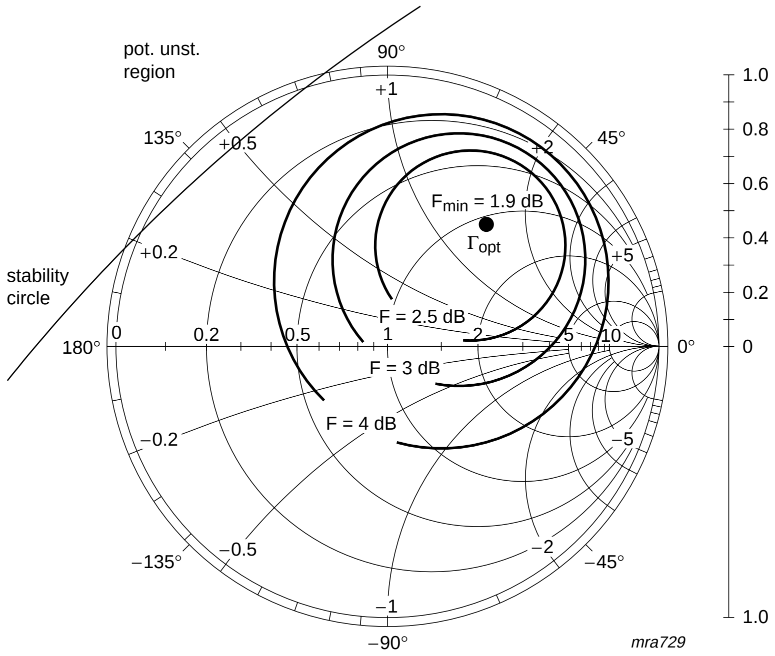
Fig 10. Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.

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

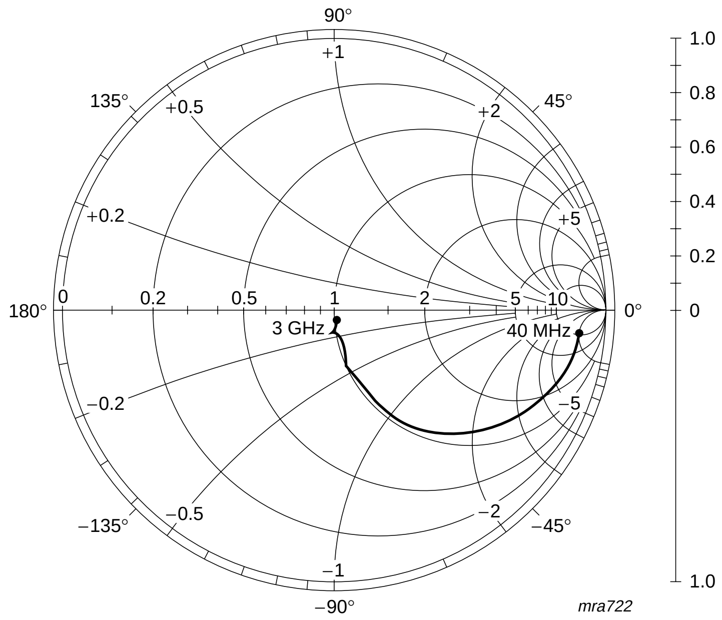
Fig 11. Noise circle figure.



Z_o = 50 Ω.

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

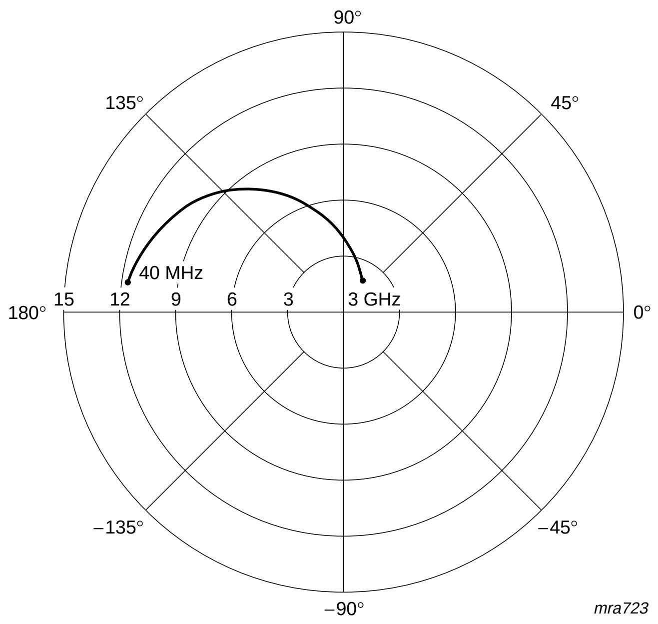
Fig 12. Noise circle figure.



$Z_o = 50\ \Omega$.

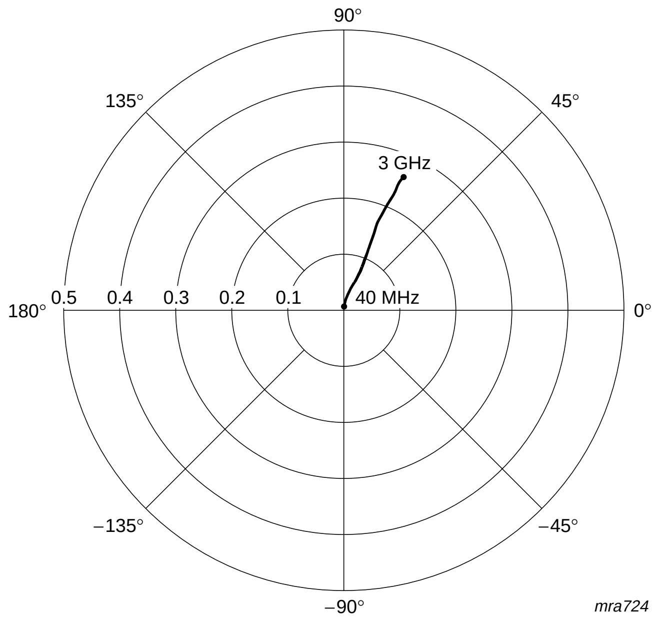
$V_{CE} = 6$ V; $I_C = 5$ mA.

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



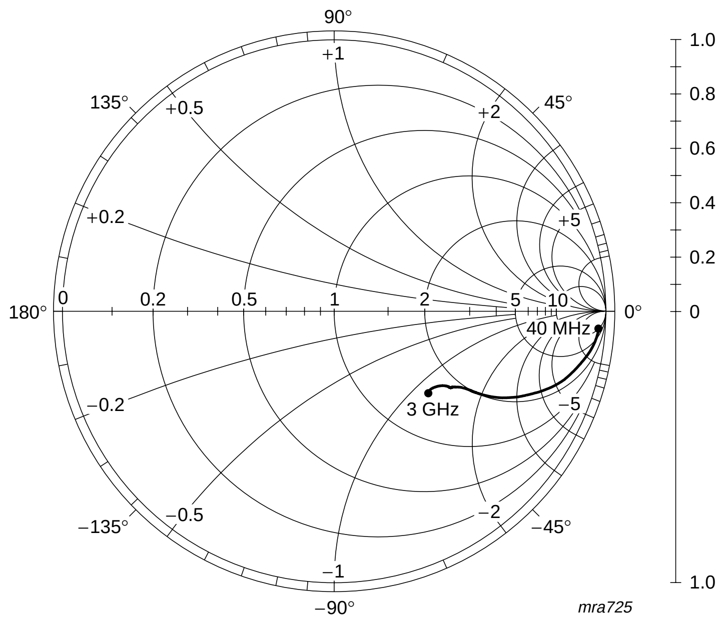
$V_{CE} = 6$ V; $I_C = 5$ mA.

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}).



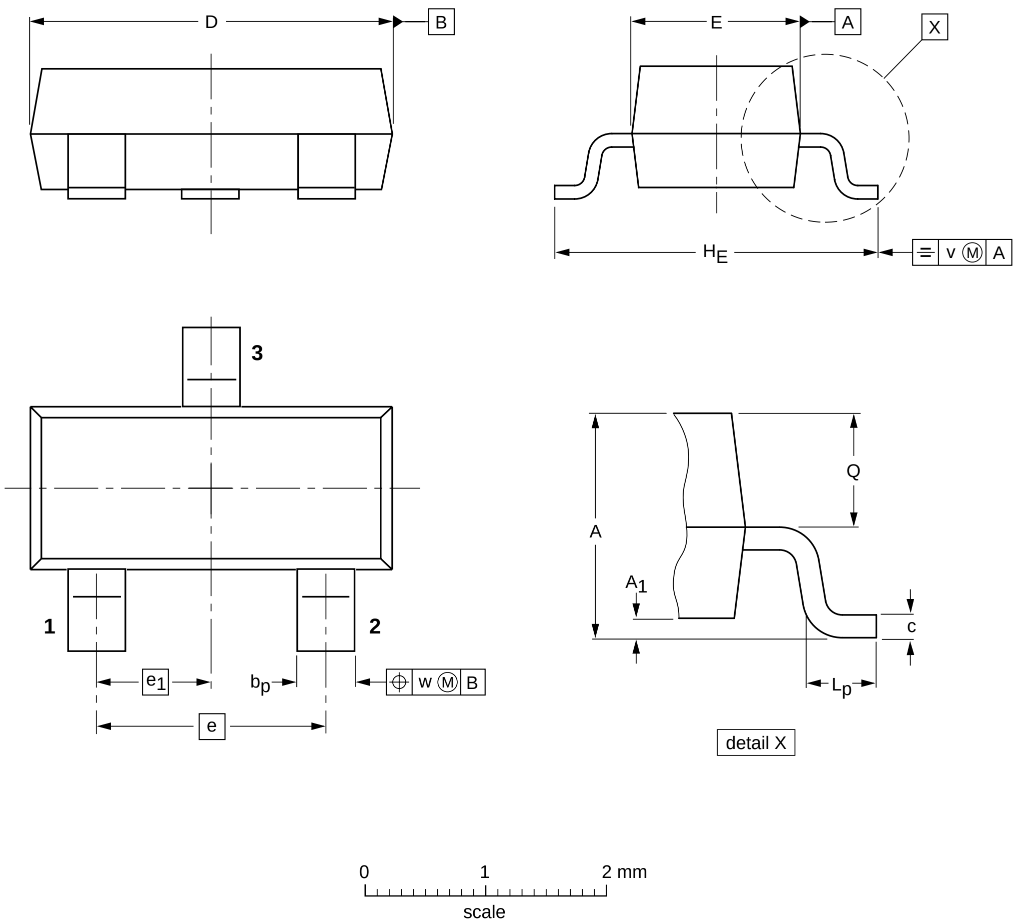
Z_o = 50 Ω.

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	EIAJ			
SOT23		TO-236AB				~~97-02-28~~ 99-09-13

Fig 17. Package outline.

9. Revision history

Table 8: Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
BFR505_3	20040720	Product data		9397 750 13396	BFR505_CNV_2
Modifications:	• Marking code added Table 4. • Data sheet updated to latest standards.				
BFR505_CNV_2	19971204	Product specification	-	-	-

10. Data sheet status

Level	Data sheet status [1]	Product status [2] [3]	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

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

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

11. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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14. Contents

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