

# DATA SHEET

## **BFG505W; BFG505W/X; BFG505W/XR** NPN 9 GHz wideband transistors

Product specification  
Supersedes data of 1998 Oct 02

2000 Oct 30

# NPN 9 GHz wideband transistors

# BFG505W; BFG505W/X; BFG505W/XR

### FEATURES

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

### APPLICATIONS

RF front end applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT2, CT3, PCN, DECT, etc.), radar detectors, pagers, satellite television tuners (SATV).

### DESCRIPTION

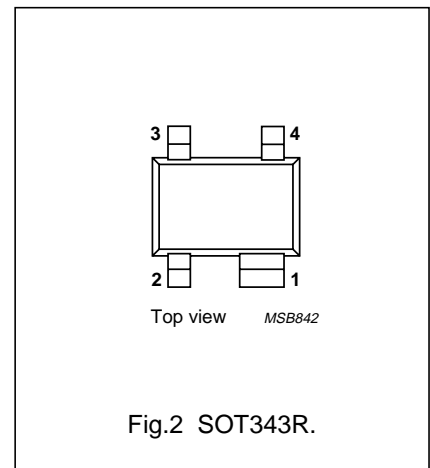
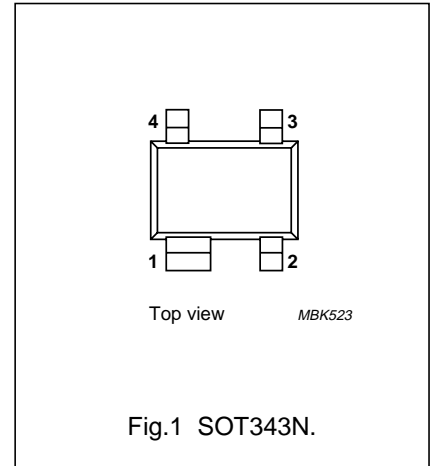
NPN silicon planar epitaxial transistors in 4-pin dual-emitter SOT343N and SOT343R plastic packages.

### MARKING

TYPE NUMBER	CODE
BFG505W	N0
BFG505W/X	N1
BFG505W/XR	P0

### PINNING

PIN	DESCRIPTION
<b>BFG505W</b> (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
<b>BFG505W/X</b> (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
<b>BFG505W/XR</b> (see Fig.2)	
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
$V_{CES}$	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
$I_C$	collector current (DC)		–	–	18	mA
$P_{tot}$	total power dissipation	$T_s \leq 85\text{ °C}$	–	–	500	mW
$h_{FE}$	DC current gain	$I_C = 5\text{ mA}; V_{CE} = 6\text{ V}$	60	120	250	
$C_{re}$	feedback capacitance	$I_C = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz}$	–	0.2	–	pF
$f_T$	transition frequency	$I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 1\text{ GHz}; T_{amb} = 25\text{ °C}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$	–	19	–	dB
		$I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$	–	12	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$	15	16	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}; I_C = 1.25\text{ mA}; V_{CE} = 6\text{ V}; f = 2\text{ GHz}$	–	1.9	–	dB

## NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
BFG505W/XR**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	$R_{BE} = 0$	–	15	V
$V_{EBO}$	emitter-base voltage	open collector	–	2.5	V
$I_C$	collector current (DC)		–	18	mA
$P_{tot}$	total power dissipation	$T_s \leq 85\text{ °C}$ ; see Fig.3; note 1	–	500	mW
$T_{stg}$	storage temperature		–65	+150	°C
$T_j$	junction temperature		–	175	°C

**Note**

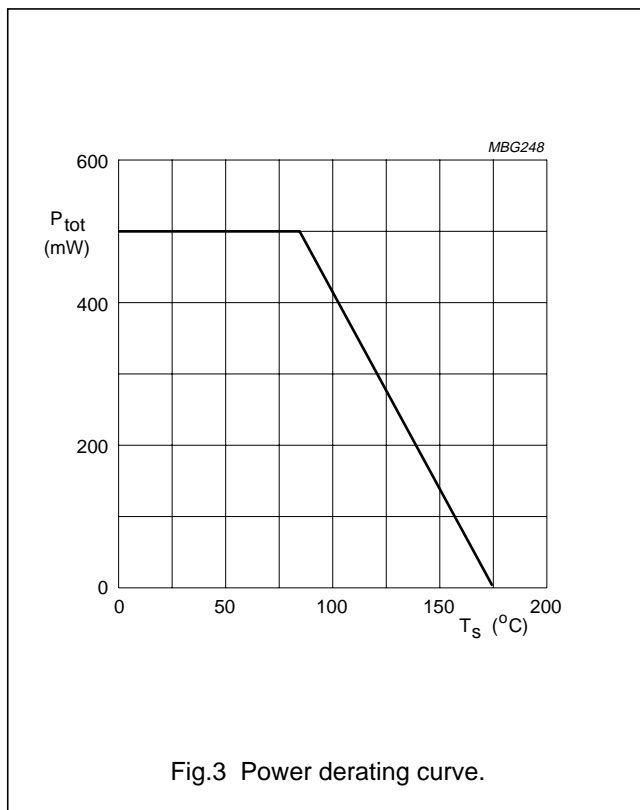
- $T_s$  is the temperature at the soldering point of the collector pin.

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	$T_s \leq 85\text{ °C}$ ; note 1	180	K/W

**Note**

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



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## CHARACTERISTICS

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

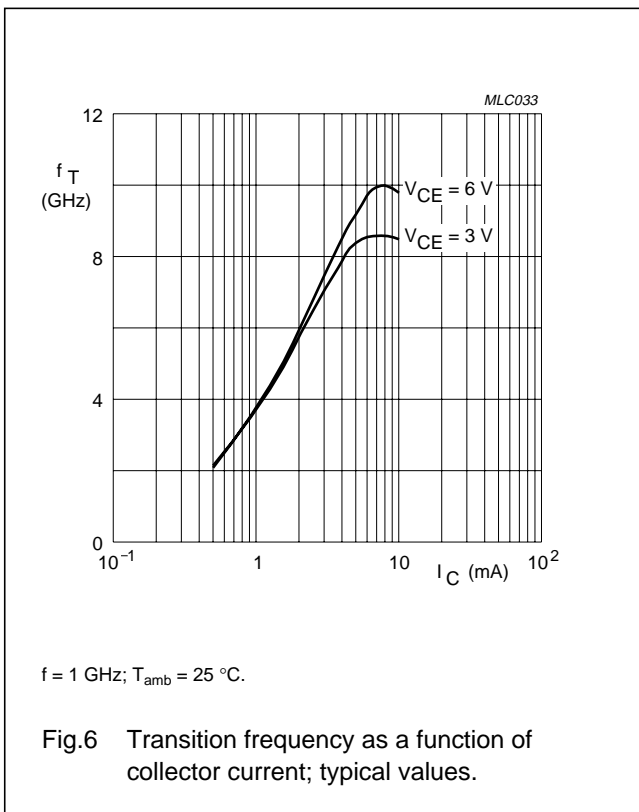
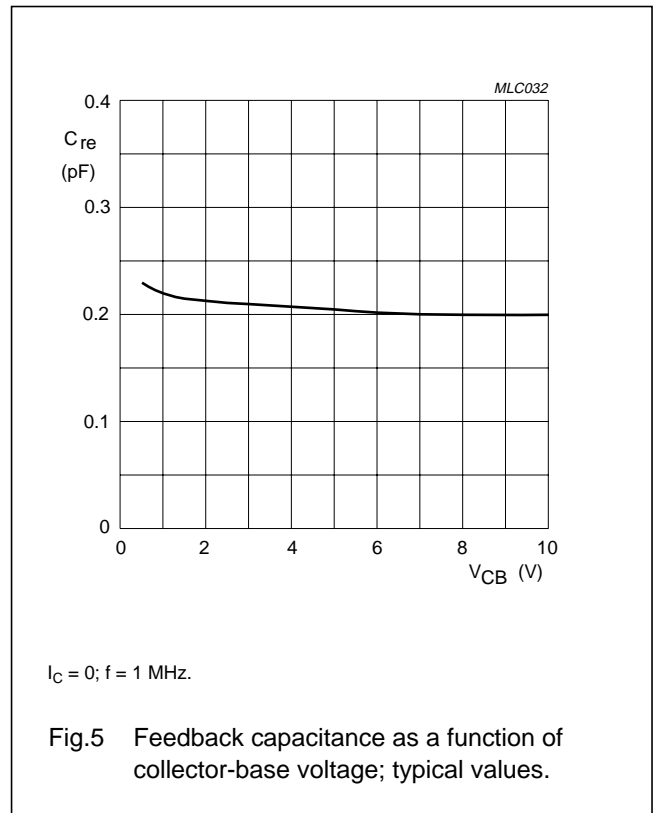
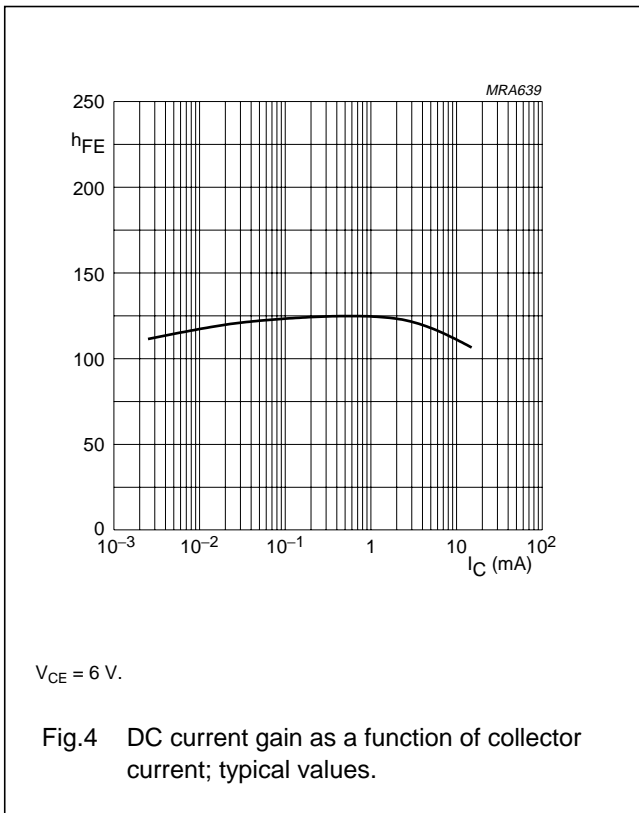
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V <sub>(BR)CBO</sub>	collector-base breakdown voltage	I <sub>C</sub> = 2.5 μA; I <sub>E</sub> = 0	20	–	–	V
V <sub>(BR)CES</sub>	collector-emitter breakdown voltage	I <sub>C</sub> = 10 μA; R <sub>BE</sub> = 0	15	–	–	V
V <sub>(BR)EBO</sub>	emitter-base breakdown voltage	I <sub>E</sub> = 2.5 μA; I <sub>C</sub> = 0	2.5	–	–	V
I <sub>CBO</sub>	collector leakage current	V <sub>CB</sub> = 6 V; I <sub>E</sub> = 0	–	–	50	nA
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V see Fig.4	60	120	250	
f <sub>T</sub>	transition frequency	I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 1 GHz; T <sub>amb</sub> = 25 °C; see Fig.6	–	9	–	GHz
C <sub>c</sub>	collector capacitance	I <sub>E</sub> = i <sub>e</sub> = 0; V <sub>CB</sub> = 6 V; f = 1 MHz	–	0.3	–	pF
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	–	0.4	–	pF
C <sub>re</sub>	feedback capacitance	I <sub>C</sub> = 0; V <sub>CB</sub> = 6 V; f = 1 MHz; see Fig.5	–	0.2	–	pF
G <sub>UM</sub>	maximum unilateral power gain; note 1	I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	19	–	dB
		I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	–	12	–	dB
s <sub>21</sub>   <sup>2</sup>	insertion power gain	I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	15	16	–	dB
F	noise figure	Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 1.25 mA; V <sub>CE</sub> = 6 V; f = 900 MHz	–	1.2	1.7	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 900 MHz	–	1.6	2.1	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 1.25 mA; V <sub>CE</sub> = 6 V; f = 2 GHz	–	1.9	–	dB
P <sub>L1</sub>	output power at 1 dB gain compression	I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 6 V; f = 900 MHz; R <sub>L</sub> = 50 Ω; T <sub>amb</sub> = 25 °C	–	4	–	dBm
ITO	third order intercept point	note 2	–	10	–	dBm

## Notes

- G<sub>UM</sub> is the maximum unilateral power gain, assuming s<sub>12</sub> is zero.  $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1 - |s_{11}|^2)(1 - |s_{22}|^2)}$  dB.
- I<sub>C</sub> = 5 mA; V<sub>CE</sub> = 6 V; R<sub>L</sub> = 50 Ω; T<sub>amb</sub> = 25 °C;  
f<sub>p</sub> = 900 MHz; f<sub>q</sub> = 902 MHz;  
measured at 2f<sub>p</sub> – f<sub>q</sub> = 898 MHz and 2f<sub>q</sub> – f<sub>p</sub> = 904 MHz.

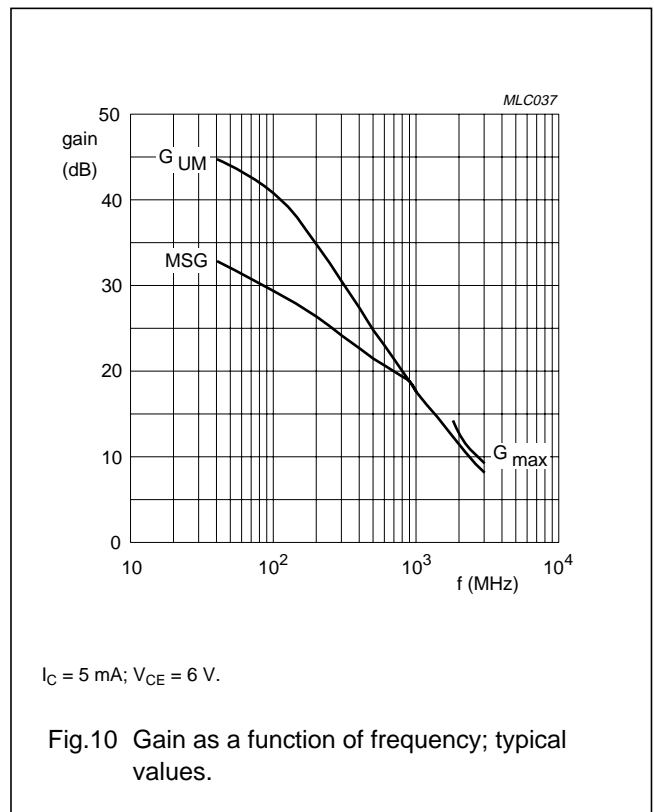
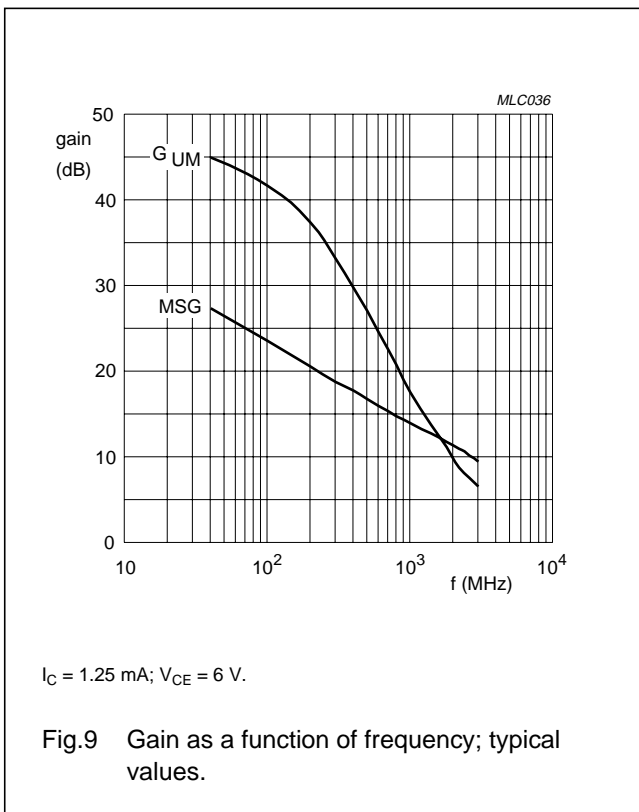
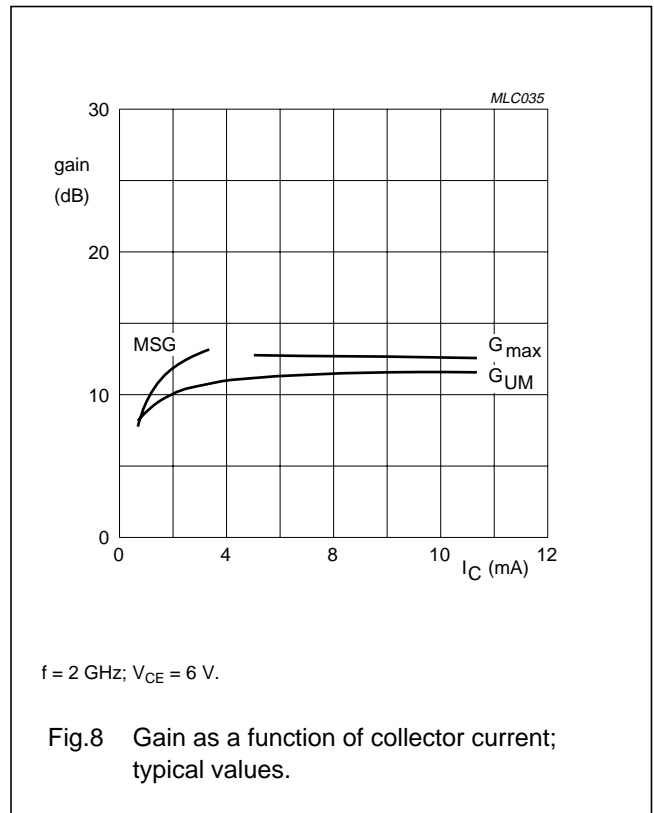
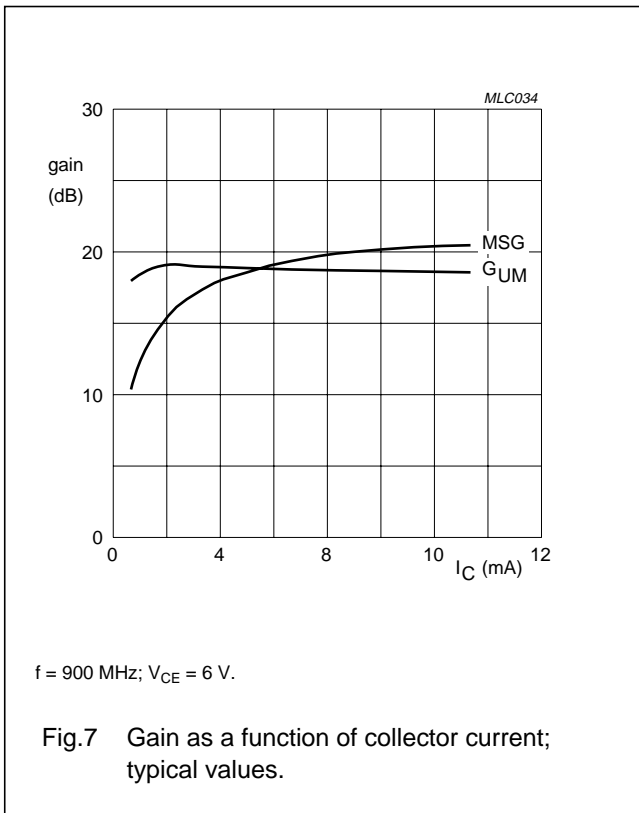
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BFG505W; BFG505W/X;  
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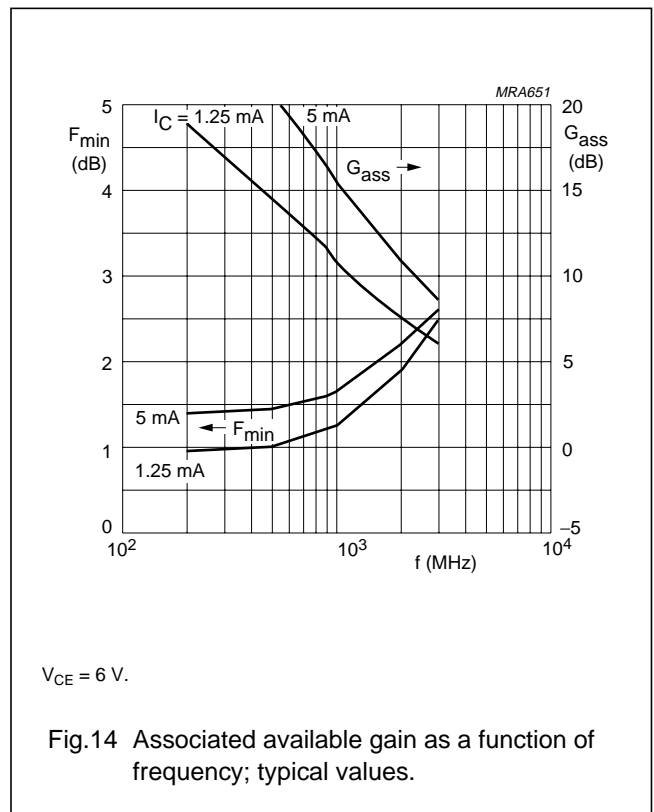
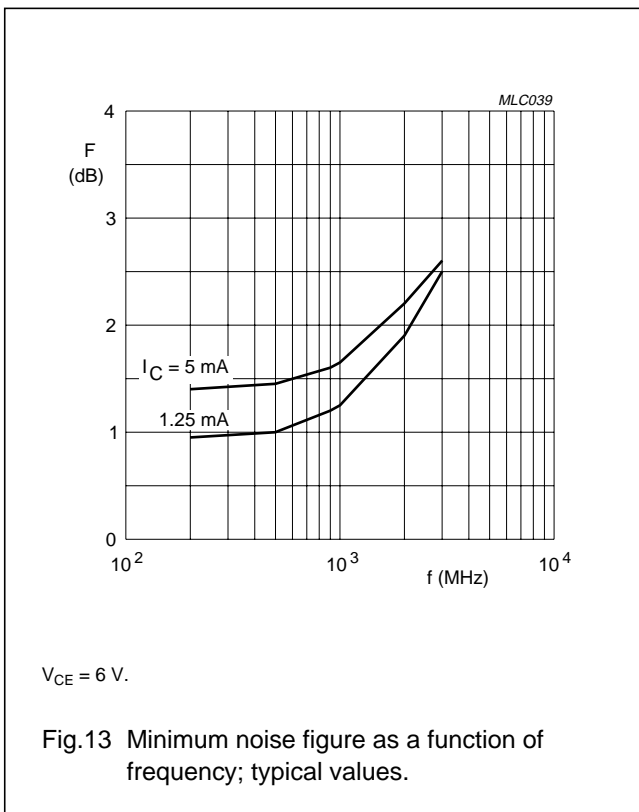
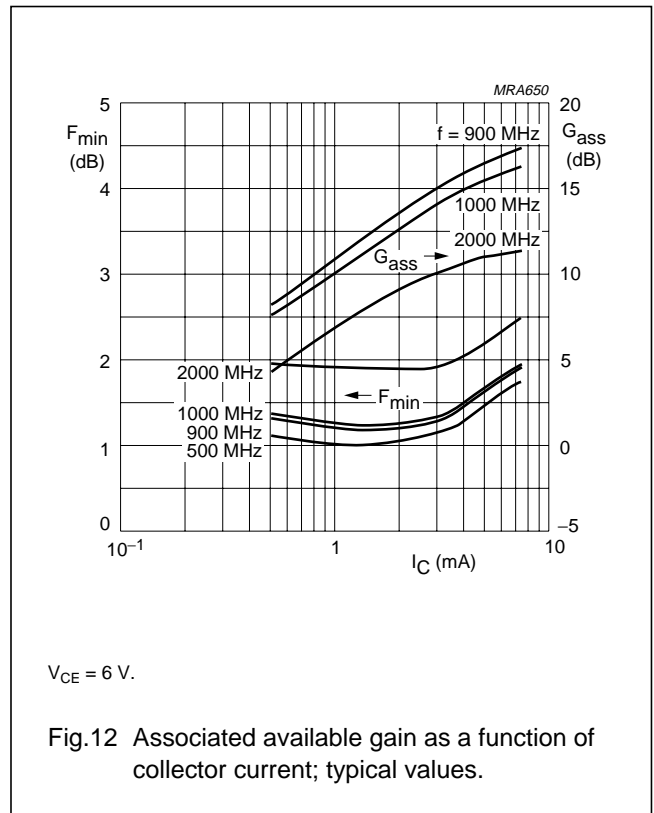
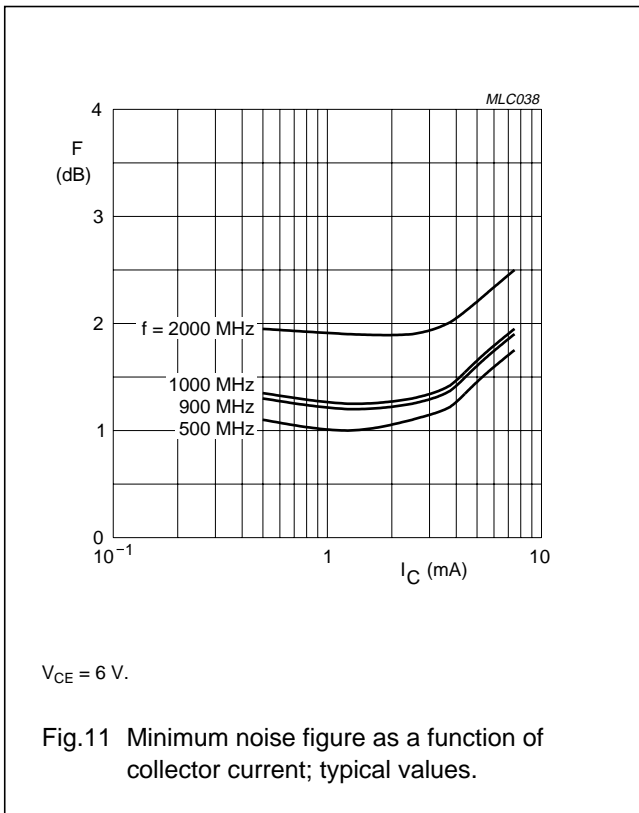
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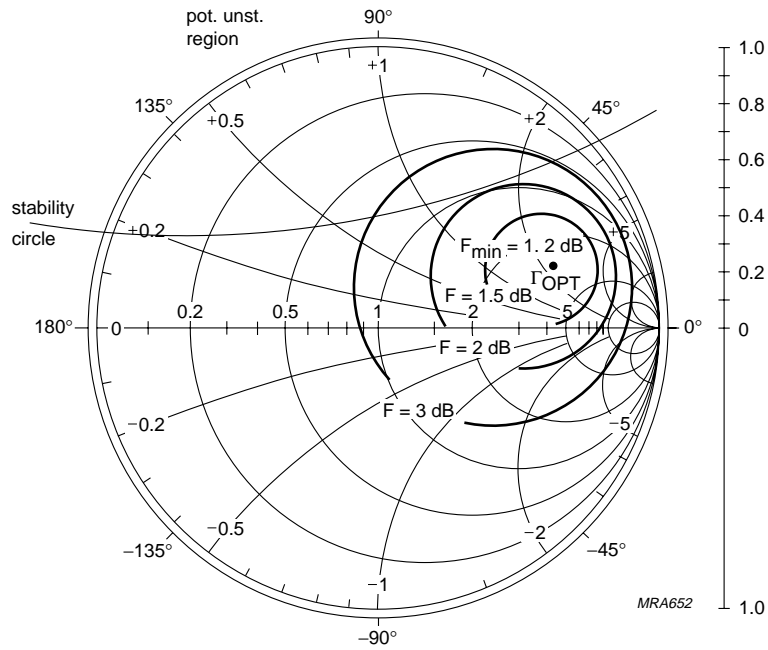
NPN 9 GHz wideband transistors

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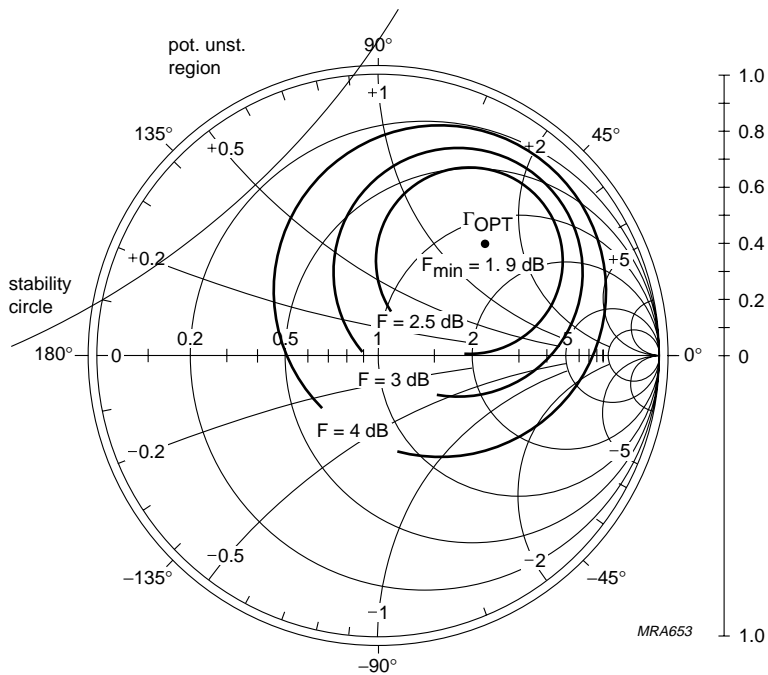
NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
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$f = 900 \text{ MHz}; V_{CE} = 6 \text{ V}; I_C = 1.25 \text{ mA}; Z_o = 50 \Omega.$

Fig.15 Common emitter noise figure circles; typical values.



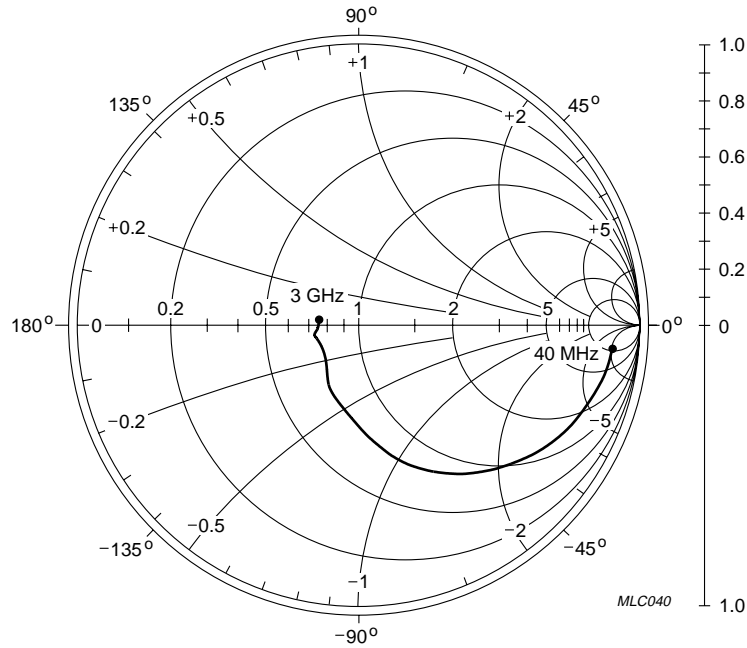
$f = 2 \text{ GHz}; V_{CE} = 6 \text{ V}; I_C = 1.25 \text{ mA}; Z_o = 50 \Omega.$

Fig.16 Common emitter noise figure circles; typical values.



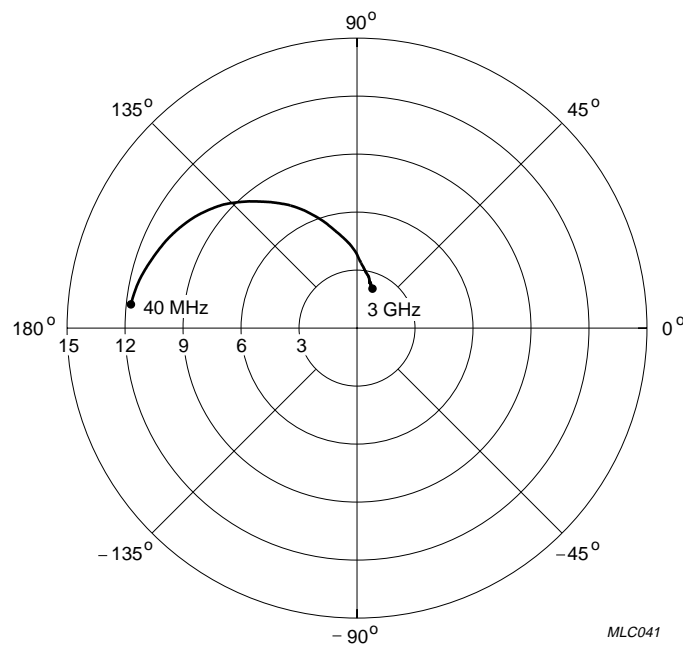
NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
BFG505W/XR



$V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; Z_o = 50\ \Omega.$

Fig.17 Common emitter input reflection coefficient ( $s_{11}$ ); typical values.

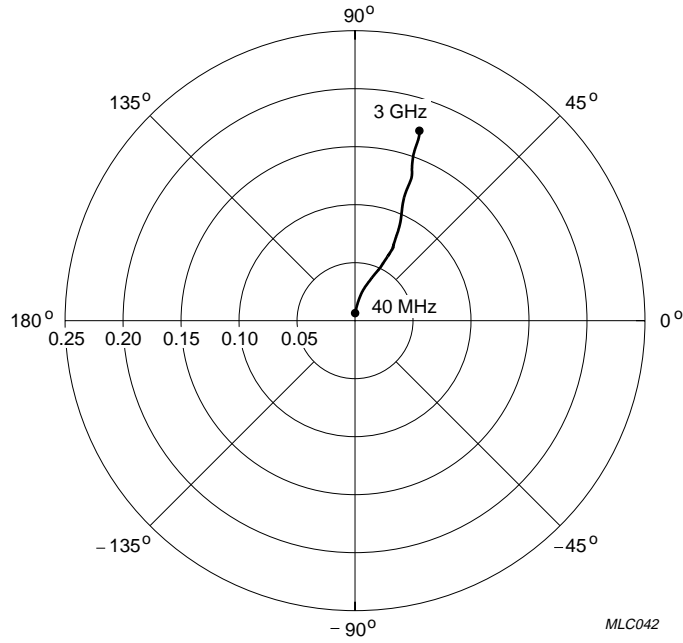


$V_{CE} = 6\text{ V}; I_C = 5\text{ mA}.$

Fig.18 Common emitter forward transmission coefficient ( $s_{21}$ ); typical values.

NPN 9 GHz wideband transistors

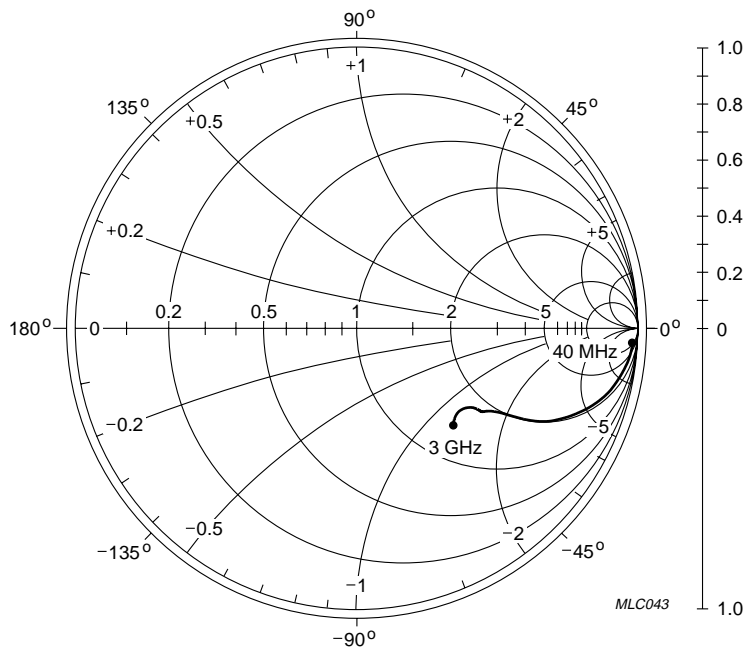
BFG505W; BFG505W/X;  
BFG505W/XR



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

MLC042

Fig.19 Common emitter reverse transmission coefficient ( $s_{12}$ ); typical values.



$V_{CE} = 6$  V;  $I_C = 5$  mA;  $Z_o = 50 \Omega$ .

MLC043

Fig.20 Common emitter output reflection coefficient ( $s_{22}$ ); typical values.

NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
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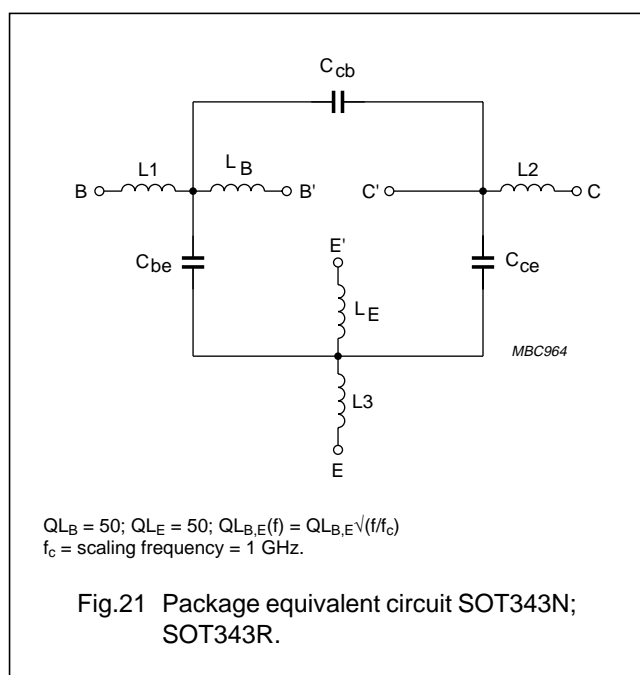
SPICE parameters for the BFG505W die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	134.1	aA
2	BF	180.0	–
3	NF	0.988	–
4	VAF	38.34	V
5	IKF	150.0	mA
6	ISE	27.81	fA
7	NE	2.051	–
8	BR	55.19	–
9	NR	0.982	–
10	VAR	2.459	V
11	IKR	2.920	mA
12	ISC	17.45	aA
13	NC	1.062	–
14	RB	20.00	Ω
15	IRB	1.000	μA
16	RBM	20.00	Ω
17	RE	1.171	Ω
18	RC	4.350	Ω
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	284.7	fF
23	VJE	600.0	mV
24	MJE	0.303	–
25	TF	7.037	ps
26	XTF	12.34	–
27	VTF	1.701	V
28	ITF	30.64	mA
29	PTF	0.000	deg
30	CJC	242.4	fF
31	VJC	188.6	mV
32	MJC	0.041	–
33	XCJC	0.130	–
34	TR	1.332	ns
35 (1)	CJS	0.000	F

SEQUENCE No.	PARAMETER	VALUE	UNIT
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.897	–

Note

1. These parameters have not been extracted, the default values are shown.



List of components (see Fig.21)

DESIGNATION	VALUE	UNIT
C <sub>be</sub>	70	fF
C <sub>cb</sub>	50	fF
C <sub>ce</sub>	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L <sub>B</sub>	0.40	nH
L <sub>E</sub>	0.40	nH

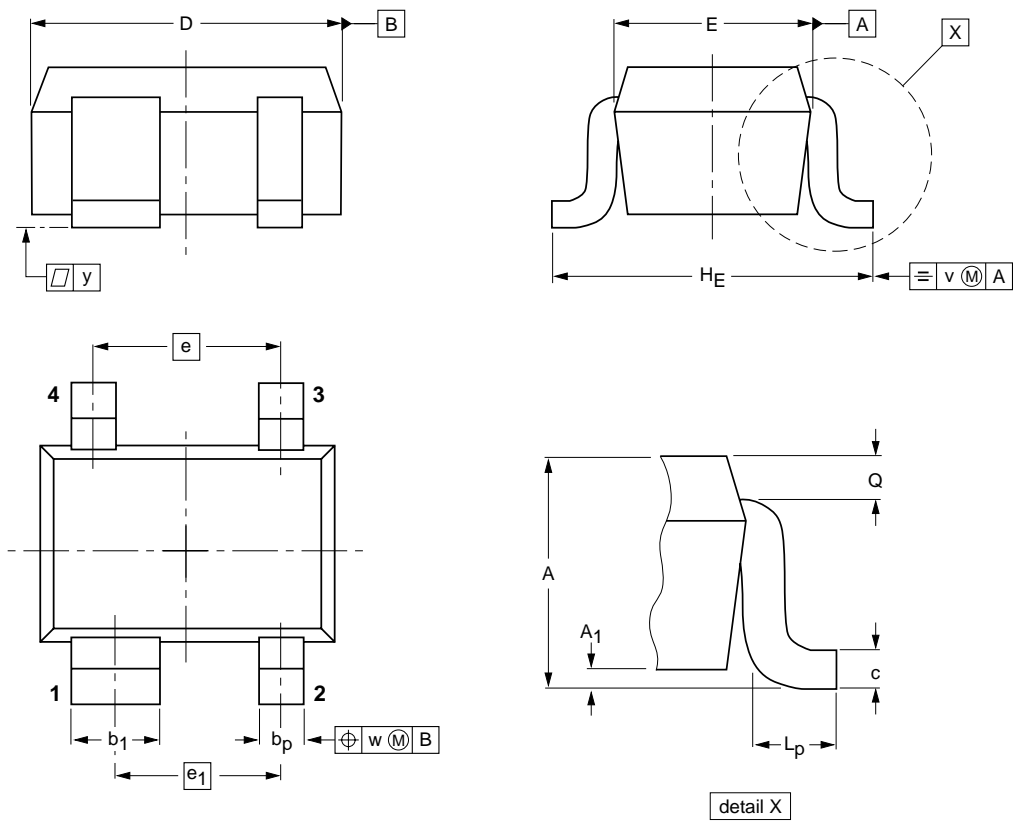
NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
BFG505W/XR

PACKAGE OUTLINES

Plastic surface mounted package; 4 leads

SOT343N



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 0.8	0.1	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2	0.1

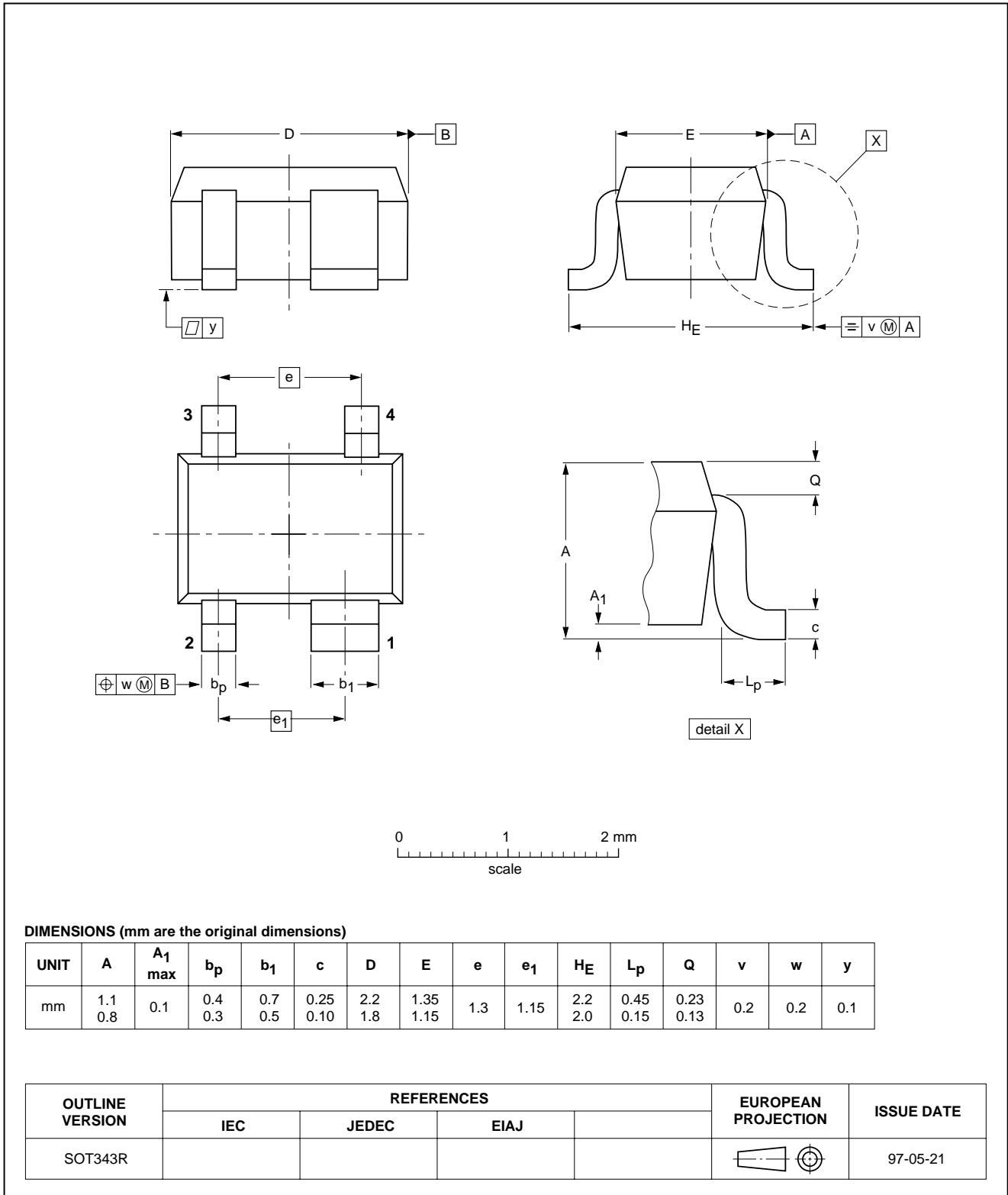
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SOT343N						97-05-21

NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
BFG505W/XR

Plastic surface mounted package; reverse pinning; 4 leads

SOT343R



## NPN 9 GHz wideband transistors

BFG505W; BFG505W/X;  
BFG505W/XR

## DATA SHEET STATUS

DATA SHEET STATUS	PRODUCT STATUS	DEFINITIONS <sup>(1)</sup>
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

## Note

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

## 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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BFG505W; BFG505W/X;  
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