BFR94AW

NPN 5 GHz wideband transistor

Rev. 2 — 2 October 2014 Product data sheet

1. Product profile

1.1 General description

Silicon NPN transistor encapsulated in a plastic SOT323 (S-mini) package. The BFR94AW uses the same crystal as the SOT23 version, BFR94A.

1.2 Features and benefits

- High power gain
- Gold metallization ensures excellent reliability
- AEC-Q101 qualified

1.3 Applications

- RF amplifiers, mixers and oscillators with signal frequencies up to 1 GHz

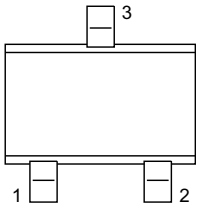
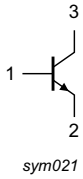
1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	-	20	V
V_{CEO}	collector-emitter voltage	open base	-	-	15	V
I_C	collector current		-	-	25	mA
P_{tot}	total power dissipation	$T_{sp} \leq 93$ °C	-	-	300	mW
h_{FE}	DC current gain	I_C = 15 mA; V_{CE} = 10 V	65	90	135	
C_{re}	feedback capacitance	I_C = 0 mA; V_{CE} = 10 V; f = 1 MHz; T_{amb} = 25 °C	-	0.35	-	pF
f_T	transition frequency	I_C = 15 mA; V_{CE} = 10 V; f = 500 MHz	3.5	5	-	GHz
G_{UM}	unilateral power gain	I_C = 15 mA; V_{CE} = 10 V; T_{amb} = 25 °C				
		f = 1 GHz	-	14	-	dB
		f = 2 GHz	-	8	-	dB
NF	noise figure	I_C = 5 mA; V_{CE} = 10 V; f = 1 GHz; $\Gamma_S = \Gamma_{opt}$	-	2	-	dB
T_j	junction temperature		-	-	150	°C

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	base		
2	emitter		
3	collector		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BFR94AW	-	plastic surface-mounted package; 3 leads	SOT323

4. Marking

Table 4. Marking

Type number	Marking code	Description
BFR94AW	XG*	* = p : made in Hong Kong
		* = t : made in Malaysia

5. Limiting values

Table 5. Limiting values

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

	Parameter	Conditions	Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	20	V
V_{CEO}	collector-emitter voltage	open base	-	15	V
V_{EBO}	emitter-base voltage	open collector	-	2	V
I_C	collector current		-	25	mA
P_{tot}	total power dissipation	$T_{sp} \leq 93$ °C; see Figure 1 [1]	-	300	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		-	+150	°C

[1] T_{sp} is the temperature at the solder point of the collector pin.

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6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	$T_{sp} \leq 93$ °C [1]	190	K/W

[1] T_{sp} is the temperature at the solder point of the collector pin.

7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	$I_E = 0$ A; $V_{CB} = 10$ V	-	-	50	nA
h_{FE}	DC current gain	$I_C = 15$ mA; $V_{CE} = 10$ V	65	90	135	
C_c	collector capacitance	$I_E = i_e = 0$ A; $V_{CB} = 10$ V; f = 1 MHz	-	0.6	-	pF
C_e	emitter capacitance	$I_C = i_c = 0$ A; $V_{EB} = 0.5$ V; f = 1 MHz	-	0.9	-	pF
C_{re}	feedback capacitance	$I_C = 0$ mA; $V_{CE} = 10$ V; f = 1 MHz; $T_{amb} = 25$ °C	-	0.35	-	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 10$ V; f = 500 MHz	3.5	5	-	GHz
G_{UM}	unilateral power gain	$I_C = 15$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C [1]				
		f = 1 GHz	-	14	-	dB
		f = 2 GHz	-	8	-	dB
NF	noise figure	$I_C = 5$ mA; $V_{CE} = 10$ V; $\Gamma_S = \Gamma_{opt}$				
		f = 1 GHz	-	2	-	dB
		f = 2 GHz	-	3	-	dB

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

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

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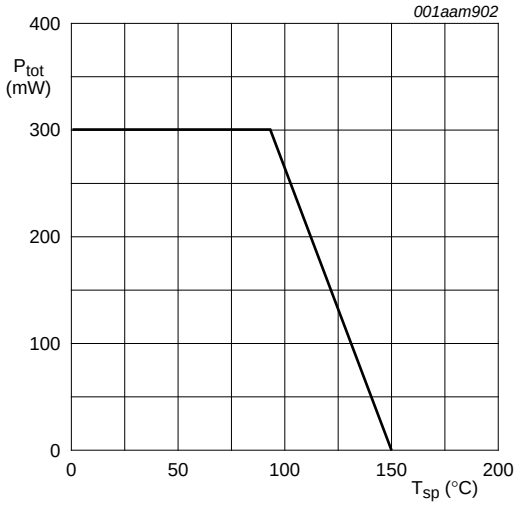
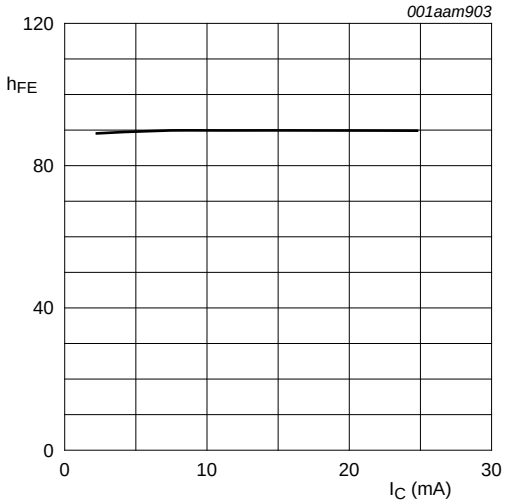
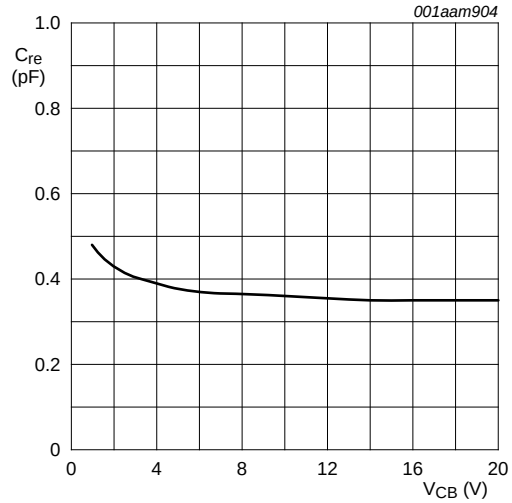


Fig 1. Power derating curve



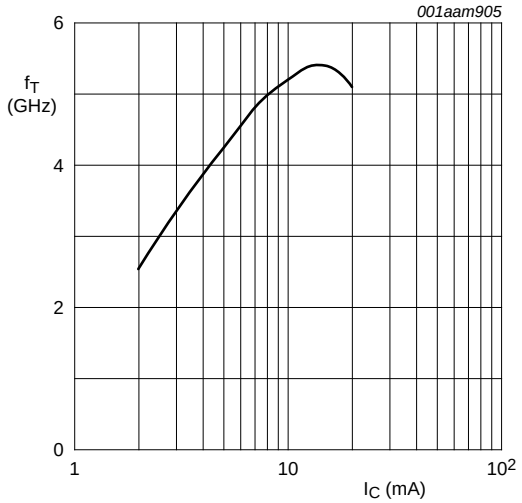
V_{CE} = 10 V.

Fig 2. DC current gain as a function of collector current; typical values



I_C = 0 mA; f = 1 MHz.

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



V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C.

Fig 4. Transition frequency as a function of collector current; typical values

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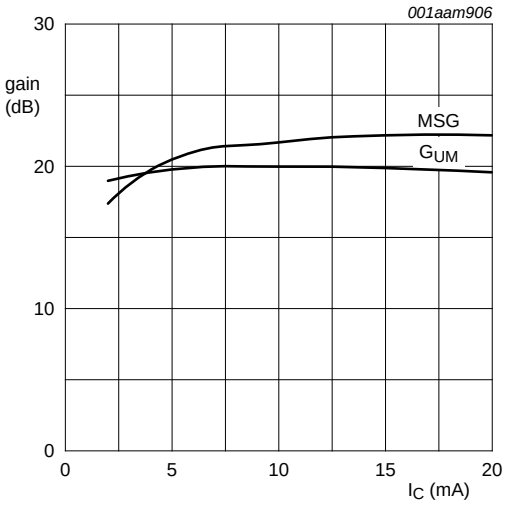
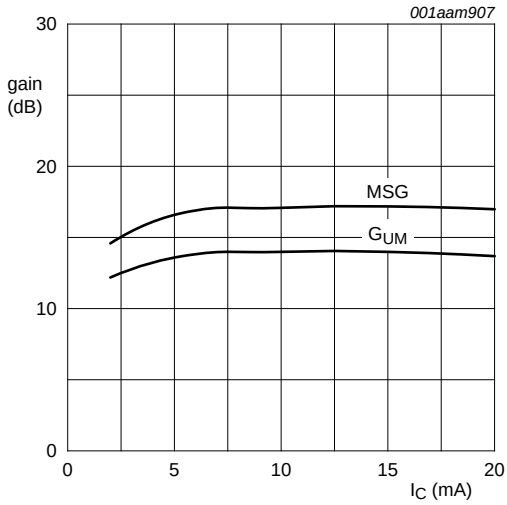


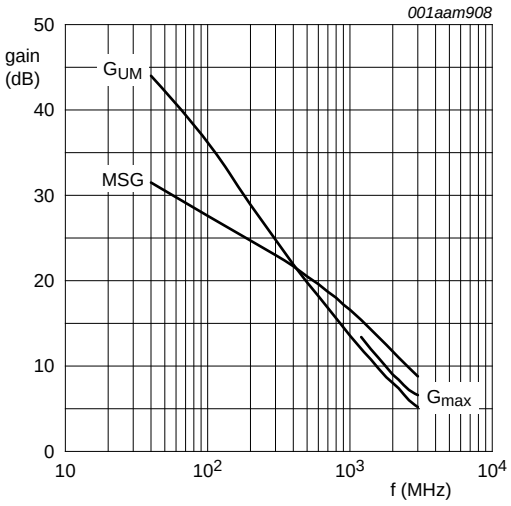
V_{CE} = 10 V; f = 500 MHz.

Fig 5. Gain as a function of collector current; typical values



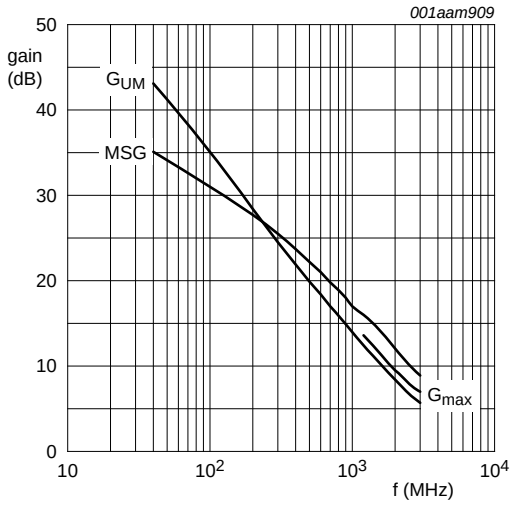
V_{CE} = 10 V; f = 1 GHz.

Fig 6. Gain as a function of collector current; typical values



V_{CE} = 10 V; I_C = 5 mA.

Fig 7. Gain as a function of frequency; typical values



V_{CE} = 10 V; I_C = 5 mA.

Fig 8. Minimum noise figure as a function of frequency; typical values

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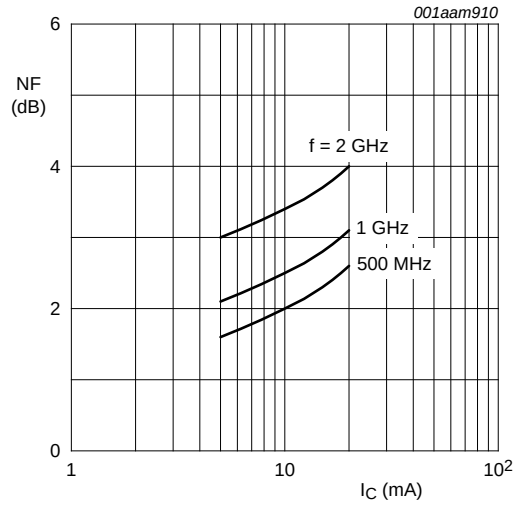
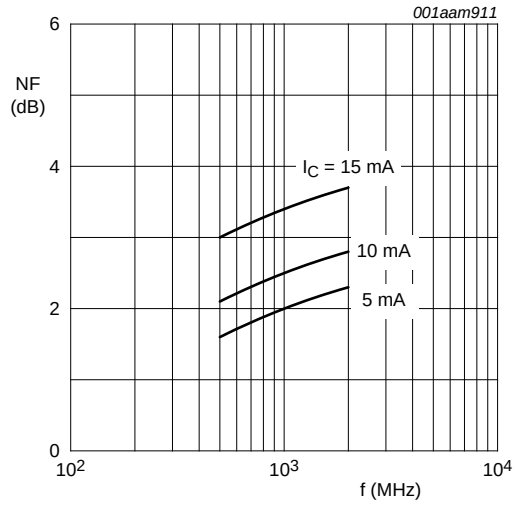


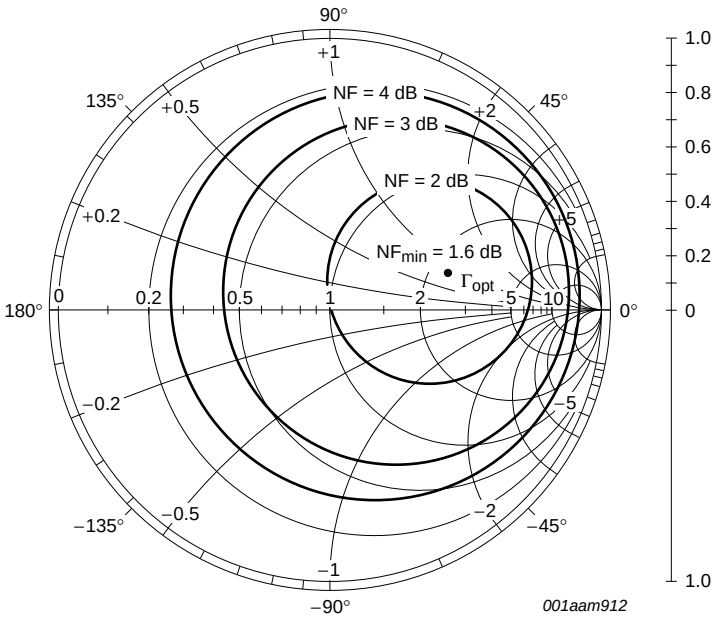
V_{CE} = 10 V.

Fig 9. Minimum noise figure as a function of collector current; typical values



V_{CE} = 10 V.

Fig 10. Minimum noise figure as a function of frequency; typical values



f = 500 MHz; V_{CE} = 10 V; I_C = 5 mA; Z_O = 50 Ω.

Fig 11. Common emitter noise figure circles; typical values

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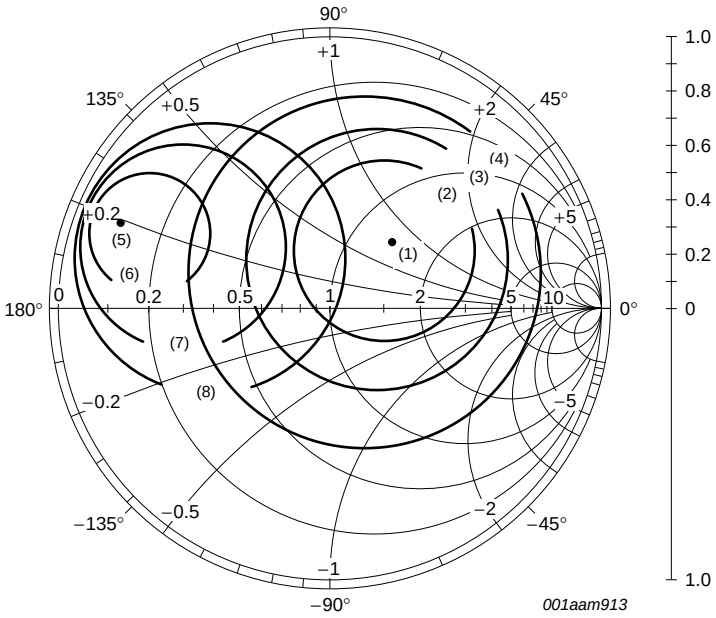

f = 1 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_O = 50 Ω.

(1) Γ_{opt}; NF_{min} = 2.1 dB

(2) NF = 2.5 dB

(3) NF = 3 dB

(4) NF = 4 dB

(5) Γ_{ms}; G_{max} = 15.7 dB

(6) G = 15 dB

(7) G = 14 dB

(8) G = 13 dB

Fig 12. Common emitter noise figure circles; typical values

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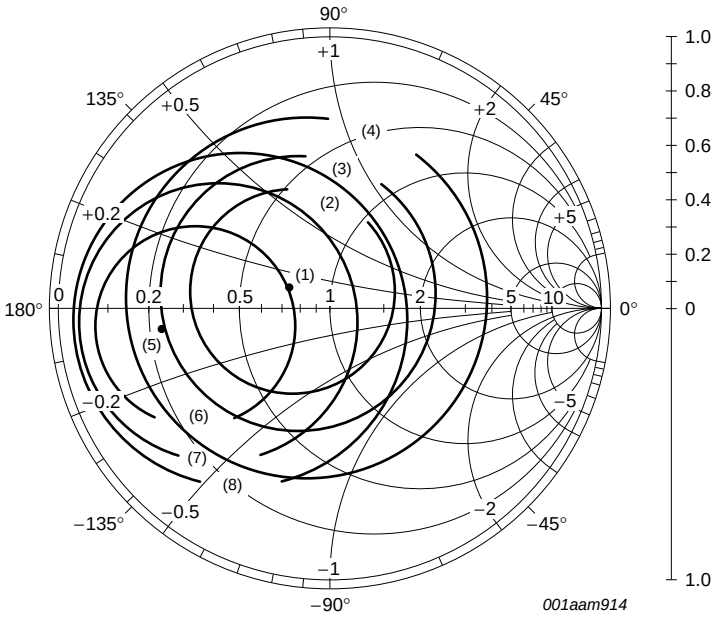

f = 2 GHz; V_{CE} = 10 V; I_C = 5 mA; Z_O = 50 Ω.

(1) Γ_{opt}; NF_{min} = 3 dB

(2) NF = 3.5 dB

(3) NF = 4 dB

(4) NF = 5 dB

(5) Γ_{ms}; G_{max} = 9.1 dB

(6) G = 8 dB

(7) G = 7 dB

(8) G = 6 dB

Fig 13. Common emitter noise figure circles; typical values

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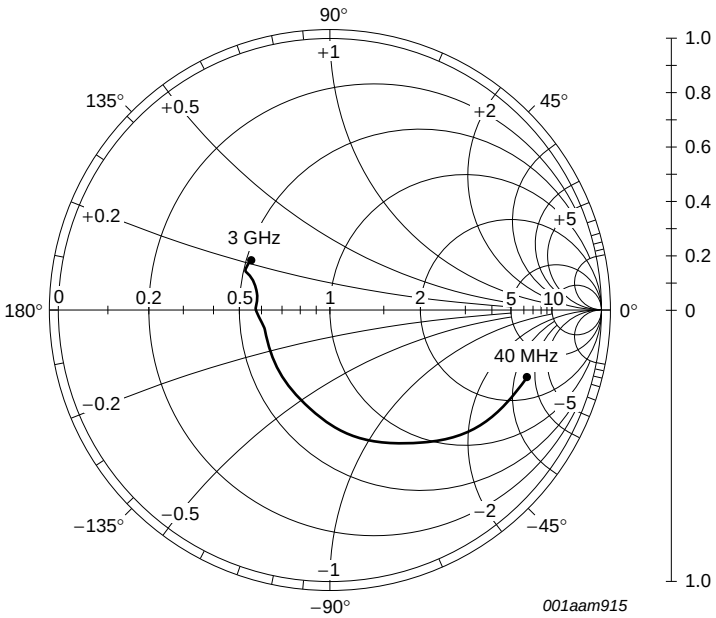
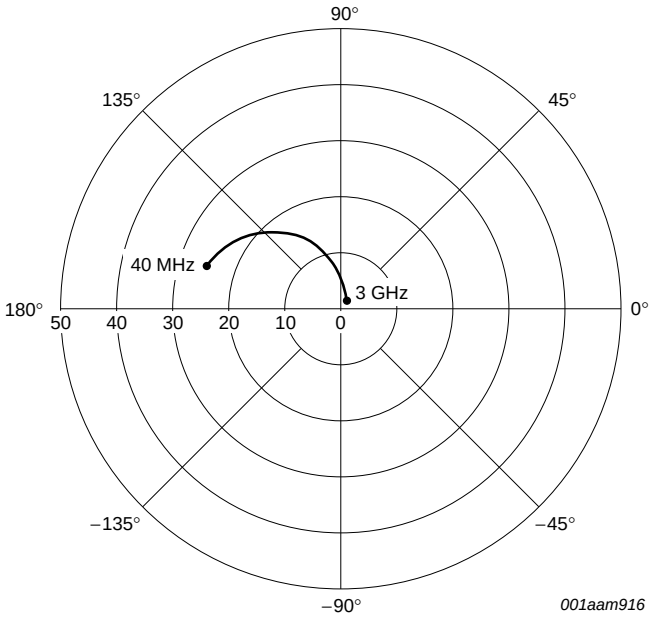


V_{CE} = 10 V; I_C = 15 mA; Z_O = 50 Ω.

Fig 14. Common emitter input reflection coefficient (S_{11}); typical values



V_{CE} = 10 V; I_C = 15 mA.

Fig 15. Common emitter forward transmission coefficient (S_{21}); typical values

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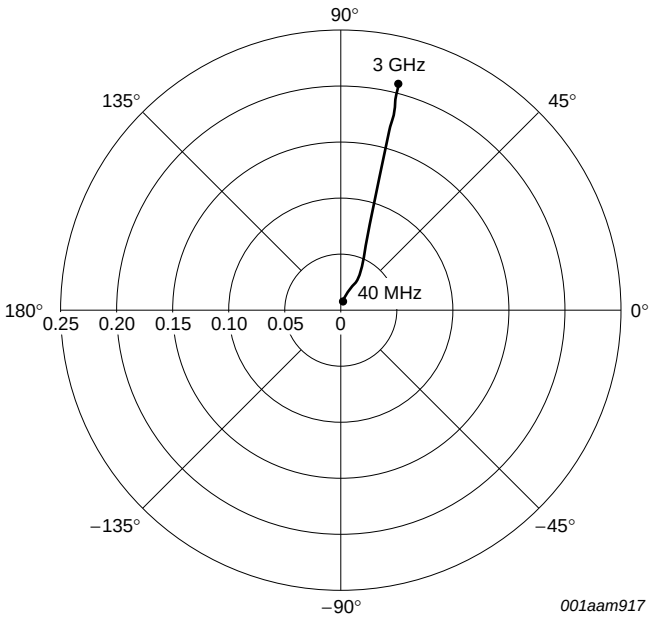
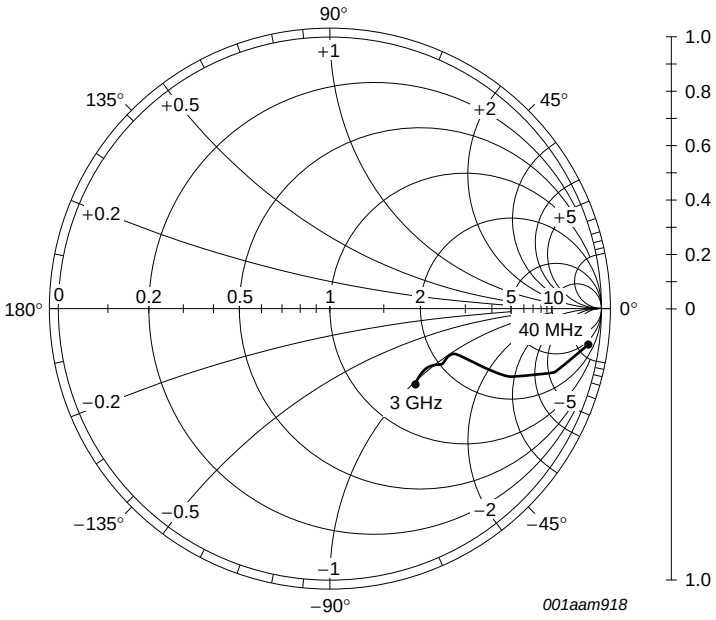


V_{CE} = 10 V; I_C = 15 mA.

Fig 16. Common emitter reverse transmission coefficient (S_{12}); typical values



V_{CE} = 10 V; I_C = 15 mA.

Fig 17. Common emitter output reflection coefficient (S_{22}); typical values

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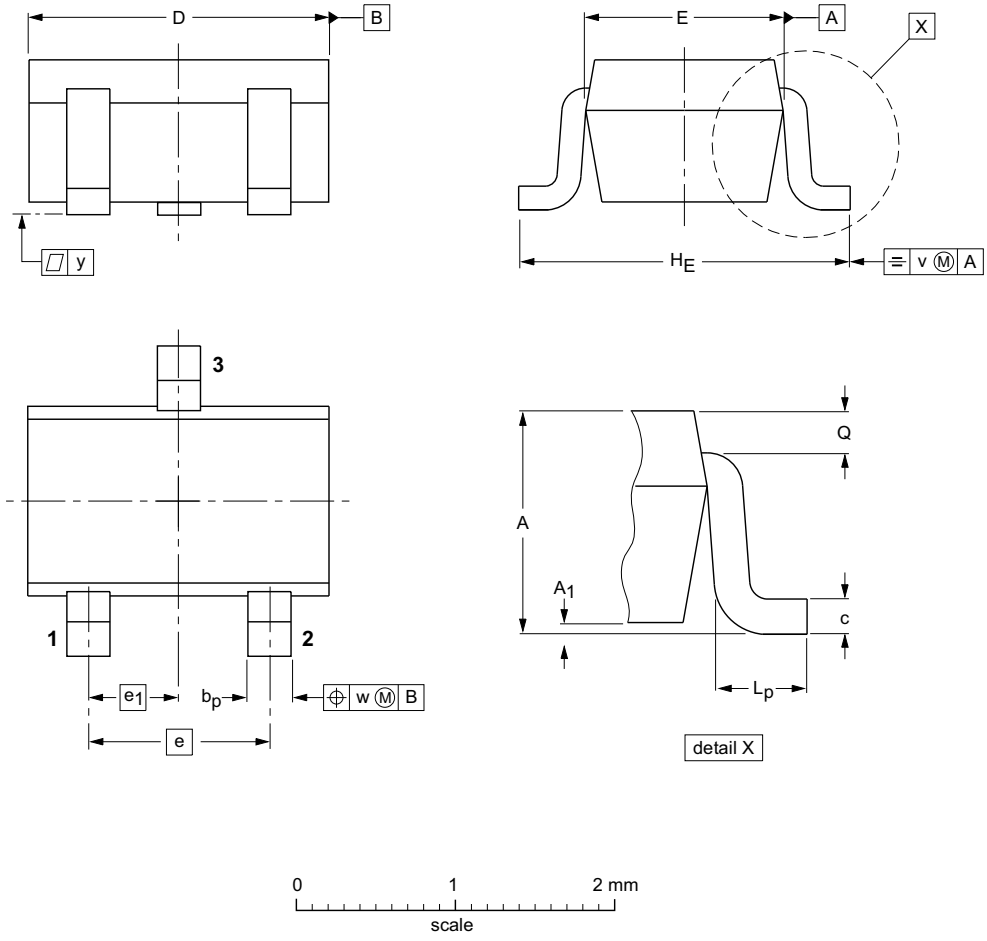
8. Package outline

Plastic surface-mounted package; 3 leads **SOT323**



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 0.8	0.1	0.4 0.3	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT323			SC-70			~~04-11-04~~ 06-03-16

Fig 18. Package outline SOT323

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9. Abbreviations

Table 8. Abbreviations

Acronym	Description
MSG	Maximum Stable Gain
NPN	Negative Positive Negative
RF	Radio Frequency

10. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFR94AW v.2	20141002	Product data sheet	-	BFR94AW v.1
Modifications:	• Table 2 on page 2: changed graphic symbol • Figure 18 on page 11: updated			
BFR94AW v.1	20101029	Product data sheet	-	-

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11.1 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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Document identifier: BFR94AW

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