

# BFG520; BFG520/X; BFG520/XR

NPN 9 GHz wideband transistor

Rev. 04 — 23 November 2007

Product data sheet

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NXP Semiconductors

# NPN 9 GHz wideband transistor

# BFG520; BFG520/X; BFG520/XR

## FEATURES

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

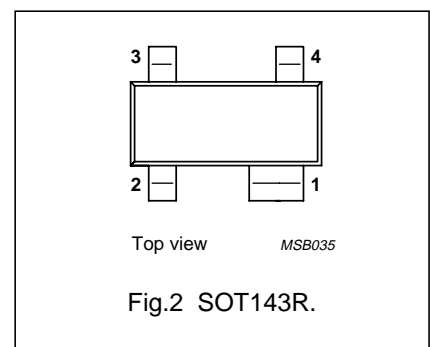
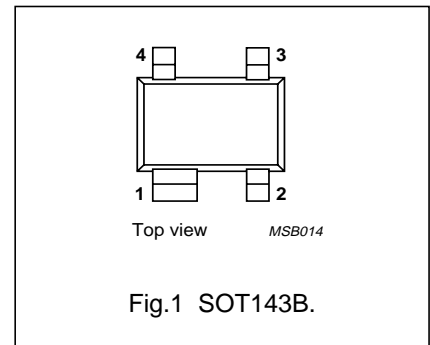
## DESCRIPTION

NPN silicon planar epitaxial transistors, intended for applications in the RF frontend 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) and repeater amplifiers in fibre-optic systems.

The transistors are encapsulated in 4-pin, dual-emitter plastic SOT143 and SOT143R envelopes.

## PINNING

PIN	DESCRIPTION
BFG520 (Fig.1) Code: %MF	
1	collector
2	base
3	emitter
4	emitter
BFG520/X (Fig.1) Code: %ML	
1	collector
2	emitter
3	base
4	emitter
BFG520/XR (Fig.2) Code: %MP	
1	collector
2	emitter
3	base
4	emitter



## 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
$I_C$	DC collector current		–	–	70	mA
$P_{tot}$	total power dissipation	up to $T_s = 88\text{ °C}$ ; note 1	–	–	300	mW
$h_{FE}$	DC current gain	$I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $T_j = 25\text{ °C}$	60	120	250	
$C_{re}$	feedback capacitance	$I_C = 0$ ; $V_{CB} = 6\text{ V}$ ; $f = 1\text{ MHz}$	–	0.3	–	pF
$f_T$	transition frequency	$I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	19	–	dB
		$I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	13	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	17	18	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.1	1.6	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.6	2.1	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.9	–	dB

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**LIMITING VALUES**

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	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	–	2.5	V
$I_C$	DC collector current		–	70	mA
$P_{tot}$	total power dissipation	up to $T_s = 88\text{ °C}$ ; note 1	–	300	mW
$T_{stg}$	storage temperature		–65	150	°C
$T_j$	junction temperature		–	175	°C

**THERMAL RESISTANCE**

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j-s}$	thermal resistance from junction to soldering point	up to $T_s = 88\text{ °C}$ ; note 1	290 K/W

**Note**

- $T_s$  is the temperature at the soldering point of the collector tab.

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**CHARACTERISTICS**

T<sub>j</sub> = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I <sub>CBO</sub>	collector cut-off current	I <sub>E</sub> = 0; V <sub>CB</sub> = 6 V	–	–	50	nA
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V	60	120	250	
C <sub>e</sub>	emitter capacitance	I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>EB</sub> = 0.5 V; f = 1 MHz	–	1	–	pF
C <sub>c</sub>	collector capacitance	I <sub>E</sub> = i <sub>e</sub> = 0; V <sub>CB</sub> = 6 V; f = 1 MHz	–	0.6	–	pF
C <sub>re</sub>	feedback capacitance	I <sub>C</sub> = 0; V <sub>CB</sub> = 6 V; f = 1 MHz	–	0.3	–	pF
f <sub>T</sub>	transition frequency	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; f = 1 GHz; T <sub>amb</sub> = 25 °C	–	9	–	GHz
G <sub>UM</sub>	maximum unilateral power gain (note 1)	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	19	–	dB
		I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	–	13	–	dB
S <sub>21</sub>   <sup>2</sup>	insertion power gain	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	17	18	–	dB
F	noise figure	Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	1.1	1.6	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	1.6	2.1	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	–	1.9	–	dB
P <sub>L1</sub>	output power at 1 dB gain compression	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; R <sub>L</sub> = 50 Ω; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm
V <sub>o</sub>	output voltage	note 3	–	275	–	mV
d <sub>2</sub>	second order intermodulation distortion	I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 6 V; V <sub>o</sub> = 75 mV; T <sub>amb</sub> = 25 °C; f <sub>(p+q)</sub> = 810 MHz	–	–50	–	dB

**Notes**

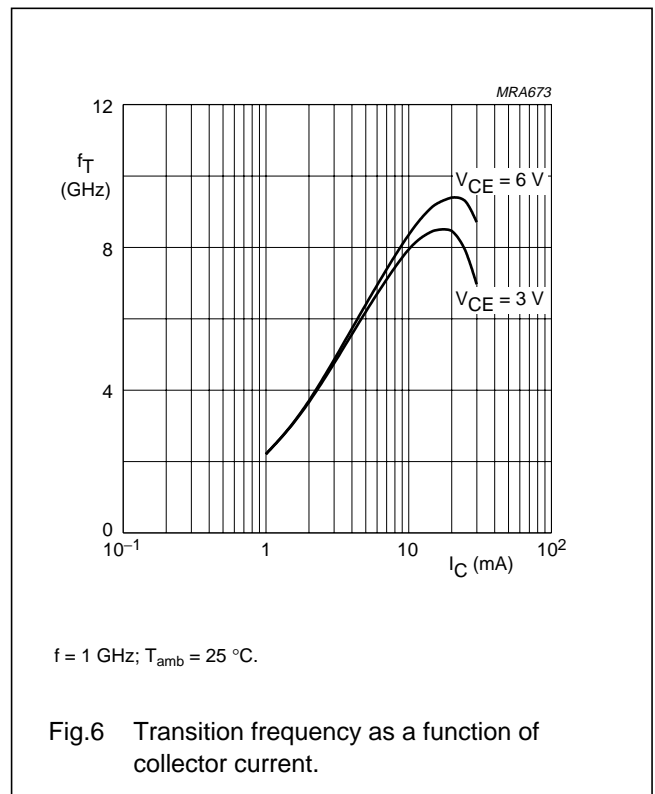
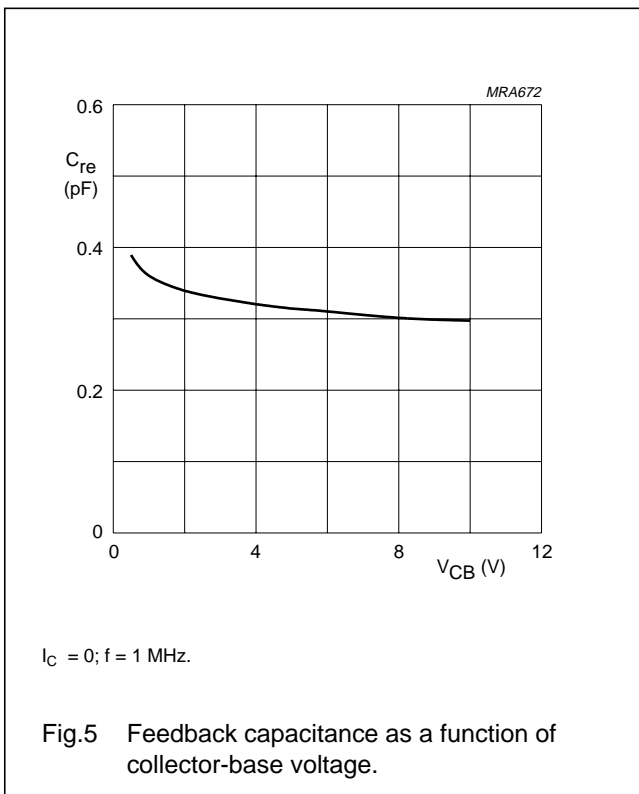
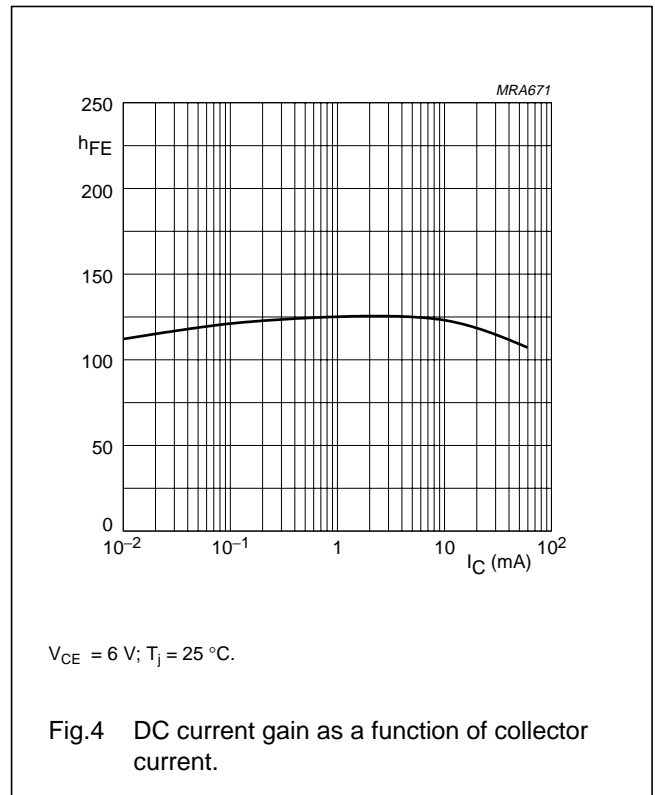
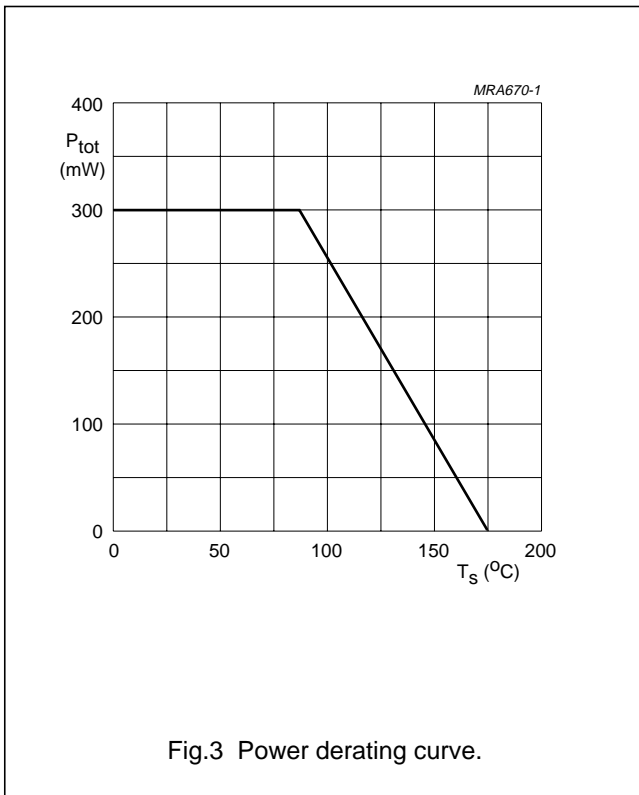
- G<sub>UM</sub> is the maximum unilateral power gain, assuming S<sub>12</sub> is zero and

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

- I<sub>C</sub> = 20 mA; V<sub>CE</sub> = 6 V; R<sub>L</sub> = 50 Ω; f = 900 MHz; T<sub>amb</sub> = 25 °C;  
f<sub>p</sub> = 900 MHz; f<sub>q</sub> = 902 MHz;  
measured at f<sub>(2p-q)</sub> = 898 MHz and f<sub>(2q-p)</sub> = 904 MHz.
- d<sub>im</sub> = –60 dB (DIN 45004B);  
V<sub>p</sub> = V<sub>o</sub>; V<sub>q</sub> = V<sub>o</sub> – 6 dB; V<sub>r</sub> = V<sub>o</sub> – 6 dB;  
f<sub>p</sub> = 795.25 MHz; f<sub>q</sub> = 803.25 MHz; f<sub>r</sub> = 805.25 MHz;  
measured at f<sub>(p+q-r)</sub> = 793.25 MHz

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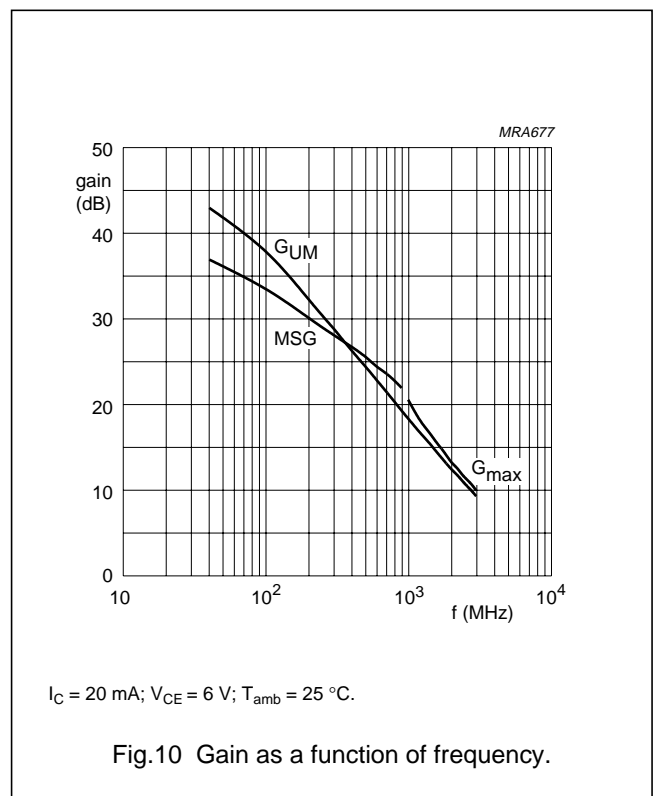
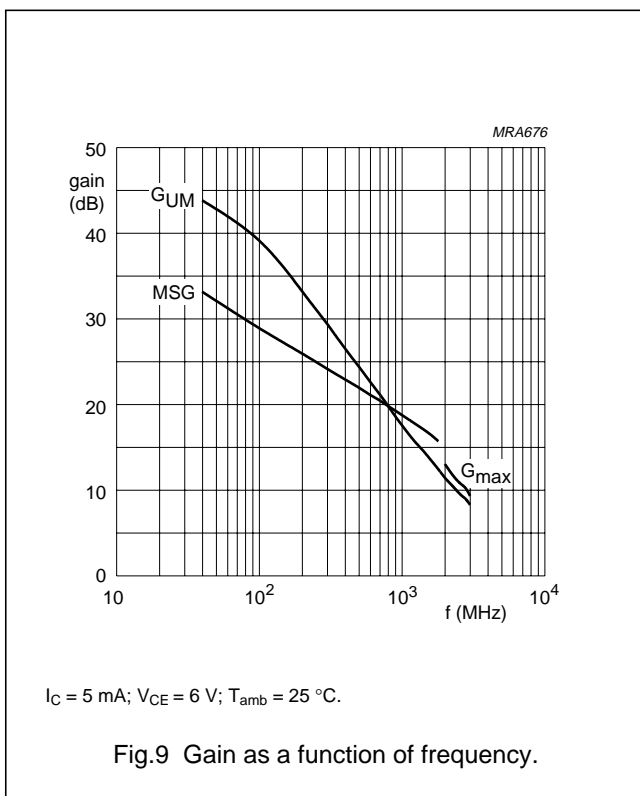
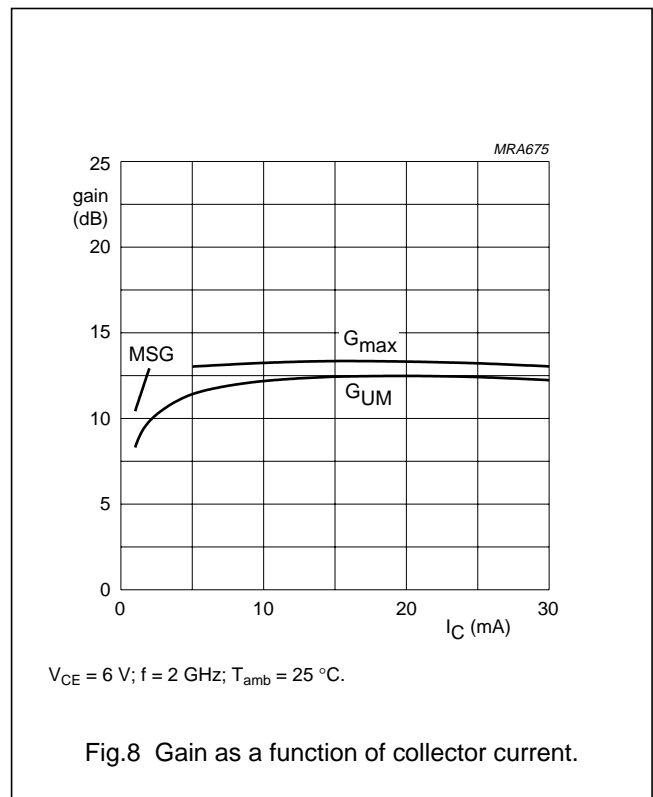
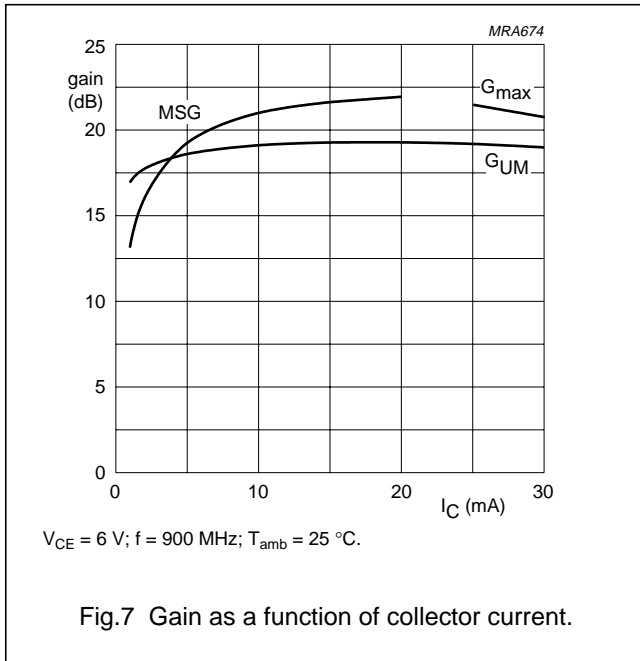
BFG520; BFG520/X; BFG520/XR



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In Figs 7 to 10,  $G_{UM}$  = maximum unilateral power gain;  $MSG$  = maximum stable gain;  $G_{max}$  = maximum available gain.



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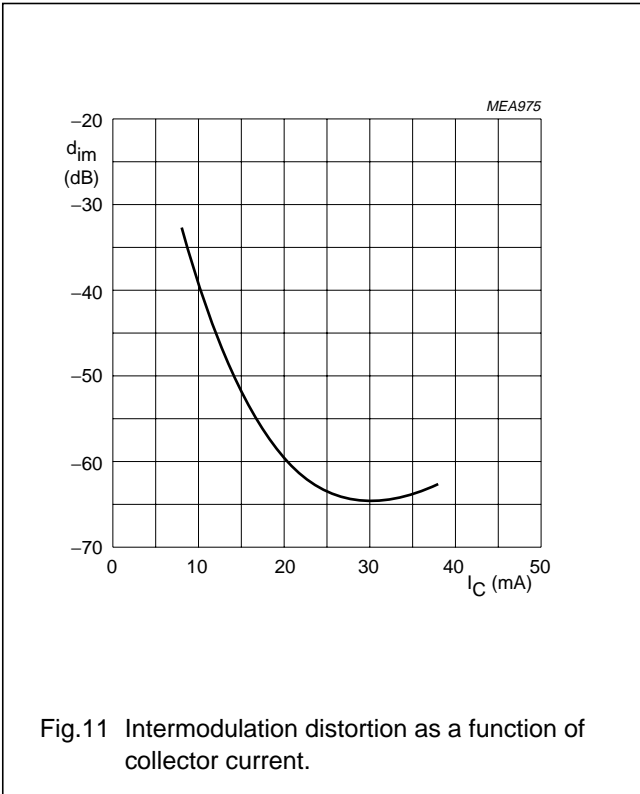


Fig.11 Intermodulation distortion as a function of collector current.

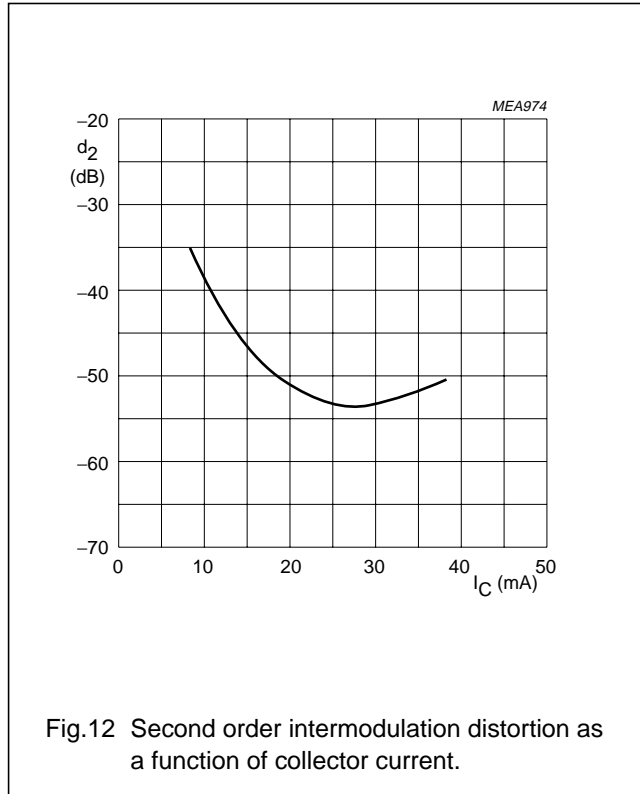
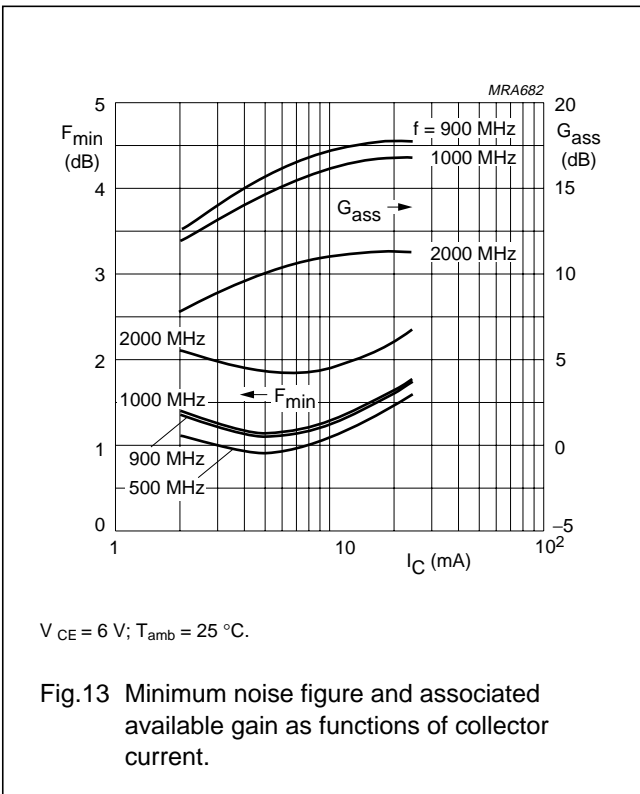
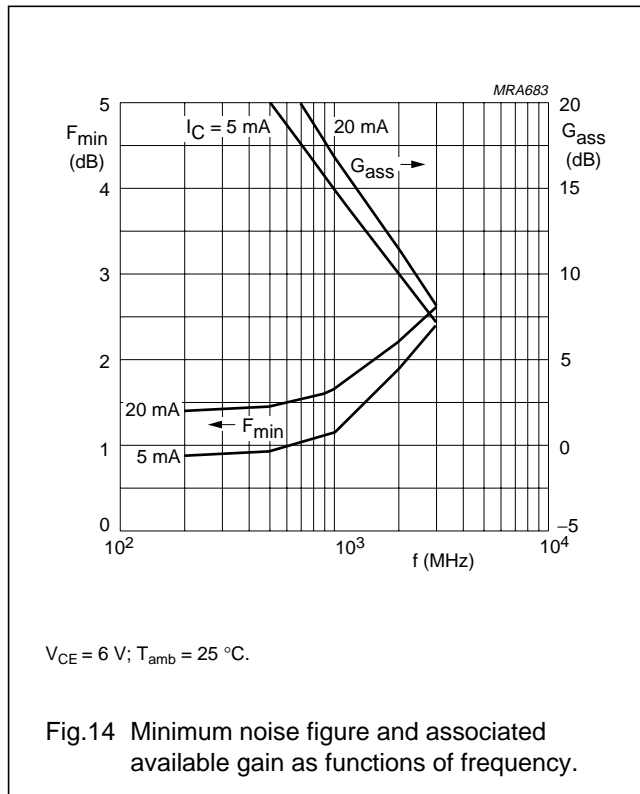


Fig.12 Second order intermodulation distortion as a function of collector current.



$V_{CE} = 6\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}.$

Fig.13 Minimum noise figure and associated available gain as functions of collector current.



$V_{CE} = 6\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}.$

Fig.14 Minimum noise figure and associated available gain as functions of frequency.

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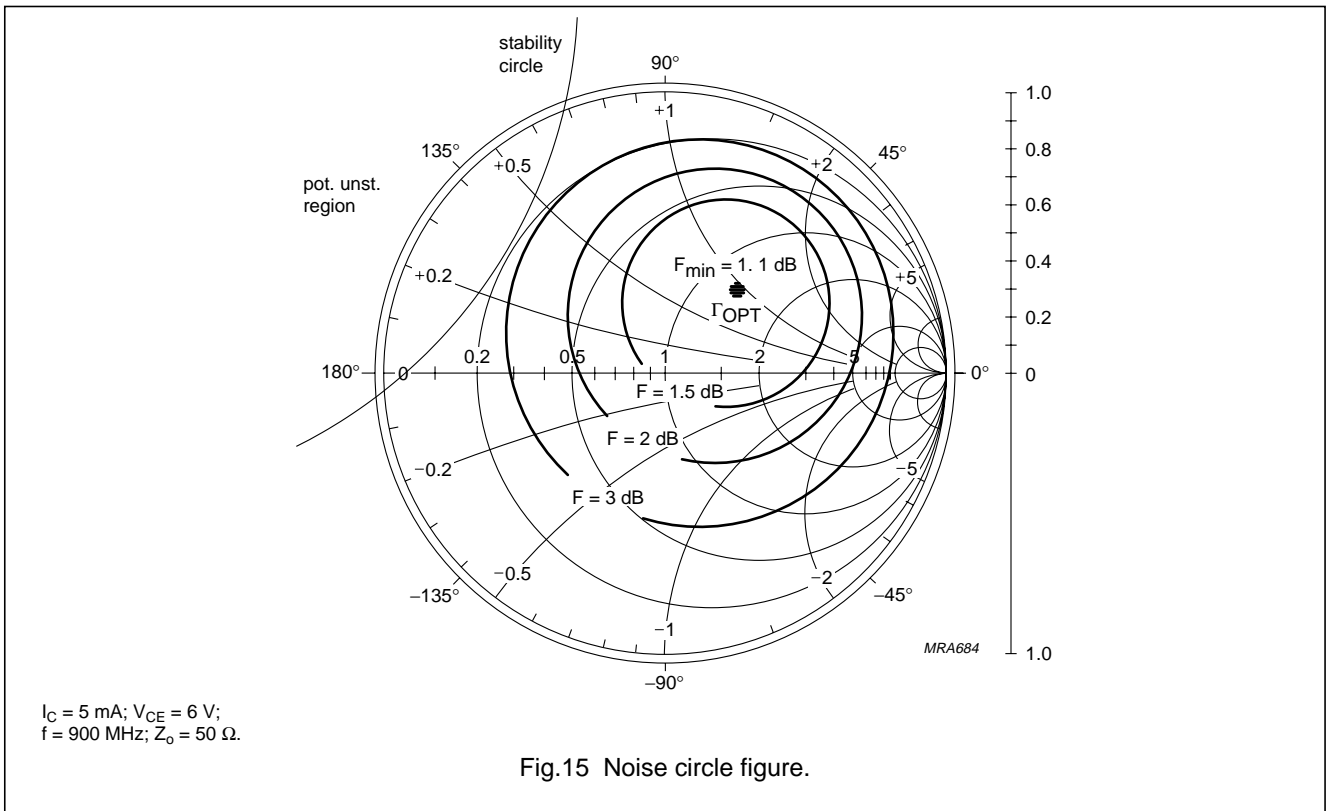


Fig.15 Noise circle figure.

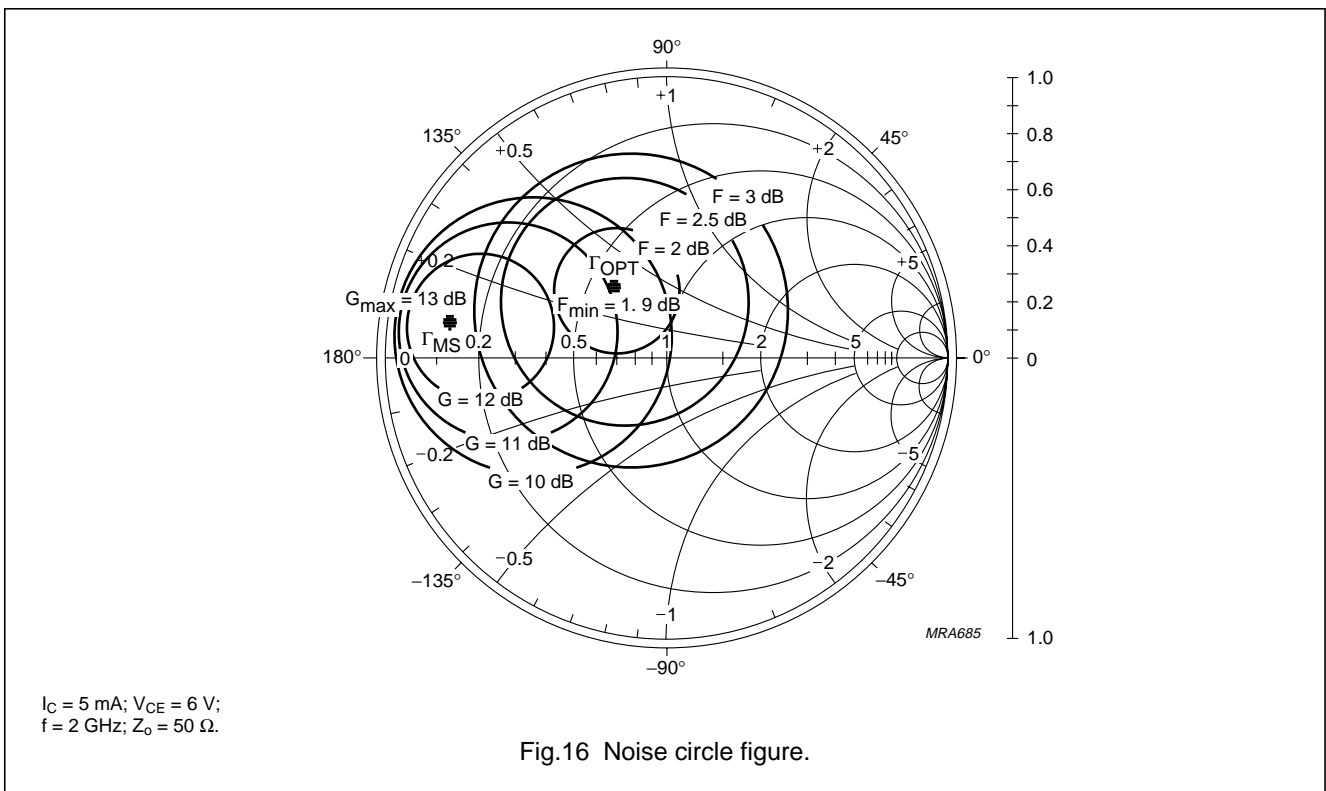
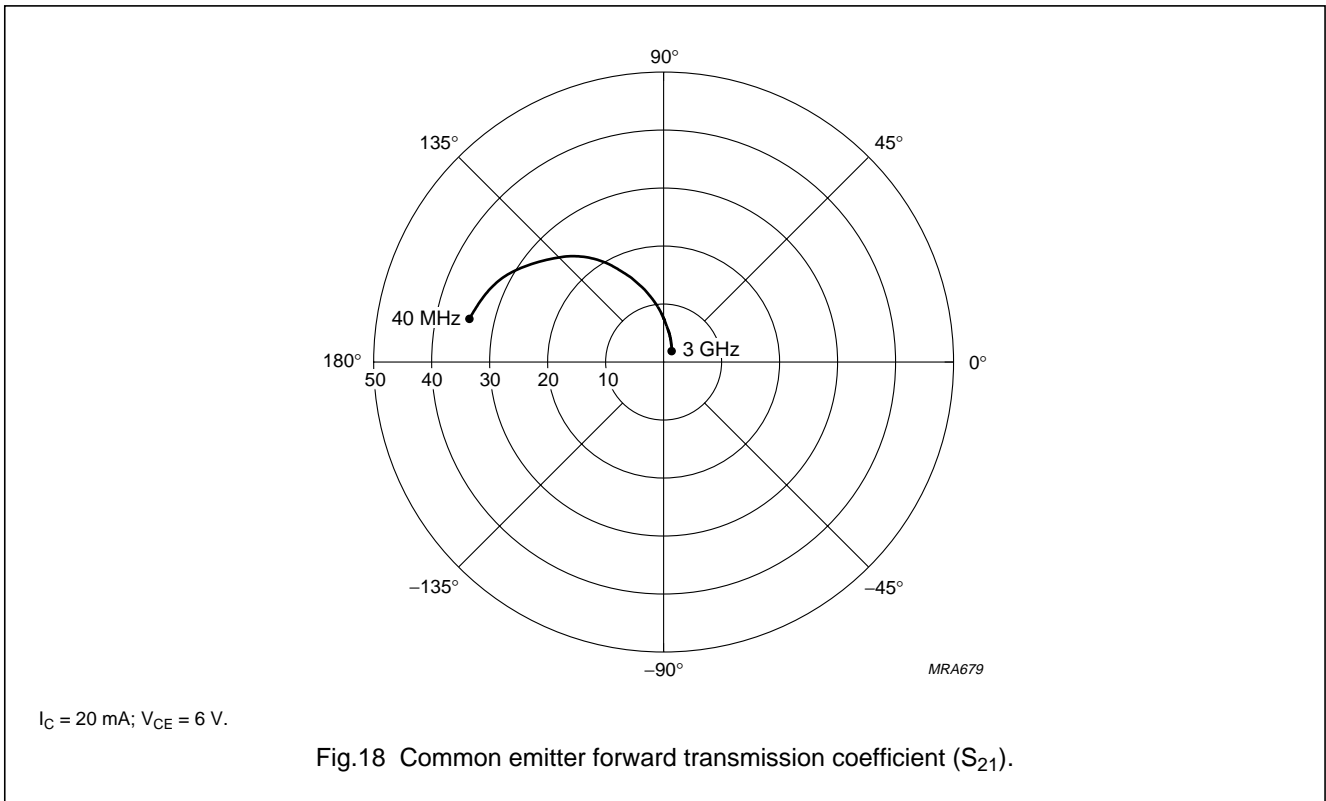
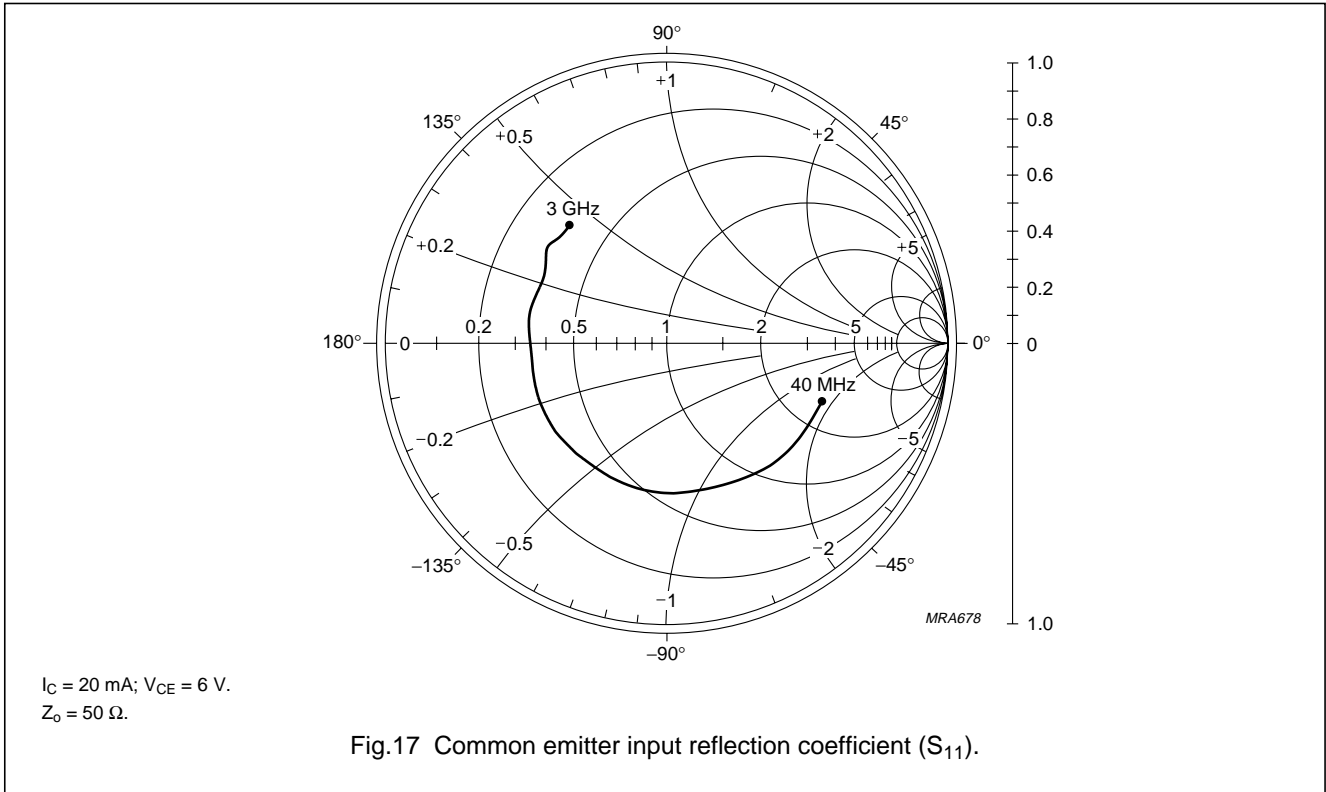


Fig.16 Noise circle figure.



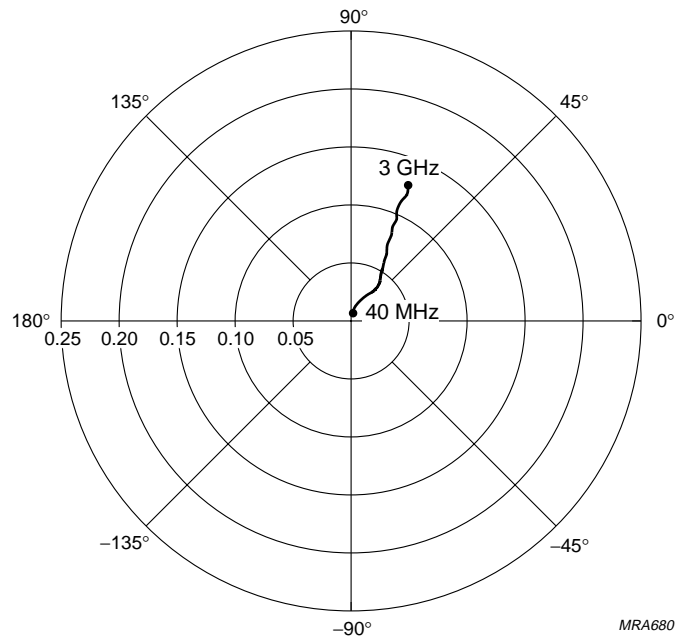
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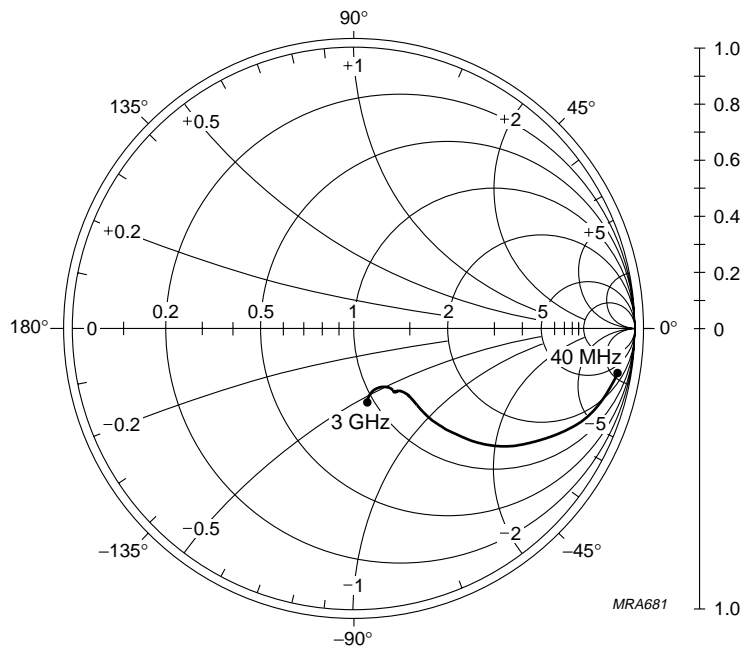
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$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}.$

MRA680

Fig.19 Common emitter reverse transmission coefficient ( $S_{12}$ ).



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

MRA681

Fig.20 Common emitter output reflection coefficient ( $S_{22}$ ).

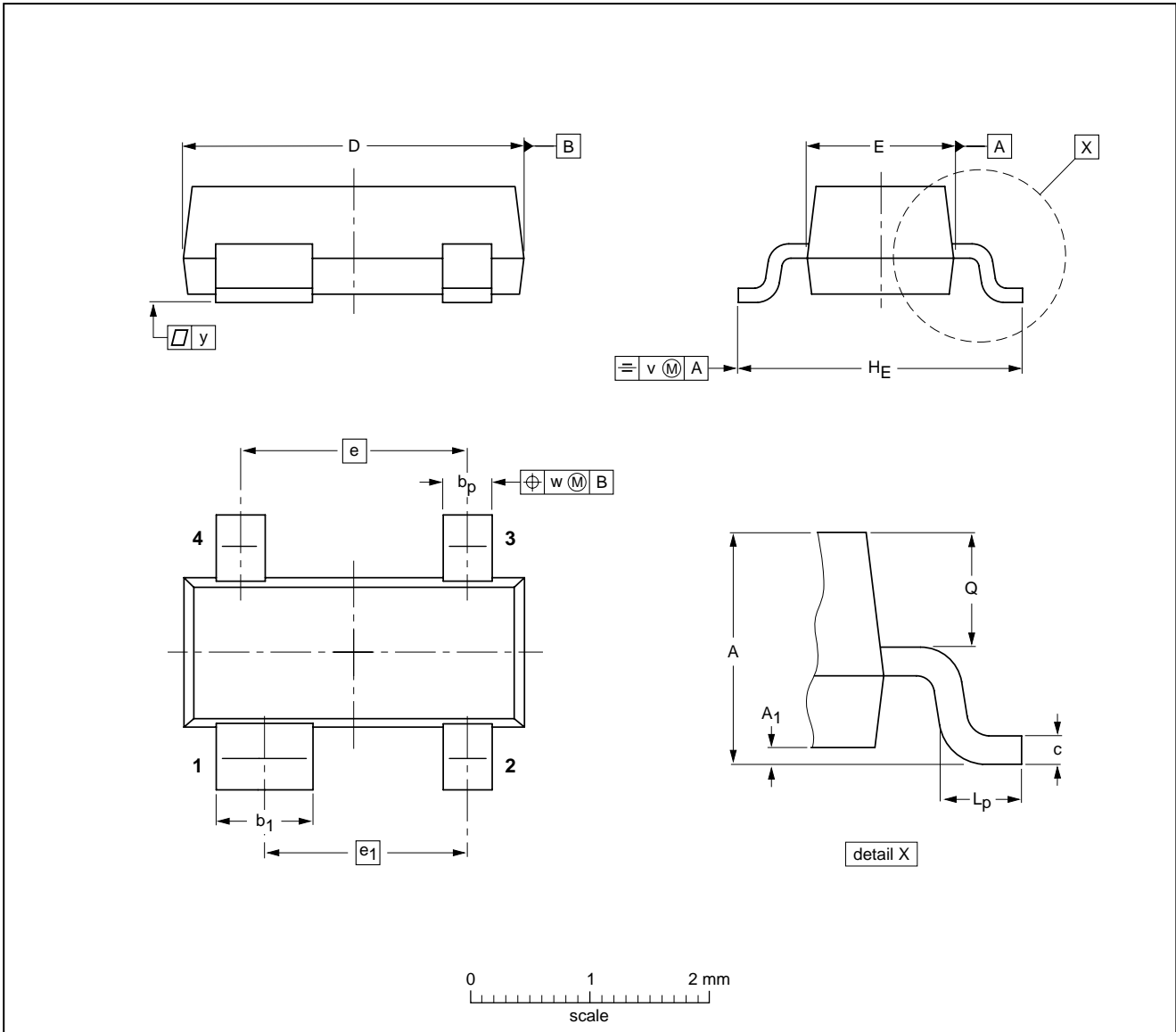
NPN 9 GHz wideband transistor

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PACKAGE OUTLINES

Plastic surface mounted package; 4 leads

SOT143B



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	b <sub>1</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1	0.1

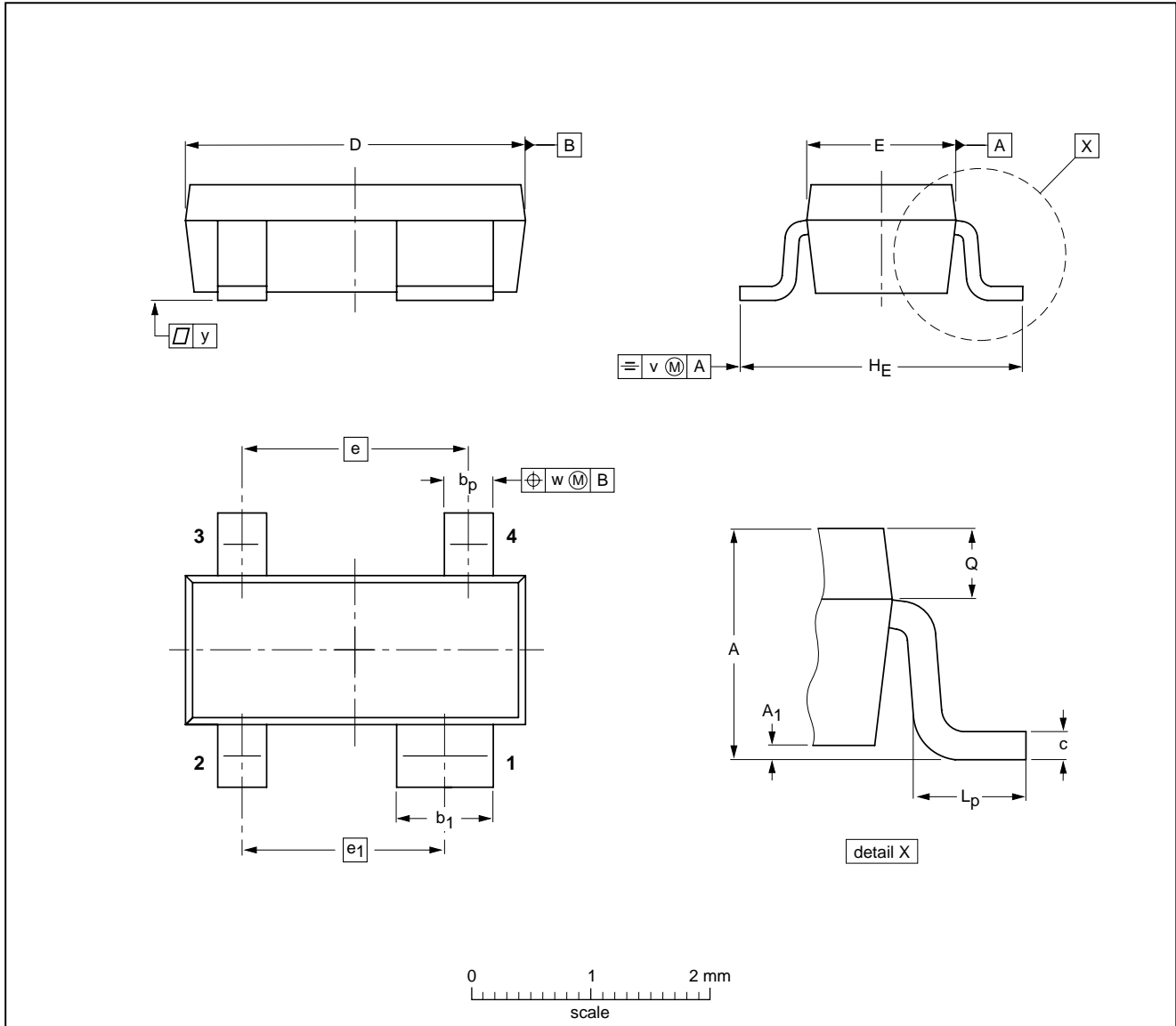
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

Plastic surface mounted package; reverse pinning; 4 leads

SOT143R



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	b <sub>1</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w	y
mm	1.1 0.9	0.1	0.48 0.38	0.88 0.78	0.15 0.09	3.0 2.8	1.4 1.2	1.9	1.7	2.5 2.1	0.55 0.25	0.45 0.25	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143R						97-03-10

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### 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.

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

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## Revision history

### Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFG520XR_N_4	20071123	Product data sheet	-	BFG520XR_CNV_3
Modifications:	<ul style="list-style-type: none"> <li>• Pinning table on page 2; changed code</li> </ul>			
BFG520XR_CNV_3	19950901	Product specification	-	BFG520XR_2
BFG520XR_2	-	Product specification	-	BFG520XR_1
BFG520XR_1	-	-	-	-

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