

**DISCRETE SEMICONDUCTORS**

# DATA SHEET

## **BFG520; BFG520/X; BFG520/XR** NPN 9 GHz wideband transistor

Product specification  
File under Discrete Semiconductors, SC14

September 1995

**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.

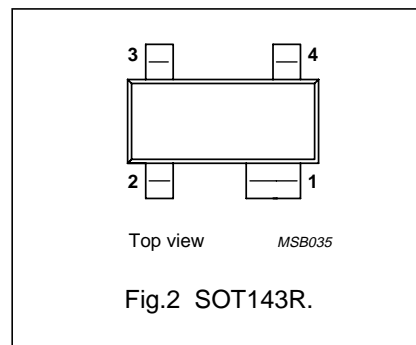
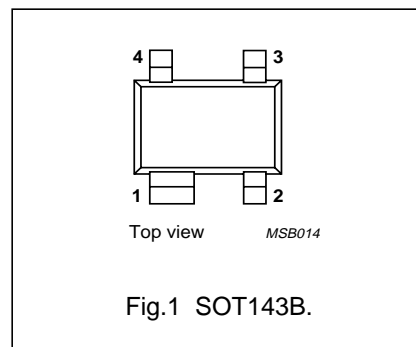
**DESCRIPTION**

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: N36	
1	collector
2	base
3	emitter
4	emitter
BFG520/X (Fig.1) Code: N42	
1	collector
2	emitter
3	base
4	emitter
BFG520/XR (Fig.2) Code: N48	
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

$T_j = 25\text{ °C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0; V_{CB} = 6\text{ V}$	–	–	50	nA
$h_{FE}$	DC current gain	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}$	60	120	250	
$C_e$	emitter capacitance	$I_C = i_c = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$	–	1	–	pF
$C_c$	collector capacitance	$I_E = i_e = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz}$	–	0.6	–	pF
$C_{re}$	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 (note 1)	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz};$ $T_{amb} = 25\text{ °C}$	–	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
		$\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$ $f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$	–	1.9	–	dB
$P_{L1}$	output power at 1 dB gain compression	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; R_L = 50\text{ }\Omega;$ $f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$	–	17	–	dBm
ITO	third order intercept point	note 2	–	26	–	dBm
$V_o$	output voltage	note 3	–	275	–	mV
$d_2$	second order intermodulation distortion	$I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; V_o = 75\text{ mV};$ $T_{amb} = 25\text{ °C}; f_{(p+q)} = 810\text{ MHz}$	–	–50	–	dB

## Notes

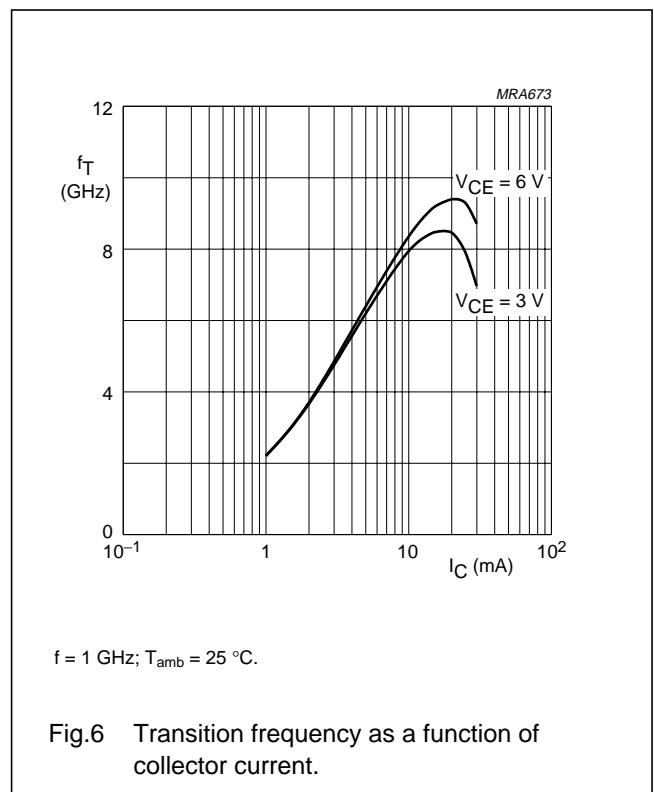
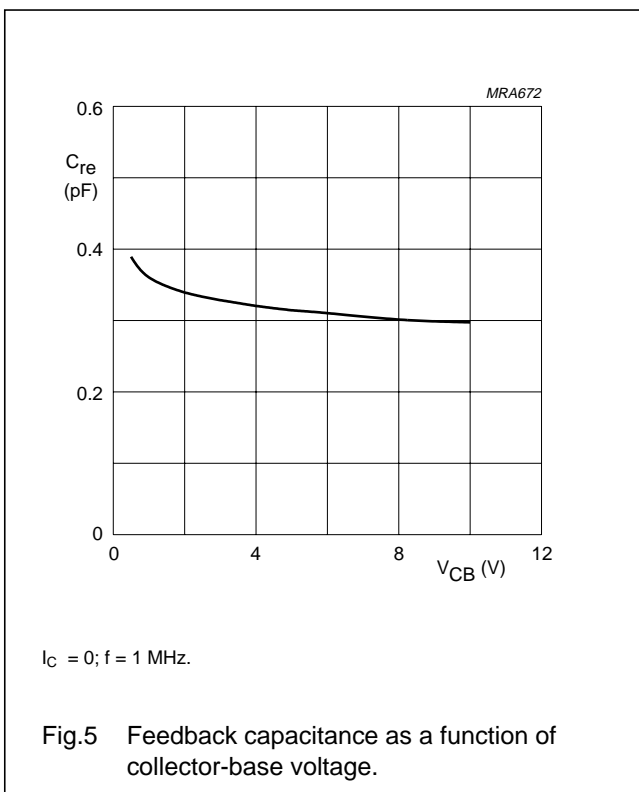
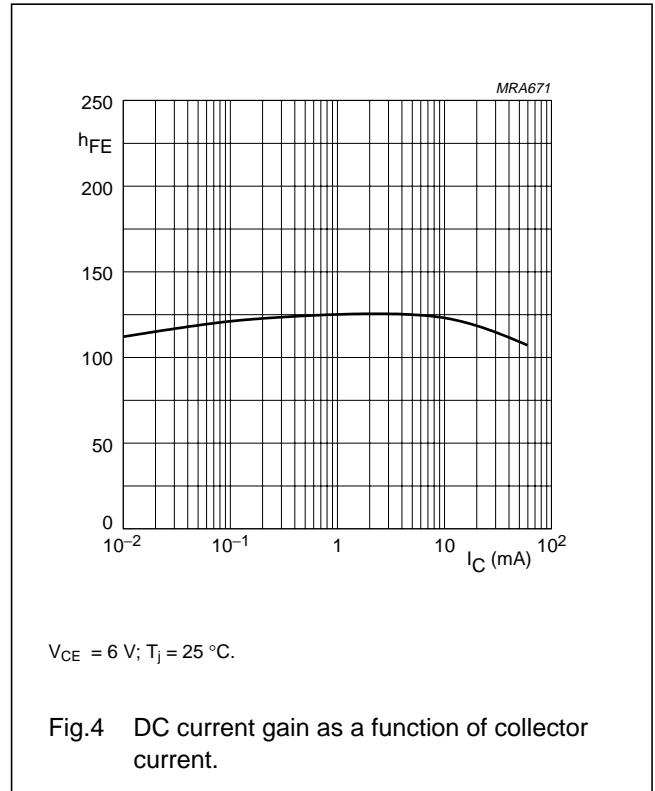
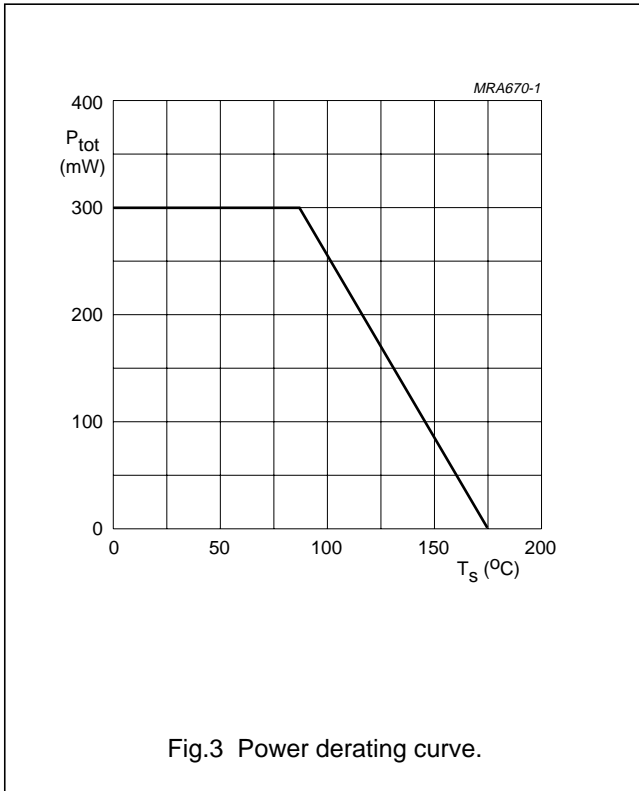
1.  $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and

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

2.  $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; R_L = 50\text{ }\Omega; f = 900\text{ MHz}; T_{amb} = 25\text{ °C};$   
 $f_p = 900\text{ MHz}; f_q = 902\text{ MHz};$   
 measured at  $f_{(2p-q)} = 898\text{ MHz}$  and  $f_{(2q-p)} = 904\text{ MHz}.$
3.  $d_{im} = -60\text{ dB}$  (DIN 45004B);  
 $V_p = V_o; V_q = V_o - 6\text{ dB}; V_r = V_o - 6\text{ dB};$   
 $f_p = 795.25\text{ MHz}; f_q = 803.25\text{ MHz}; f_r = 805.25\text{ MHz};$   
 measured at  $f_{(p+q-r)} = 793.25\text{ MHz}$

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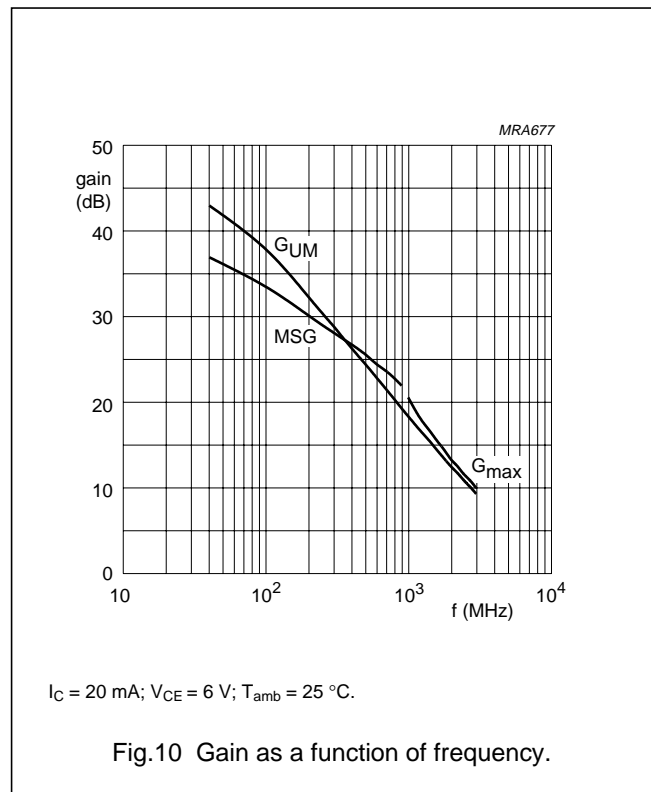
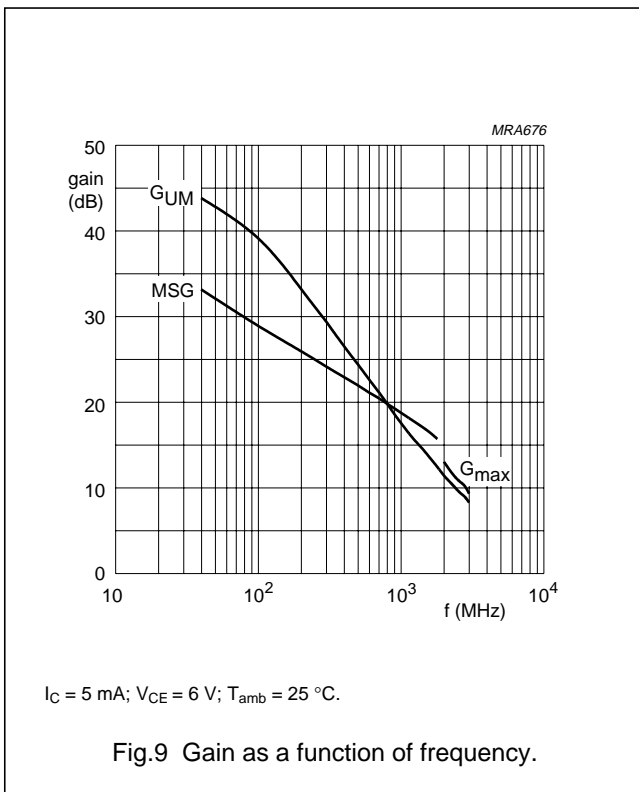
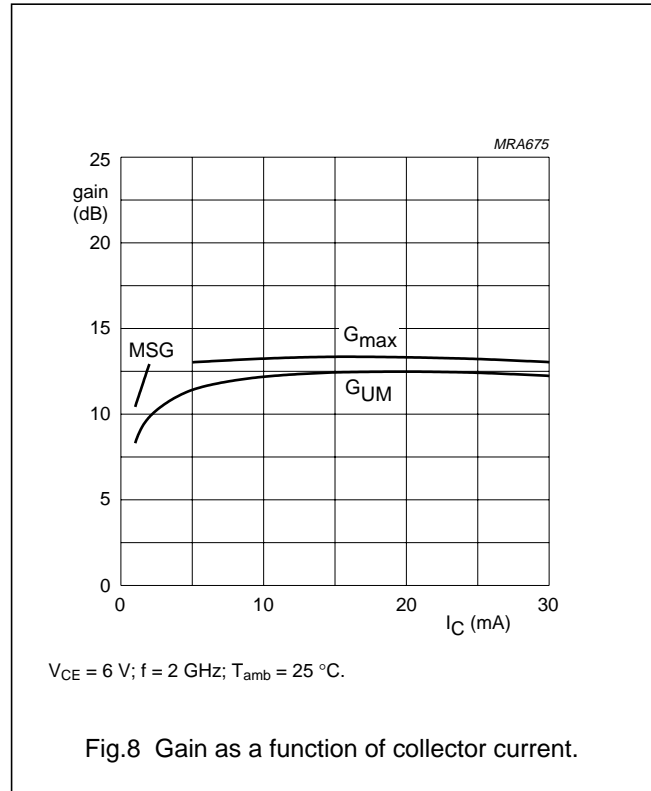
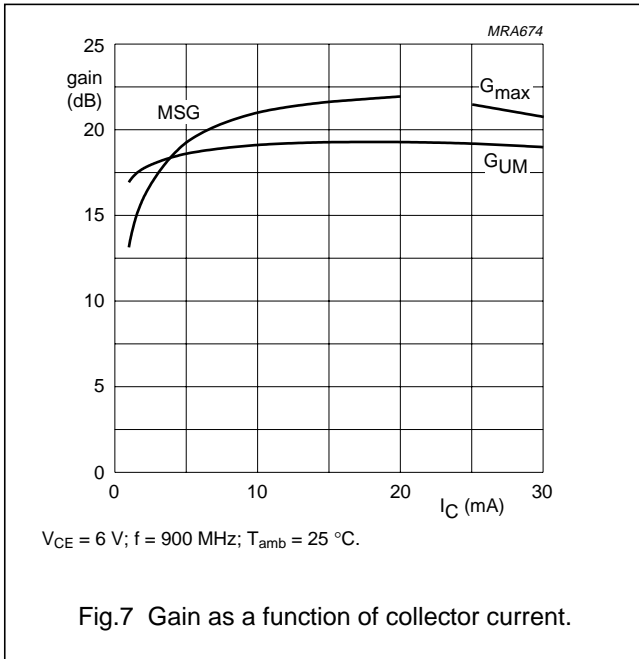
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In Figs 7 to 10,  $G_{UM}$  = maximum unilateral power gain; MSG = maximum stable gain;  $G_{max}$  = maximum available gain.



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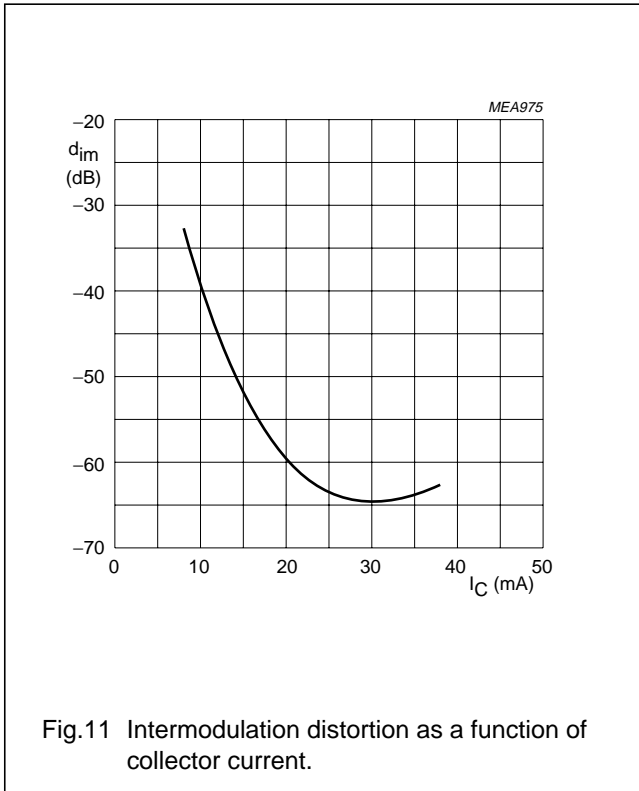


Fig.11 Intermodulation distortion as a function of collector current.

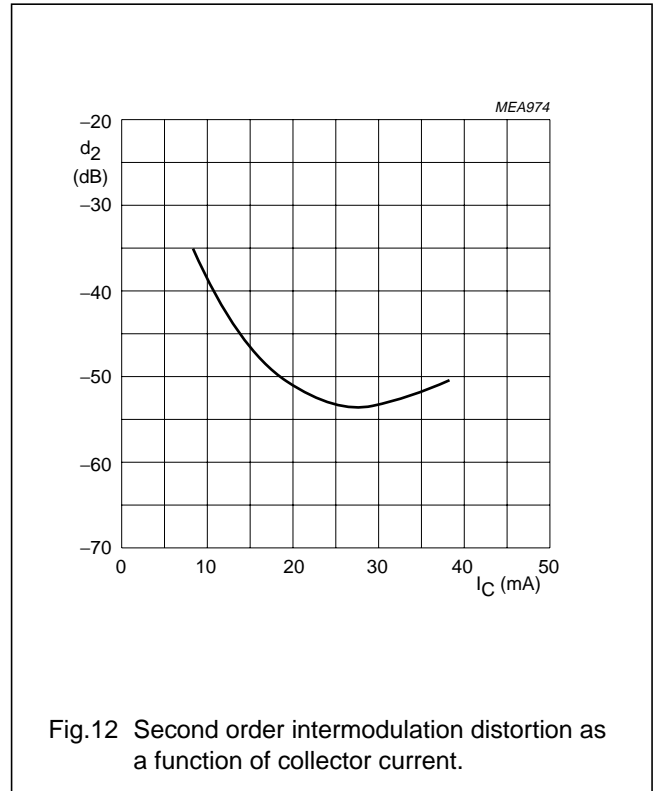
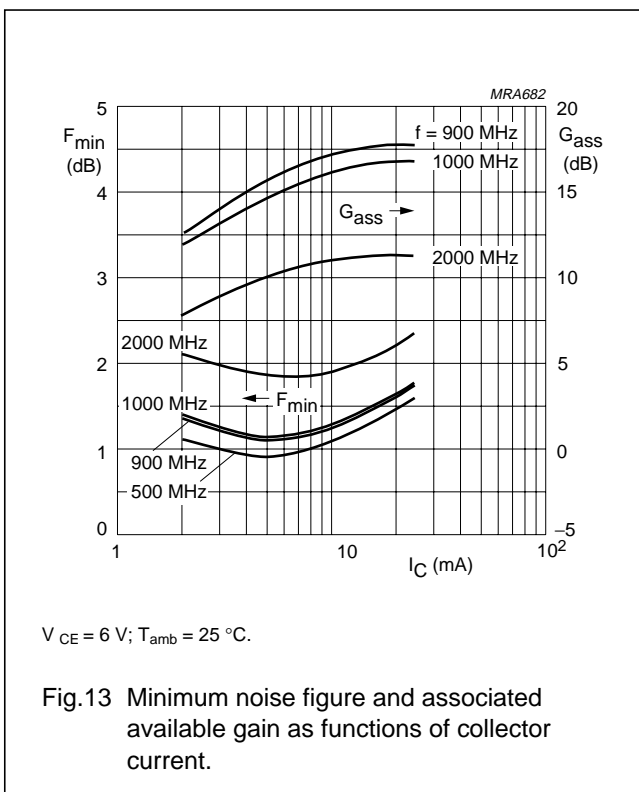
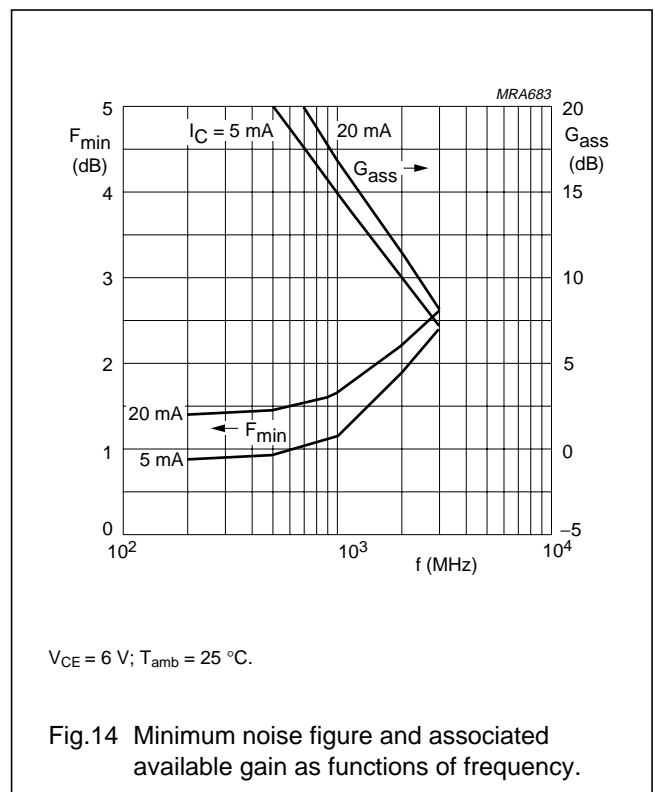


Fig.12 Second order intermodulation distortion as a function of collector current.



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

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

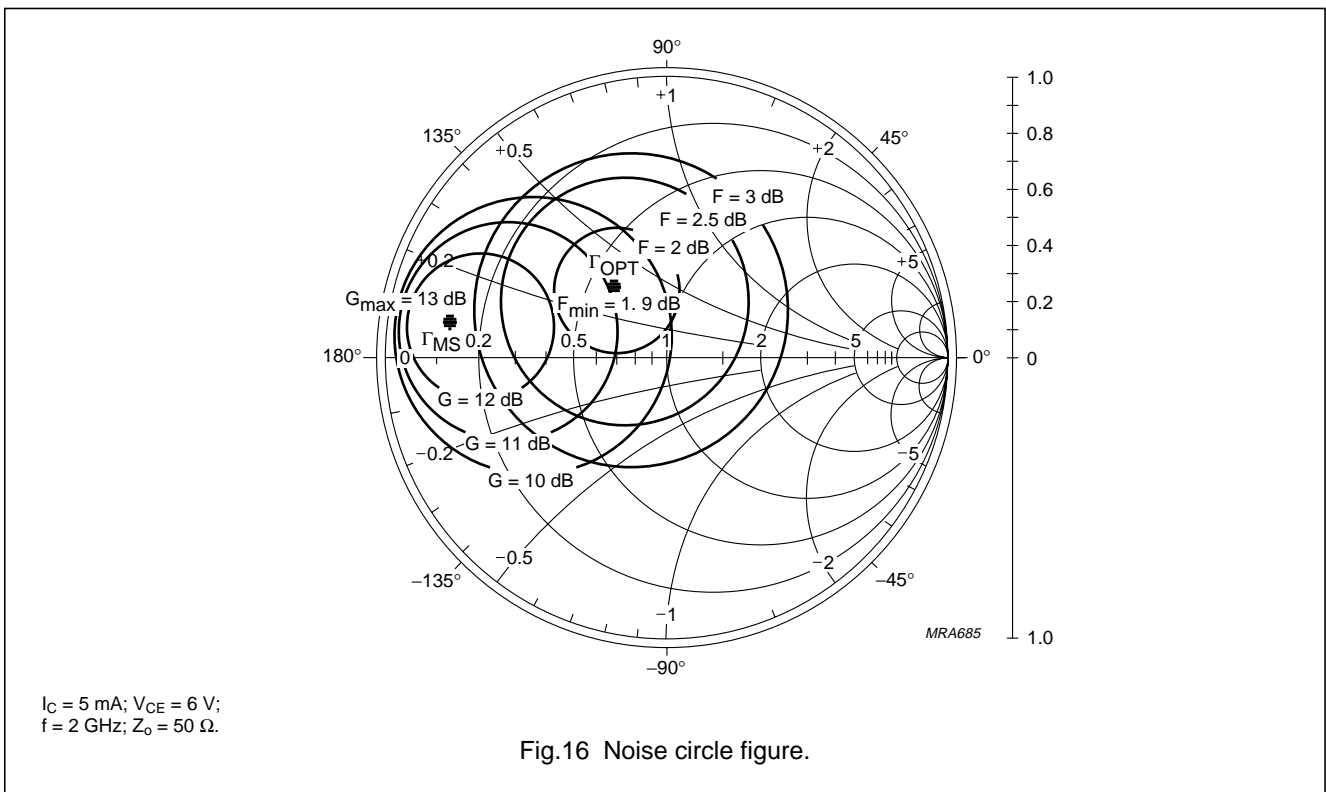
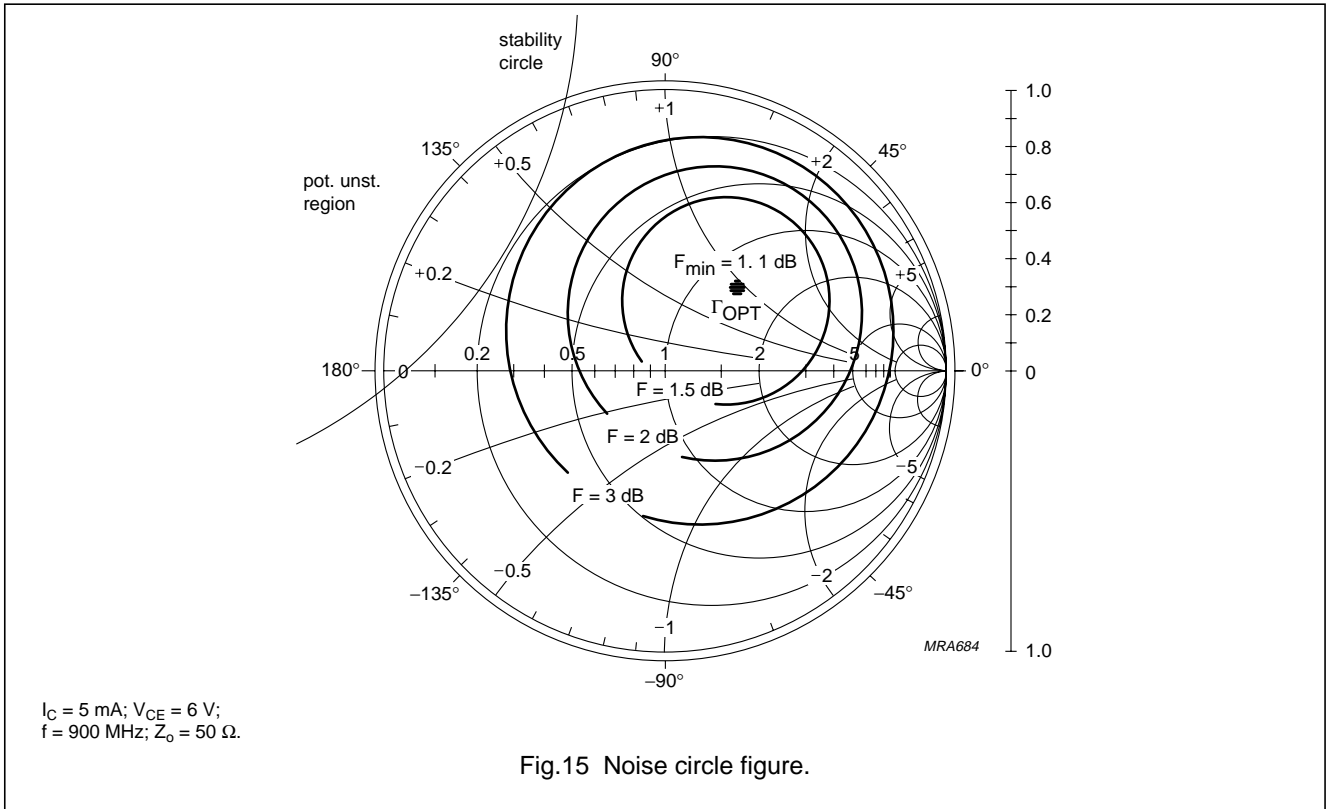


$V_{CE} = 6 V$ ;  $T_{amb} = 25 ^\circ C$ .

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

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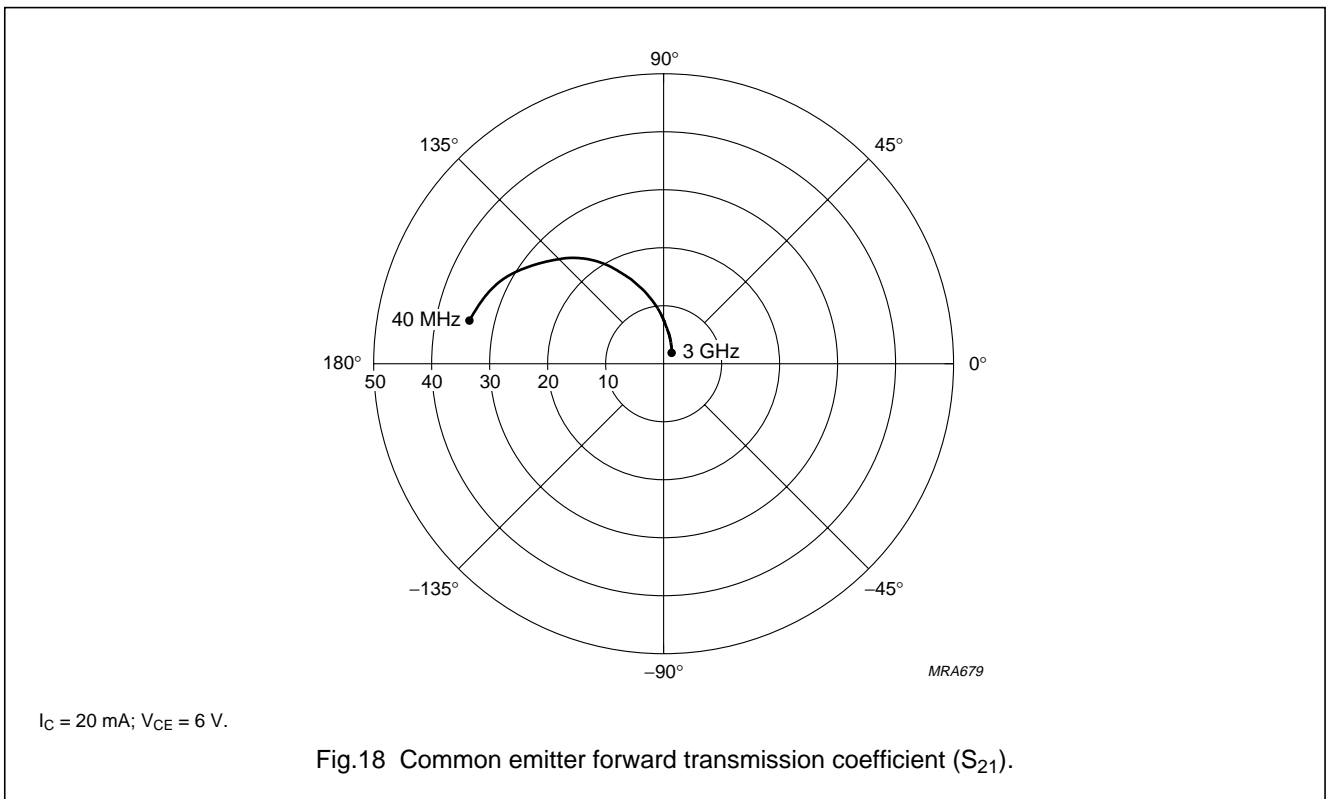
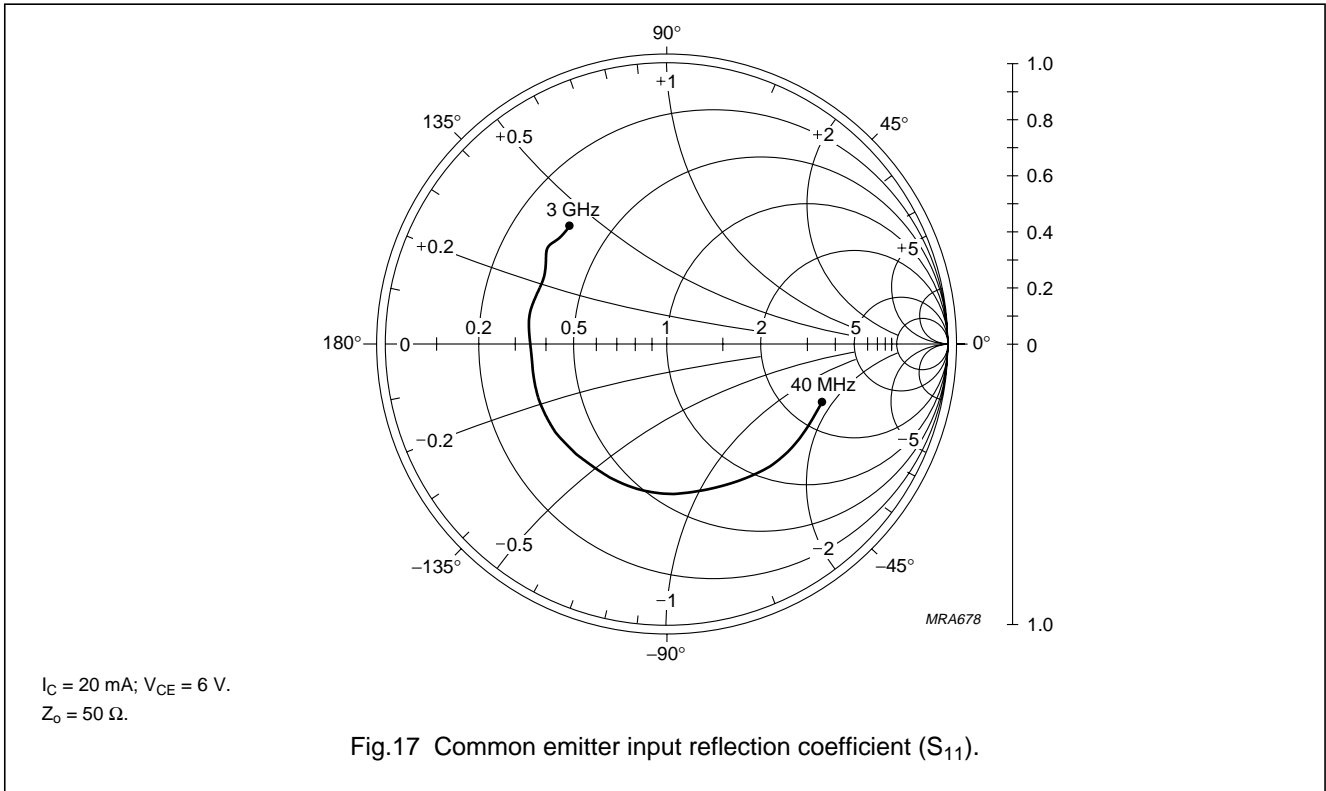
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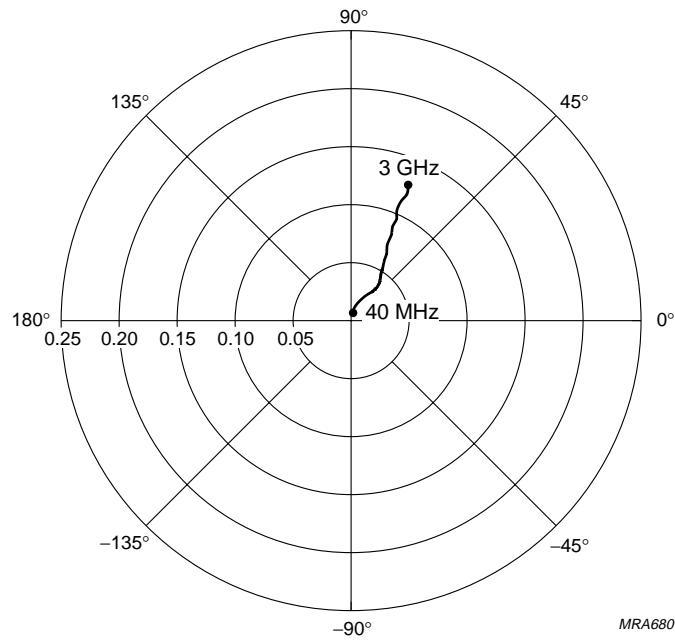
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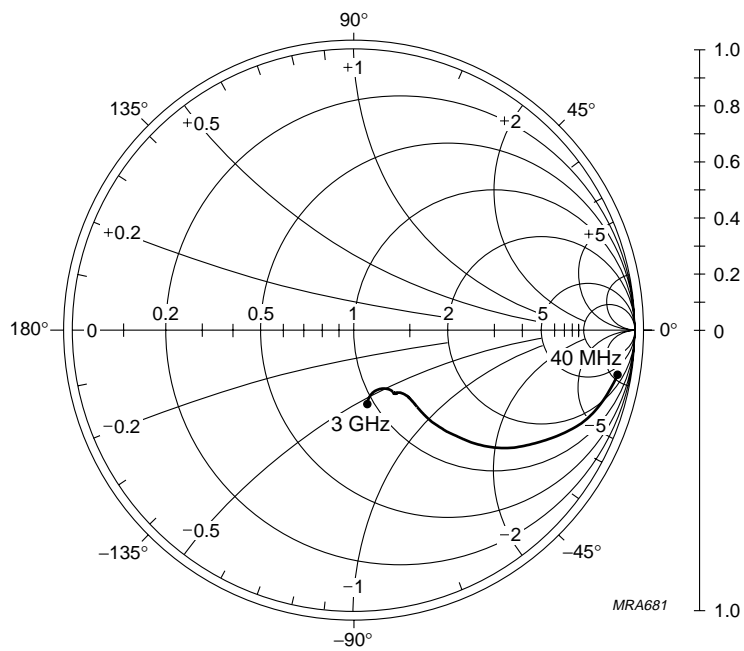
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$I_C = 20 \text{ mA}; V_{CE} = 6 \text{ V}.$

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



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

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

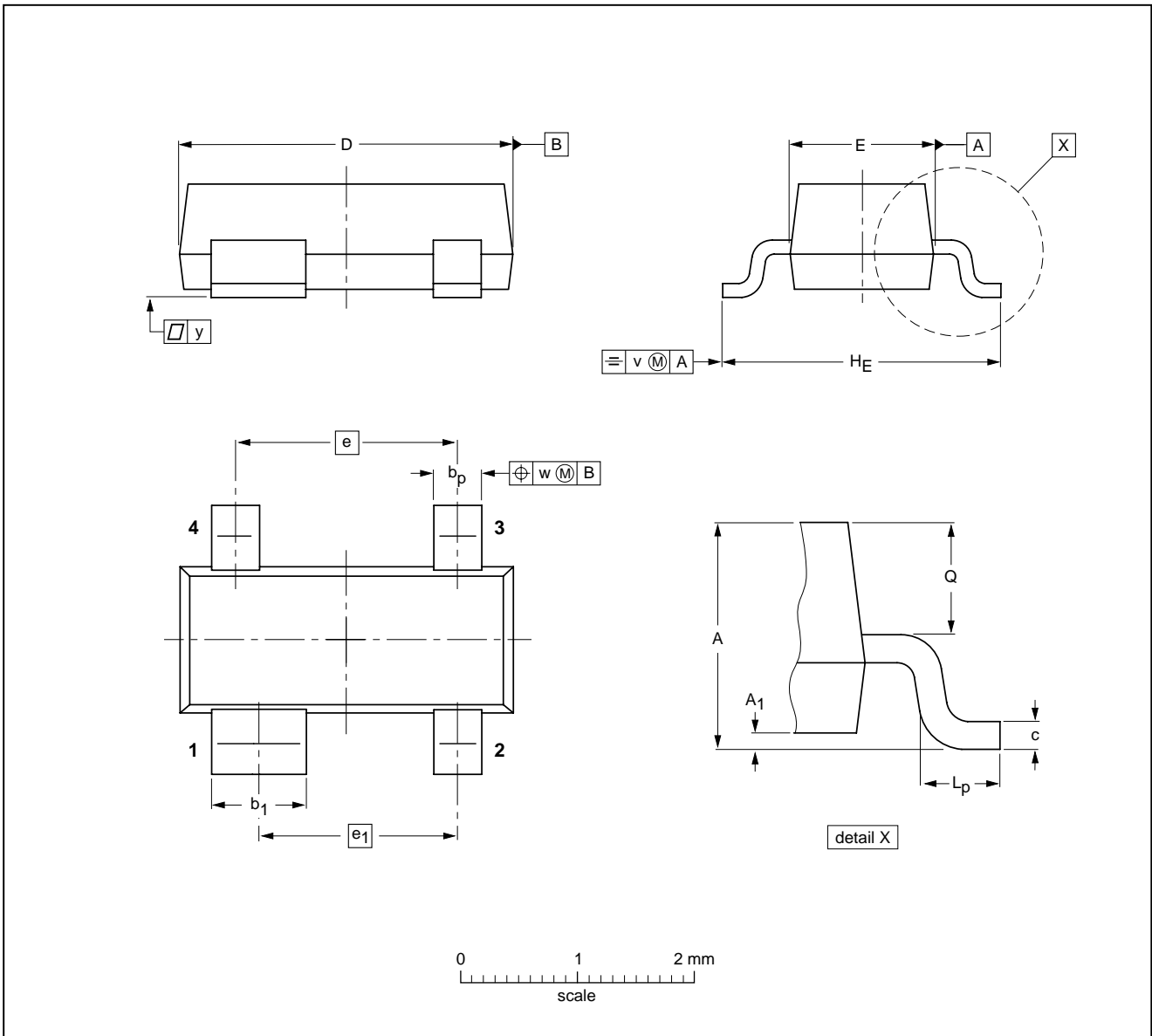
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PACKAGE OUTLINES

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

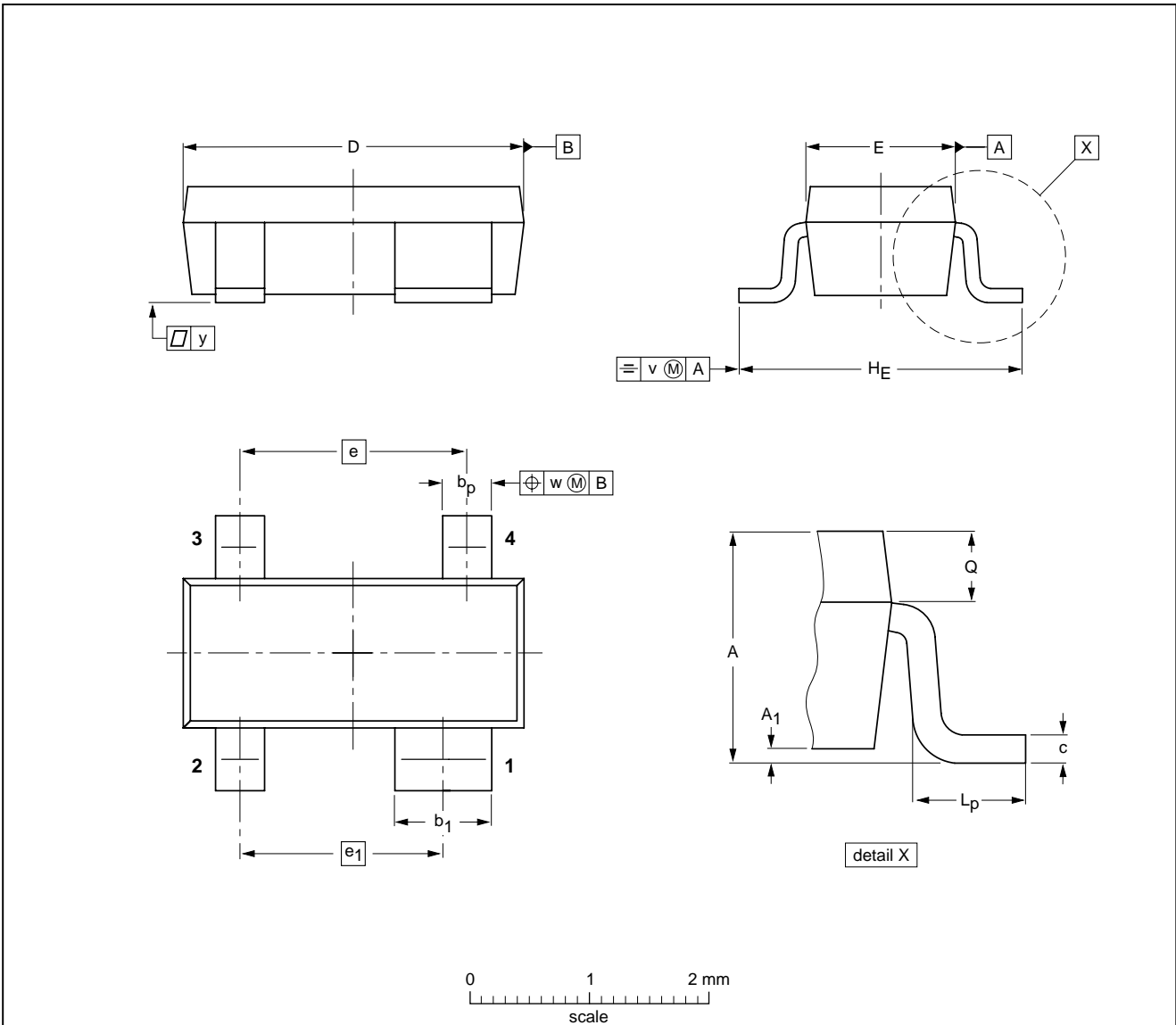
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

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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**DEFINITIONS**

<b>Data Sheet Status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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