DATA SHEET

BFG540W
BFG540W/X; BFG540W/XR
NPN 9 GHz wideband transistor

Product specification
Supersedes data of August 1995
File under Discrete Semiconductors, SC14

1997 Dec 04

Philips
Semiconductors

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NPN 9 GHz wideband transistor

BFG540W
BFG540W/X; BFG540W/XR

FEATURES

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

APPLICATIONS

They are intended for applications in the RF front end, in wideband 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), MATV/CATV amplifiers and repeater amplifiers in fibre-optic systems.

DESCRIPTION

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

MARKING

TYPE NUMBER	CODE
BFG540W	N9
BFG540W/X	N7
BFG540W/XR	N8

PINNING

PIN	DESCRIPTION
BFG540W (see Fig.1)	
1	collector
2	base
3	emitter
4	emitter
BFG540W/X (see Fig.1)	
1	collector
2	emitter
3	base
4	emitter
BFG540W/XR (see Fig.2)	
1	collector
2	emitter
3	base
4	emitter

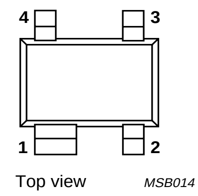


Fig.1 SOT343N.

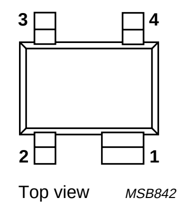


Fig.2 SOT343R.

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)		–	–	120	mA
P_{tot}	total power dissipation	up to T_s = 85 °C	–	–	500	mW
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V	60	120	250	
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.5	–	pF
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 40 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C		10	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	14	15	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 2 GHz	–	2.1	–	dB

LIMITING VALUES

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

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)		–	120	mA
P_{tot}	total power dissipation	up to T_s = 85 °C; see Fig.3; note 1	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

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

Note to the “Limiting values” **and** “Thermal characteristics”

1. T_s is the temperature at the soldering point of the collector pin.

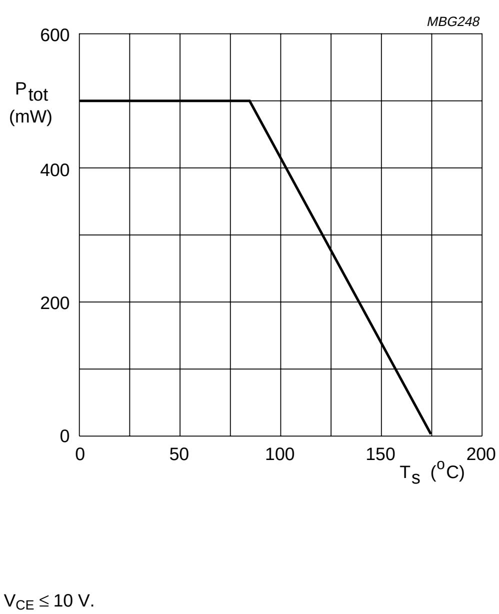


Fig.3 Power derating curve.

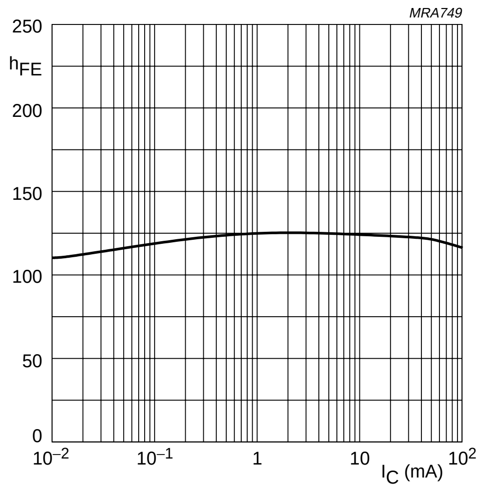
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	open emitter; I_C = 10 μA ; I_E = 0	20	–	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	R_{BE} = 0; I_C = 40 μA	15	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 100 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector cut-off current	open emitter; V_{CB} = 8 V; I_E = 0	–	–	50	nA
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V	60	120	250	
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz; T_{amb} = 25 °C	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.9	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	2	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.5	–	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	–	16	–	dB
		I_C = 40 mA; V_{CE} = 8 V; f = 2 GHz; T_{amb} = 25 °C	–	10	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; T_{amb} = 25 °C	14	15	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 900 MHz	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; f = 2 GHz	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 40 mA; V_{CE} = 8 V; f = 900 MHz; R_L = 50 Ω; T_{amb} = 25 °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V_o	output voltage	note 3	–	500	–	mV
d_2	second order intermodulation distortion	note 4	–	–50	–	dB

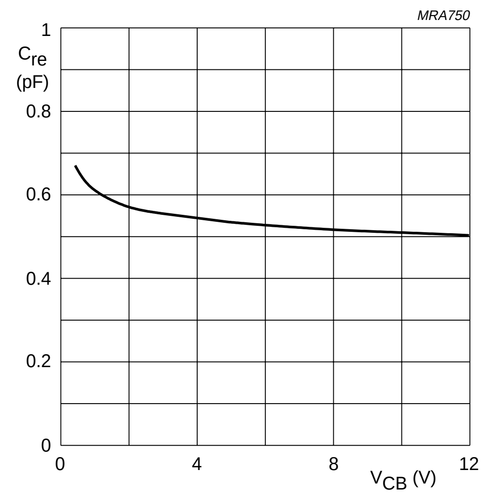
Notes

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.
2. I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω; T_{amb} = 25 °C;
   a) f_p = 900 MHz; f_q = 902 MHz; measured at $f_{(2p-q)}$ = 898 MHz and $f_{(2q-p)}$ = 904 MHz.
3. d_{im} = –60 dB (DIN45004B); $V_p = V_o$; $V_q = V_o$ –6 dB; $V_r = V_o$ –6 dB; R_L = 75 Ω; V_{CE} = 8 V; I_C = 40 mA;
   a) f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at $f_{(p+q-r)}$ = 793.25 MHz.
4. I_C = 40 mA; V_{CE} = 8 V; V_o = 275 mV; R_L = 75 Ω; T_{amb} = 25 °C;
   a) f_p = 250 MHz; f_q = 560 MHz; measured at $f_{(p+q)}$ = 810 MHz.



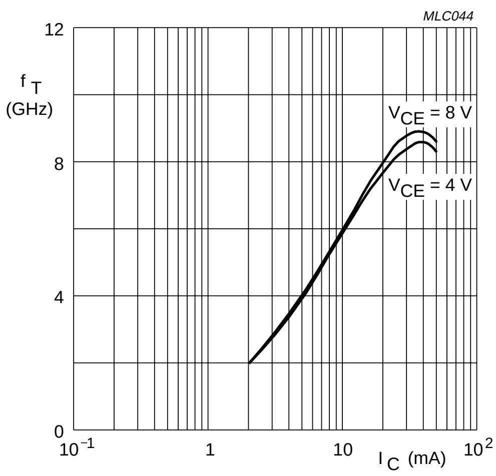
V_{CE} = 8 V.

Fig.4 DC current gain as a function of collector current; typical values.



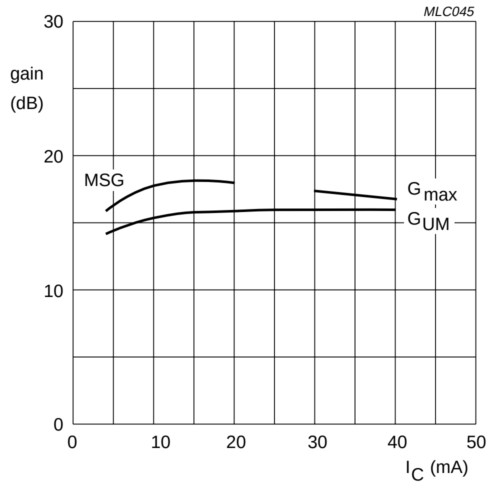
I_C = 0; f = 1 MHz.

Fig.5 Feedback capacitance as a function of collector-base voltage; typical values.



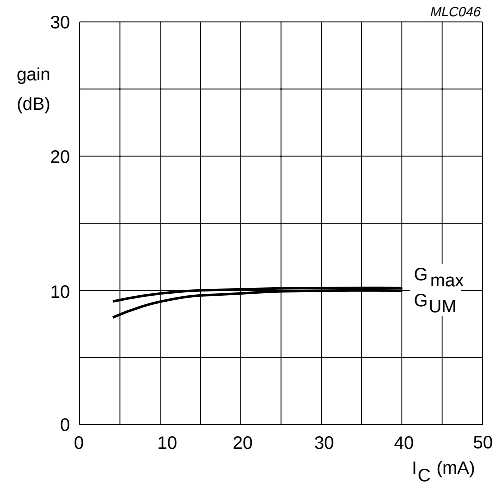
f = 1 GHz; T_{amb} = 25 °C.

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



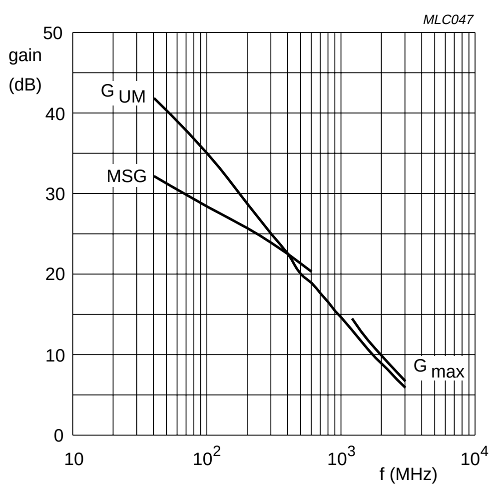
f = 900 MHz; V_{CE} = 8 V.

Fig.7 Gain as a function of collector current; typical values.



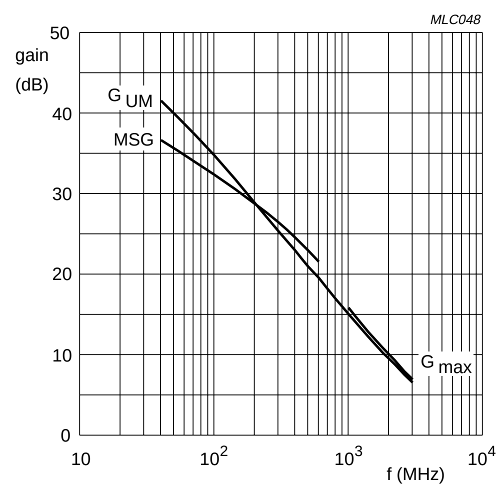
f = 2 GHz; V_{CE} = 8 V.

Fig.8 Gain as a function of collector current; typical values.



I_C = 10 mA; V_{CE} = 8 V.

Fig.9 Gain as a function of frequency; typical values.

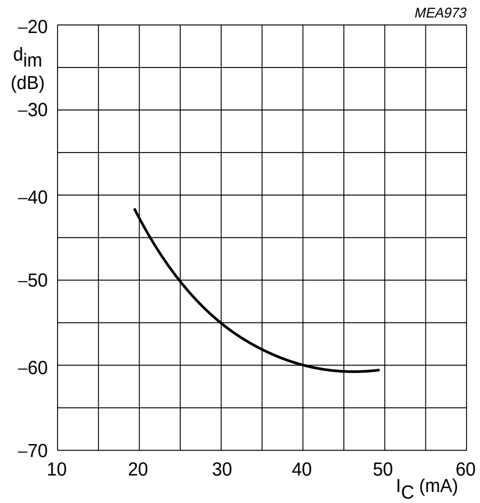


I_C = 40 mA; V_{CE} = 8 V.

Fig.10 Gain as a function of frequency; typical values.

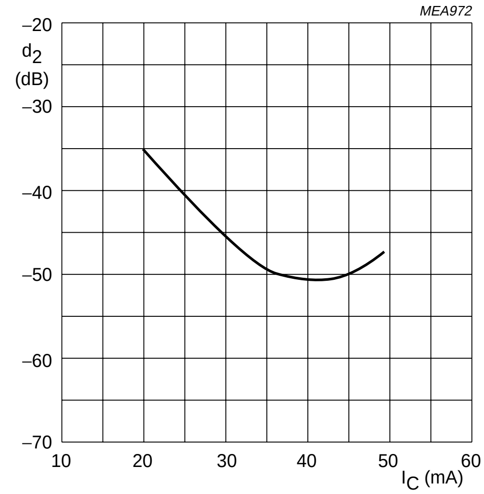
NPN 9 GHz wideband transistor

BFG540W
BFG540W/X; BFG540W/XR



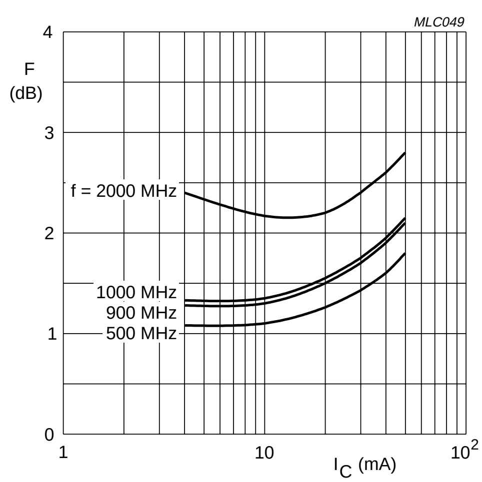
V_o = 500 mV; $f_{(p + q - r)}$ = 793.25 MHz; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω.

Fig.11 Intermodulation distortion as a function of collector current; typical values.



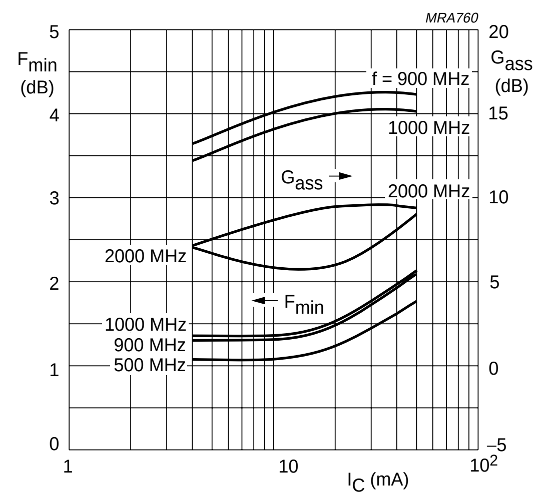
V_o = 275 mV; $f_{(p + q)}$ = 810 MHz; V_{CE} = 8 V; T_{amb} = 25 °C; R_L = 75 Ω.

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



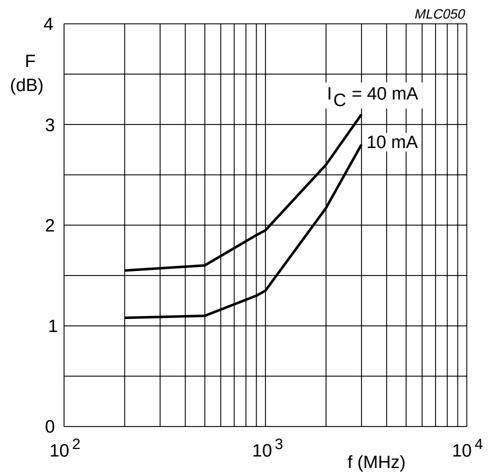
V_{CE} = 8 V.

Fig.13 Minimum noise figure as a function of collector current; typical values.



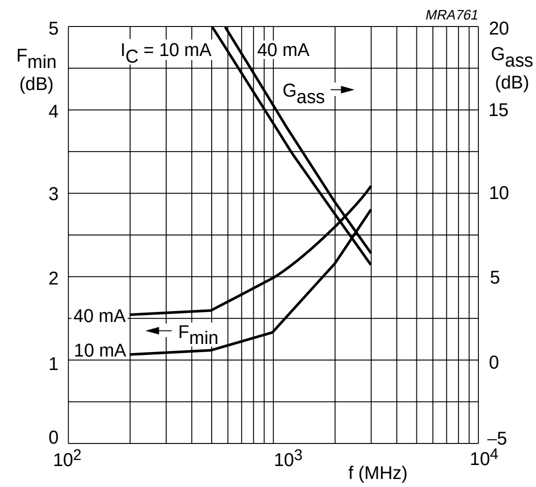
V_{CE} = 8 V.

Fig.14 Associated available gain as a function of collector current; typical values.



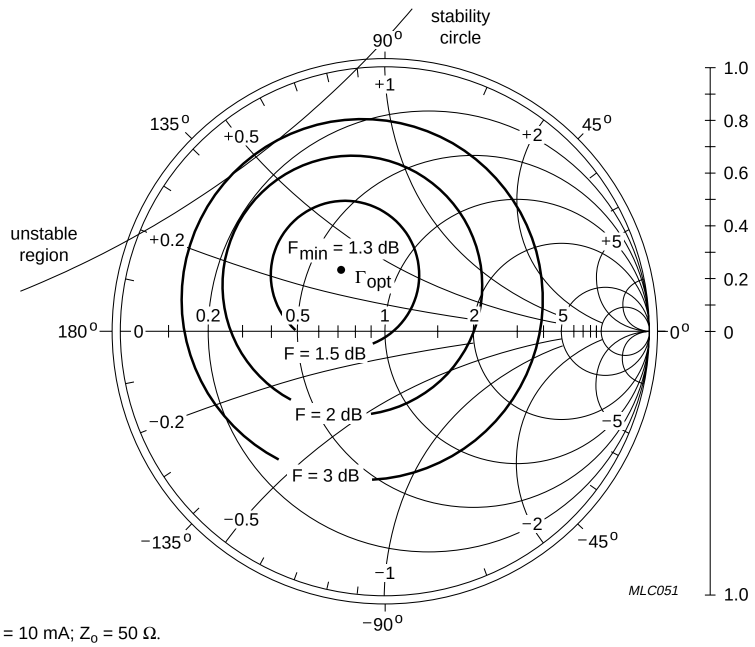
V_{CE} = 8 V.

Fig.15 Minimum noise figure as a function of frequency; typical values.



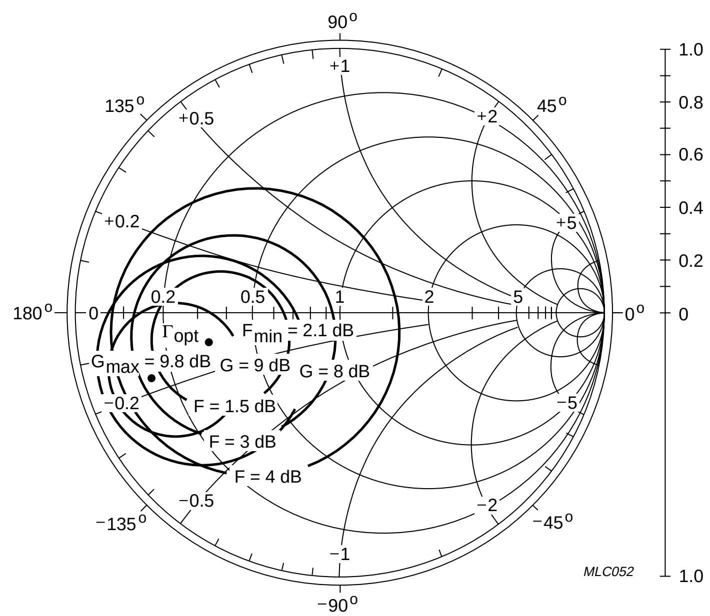
V_{CE} = 8 V.

Fig.16 Associated available gain as a function of frequency; typical values.



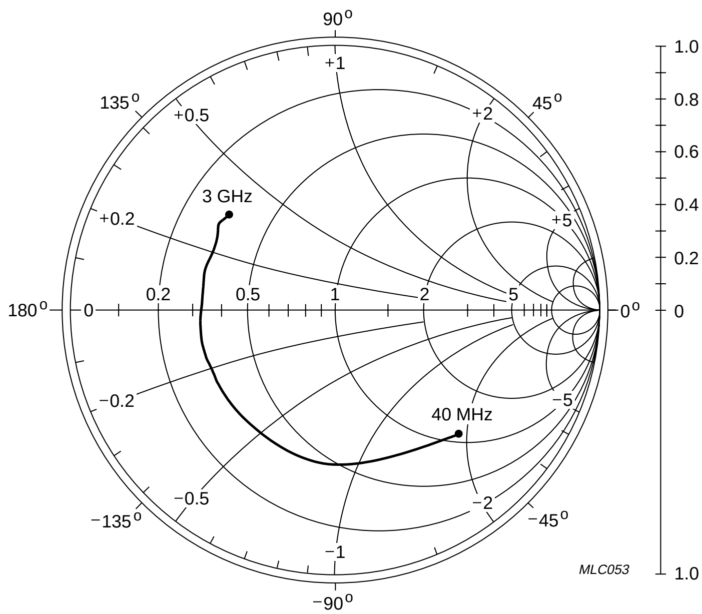
f = 900 MHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.17 Common emitter noise figure circles; typical values.



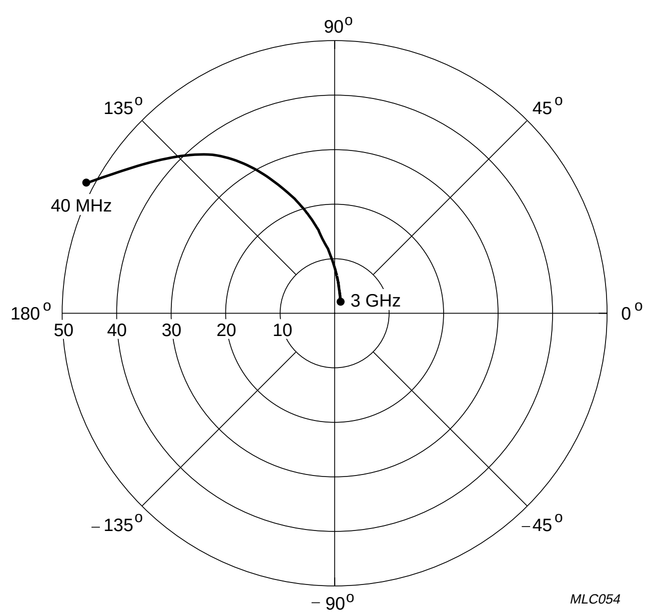
f = 2 GHz; V_{CE} = 8 V; I_C = 10 mA; Z_o = 50 Ω.

Fig.18 Common emitter noise figure circles; typical values.



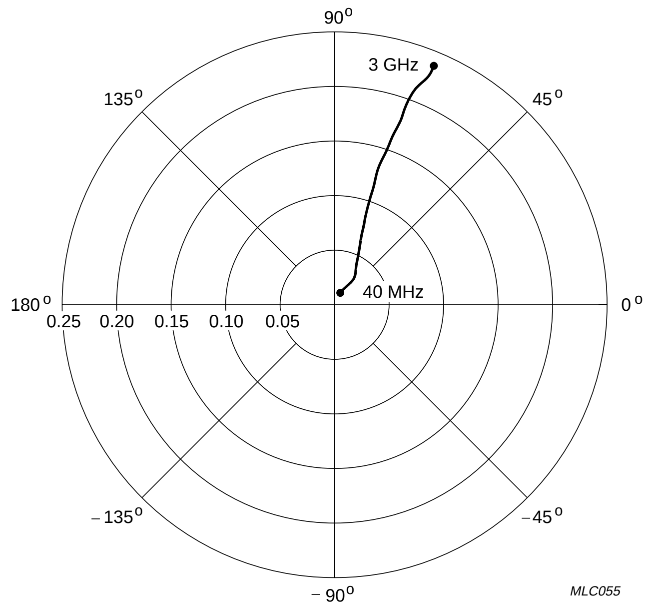
V_{CE} = 8 V; I_C = 40 mA; Z_o = 50 Ω.

Fig.19 Common emitter input reflection coefficient (s_{11}); typical values.



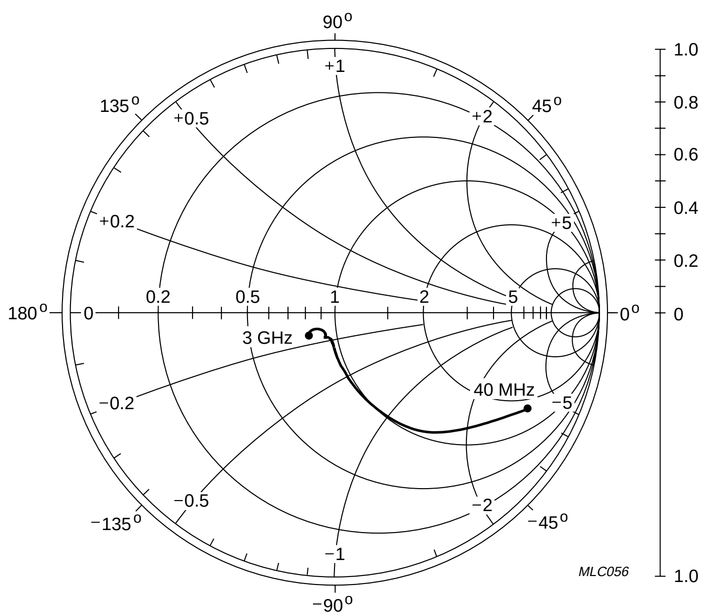
V_{CE} = 8 V; I_C = 40 mA.

Fig.20 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 8 V; I_C = 40 mA.

Fig.21 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 8 V; I_C = 40 mA; Z_o = 50 Ω.

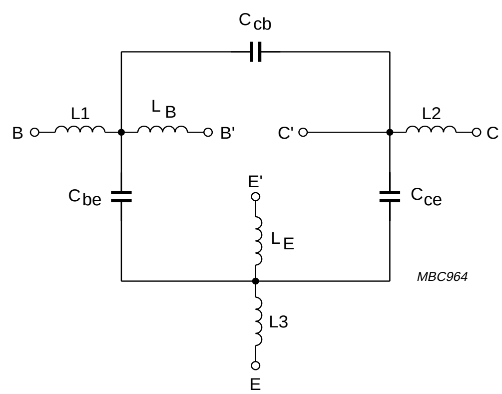
Fig.22 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BFG540W crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.045	fA
2	BF	184.3	–
3	NF	0.981	–
4	VAF	41.69	V
5	IKF	10.00	A
6	ISE	232.4	fA
7	NE	2.028	–
8	BR	43.99	–
9	NR	0.992	–
10	VAR	2.097	V
11	IKR	166.2	mA
12	ISC	129.8	aA
13	NC	1.064	–
14	RB	5.000	Ω
15	IRB	1.000	μA
16	RBM	5.000	Ω
17	RE	353.5	mΩ
18	RC	1.340	Ω
19 (1)	XTB	0.000	–
20 (1)	EG	1.110	eV
21 (1)	XTI	3.000	–
22	CJE	1.978	pF
23	VJE	600.0	mV
24	MJE	0.332	–
25	TF	7.457	ps
26	XTF	11.40	–
27	VTF	3.158	V
28	ITF	156.9	mA
29	PTF	0.000	deg
30	CJC	793.7	fF
31	VJC	185.5	mV
32	MJC	0.084	–
33	XCJC	0.150	–
34	TR	1.598	ns
35 (1)	CJS	0.000	F
36 (1)	VJS	750.0	mV
37 (1)	MJS	0.000	–
38	FC	0.814	–

Note

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



QL_B = 50; QL_E = 50; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$
f_c = scaling frequency = 1 GHz.

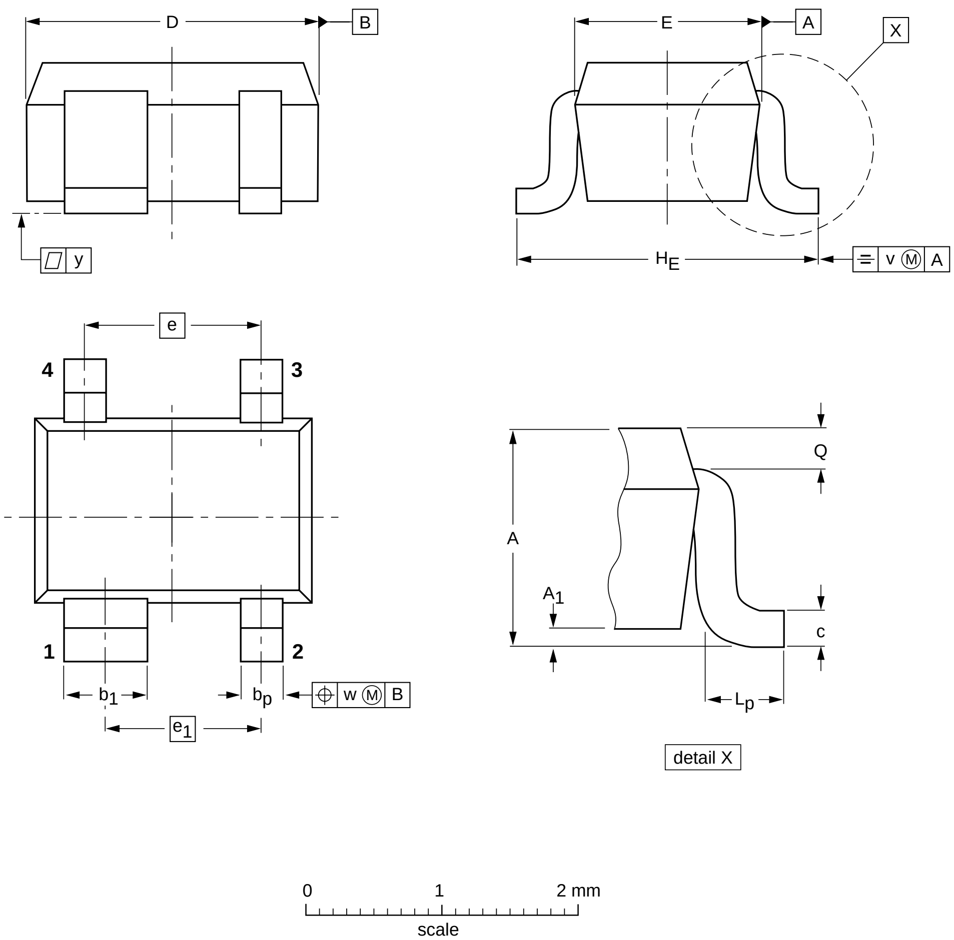
Fig.23 Package equivalent circuit SOT343N; SOT343R.

List of components (see Fig.23)**.**

DESIGNATION	VALUE	UNIT
C_{be}	70	fF
C_{cb}	50	fF
C_{ce}	115	fF
L1	0.34	nH
L2	0.10	nH
L3	0.25	nH
L_B	0.40	nH
L_E	0.40	nH

PACKAGE OUTLINES

Plastic surface mounted package; 4 leads **SOT343N**

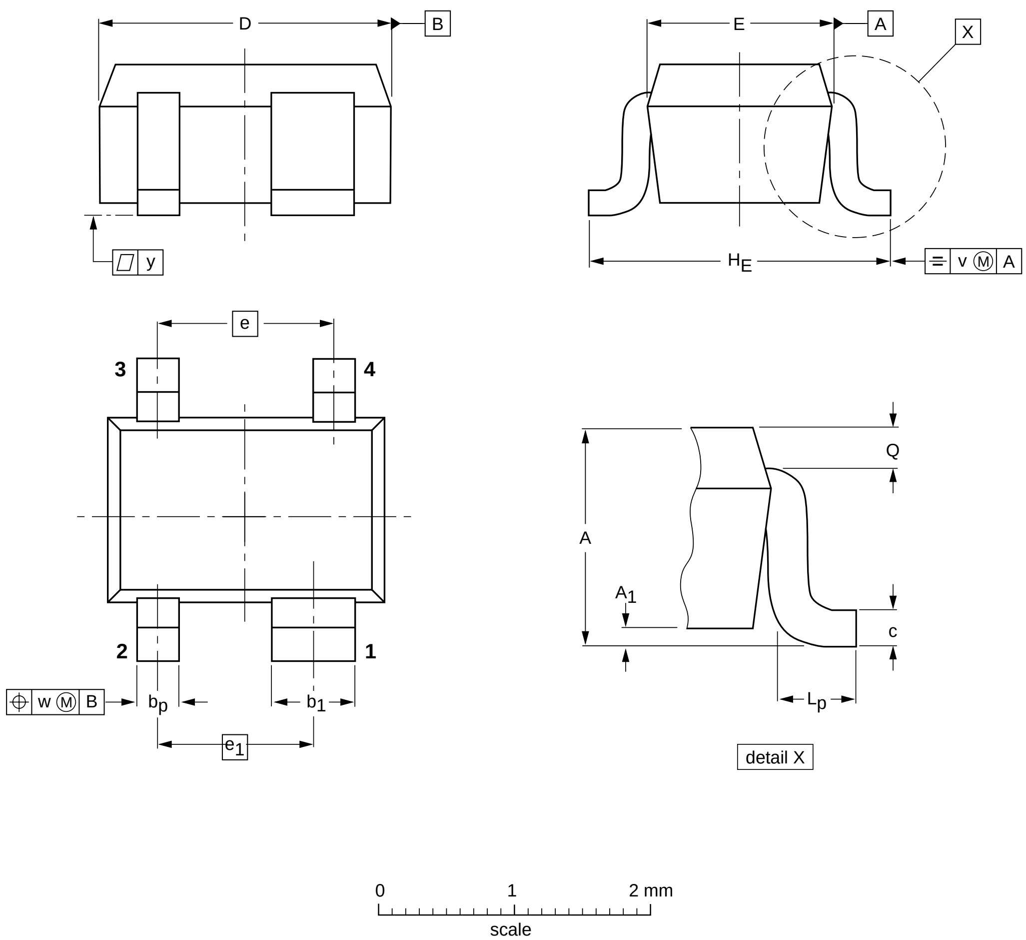


DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	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

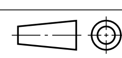
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343N						97-05-21

Plastic surface mounted package; reverse pinning; 4 leads **SOT343R**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343R						97-05-21

DEFINITIONS

Data Sheet Status	
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.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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