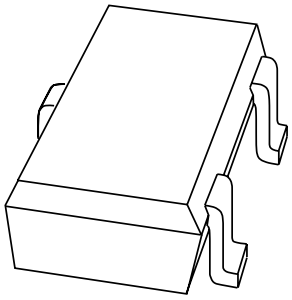
DATA SHEET



PRF957
UHF wideband transistor

Product specification
Supersedes data of 1999 Mar 01

1999 Jul 23

Philips
Semiconductors

PHILIPS

UHF wideband transistor PRF957

FEATURES

- Small size
- Low noise
- Low distortion
- High gain
- Gold metallization ensures excellent reliability.

APPLICATIONS

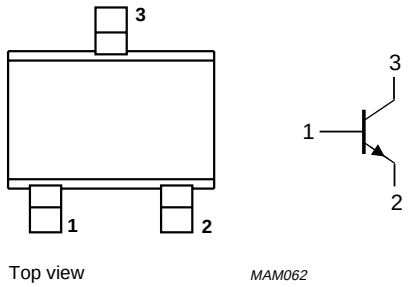
- Communication and instrumentation systems.

DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT323 package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular telephones, cordless phones, radar detectors, pagers and satellite TV-tuners.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Top view MAM062

Marking code: W2.

Fig.1 Simplified outline (SOT323) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 6 V; f_m = 1 GHz	–	8.5	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	15	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz	–	1.3	–	dB
P_{tot}	total power dissipation	T_s = 60 °C; note 1	–	–	270	mW
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 270 mW	–	–	425	K/W

Note

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

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_{CEO}	collector-emitter voltage	open base	–	10	V
V_{EBO}	emitter-base voltage	open collector	–	1.5	V
I_C	DC collector current		–	100	mA
$I_{C(AV)}$	average collector current		–	100	mA
P_{tot}	total power dissipation	T_s = 60 °C; note 1	–	270	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	P_{tot} = 270 mW; T_s = 60 °C; note 1	425	K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics						
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 μA; I_E = 0	20	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 100 μA; I_B = 0	10	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 μA; I_C = 0	1.5	–	–	V
I_{CBO}	collector-base leakage current	V_{CB} = 10 V; I_E = 0	–	–	100	nA
I_{EBO}	emitter-base leakage current	V_{EB} = 1 V; I_C = 0	–	–	100	nA
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 6 V	50	100	200	
		I_C = 15 mA; V_{CE} = 6 V	–	100	–	
AC characteristics						
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 6 V; f = 1 MHz	–	0.4	–	pF
f_T	transition frequency	I_C = 30 mA; V_{CE} = 6 V; f_m = 1 GHz	–	8.5	–	GHz
$\|s_{21}\|^2$	insertion gain	I_C = 30 mA; V_{CE} = 6 V; f = 1 GHz	–	14	–	dB
G_{UM}	maximum unilateral power gain; note 1	I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 1 GHz	–	15	–	dB
		I_C = 30 mA; V_{CE} = 6 V; T_{amb} = 25 °C; f = 2 GHz	–	9.2	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 1 GHz	–	1.3	–	dB
		$\Gamma_S = \Gamma_{opt}$; I_C = 5 mA; V_{CE} = 6 V; f = 2 GHz	–	1.8	–	dB

Note

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

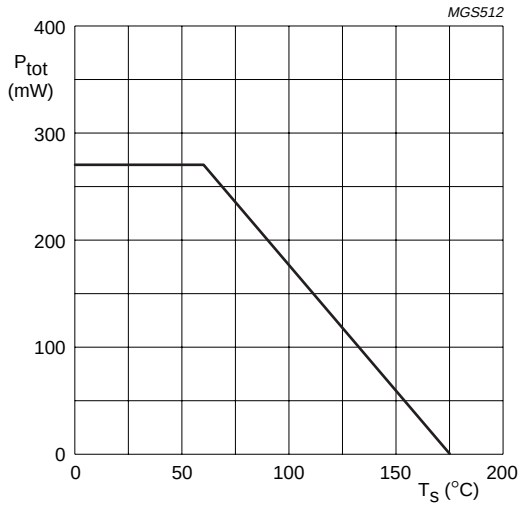
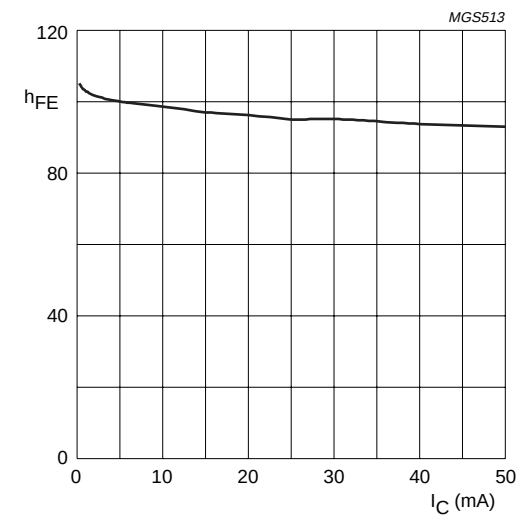
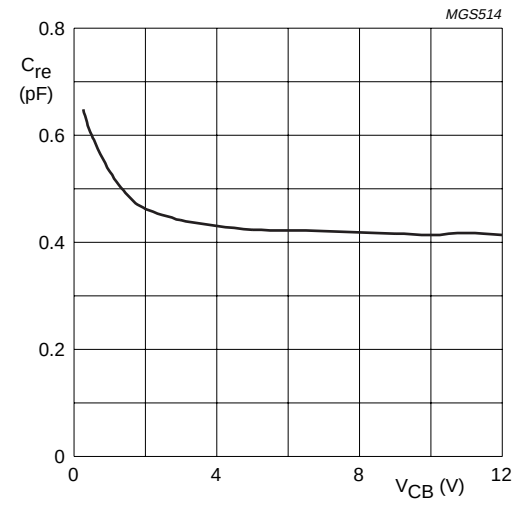


Fig.2 Power derating as a function of soldering point temperature.



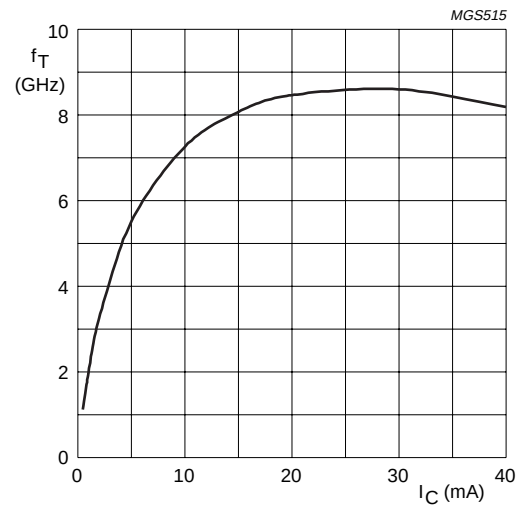
V_{CE} = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



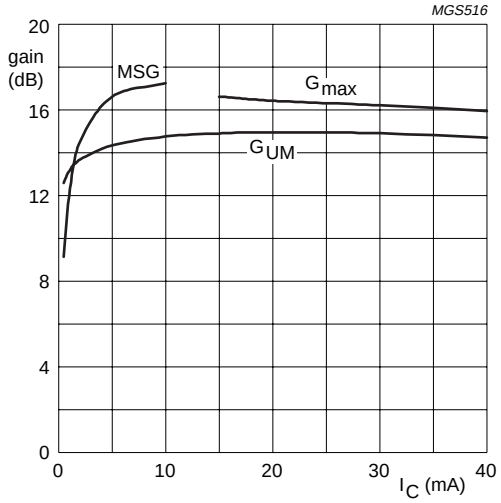
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



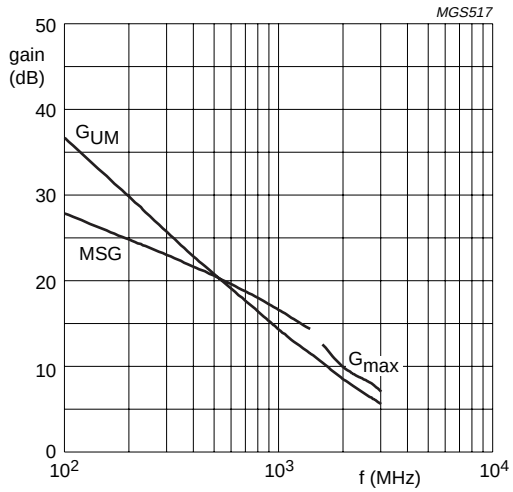
V_{CE} = 6 V; f_m = 1 GHz; T_{amb} = 25 ◦C.

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



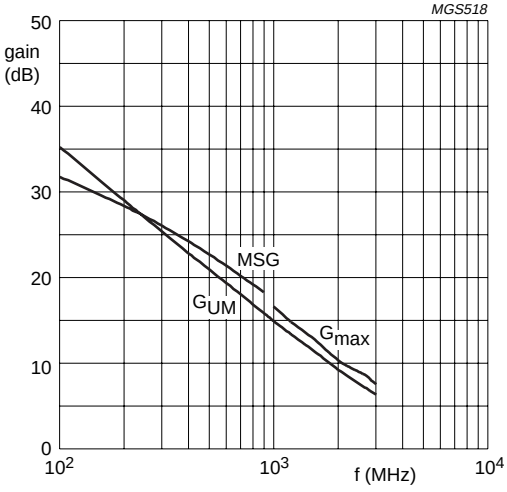
f = 1 GHz; V_{CE} = 6 V.

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



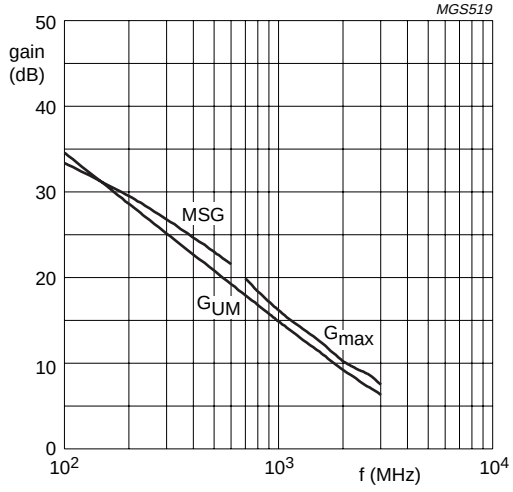
I_C = 5 mA; V_{CE} = 6 V.

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



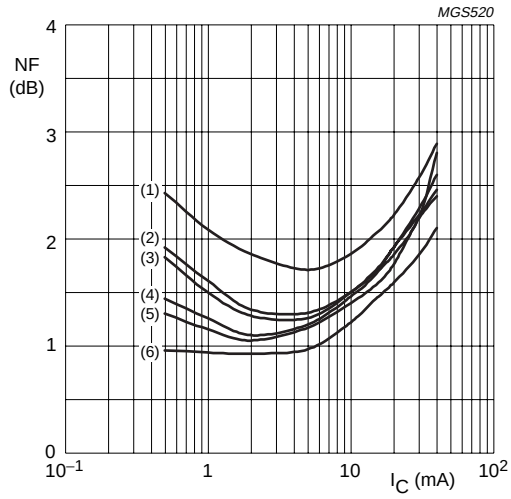
I_C = 15 mA; V_{CE} = 6 V.

Fig.8 Gain as a function of frequency; typical values.



I_C = 30 mA; V_{CE} = 6 V.

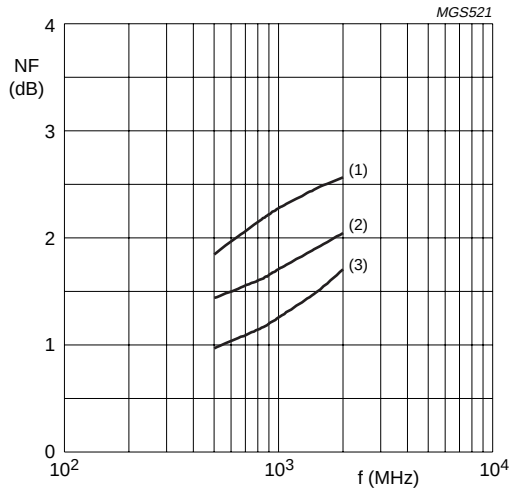
Fig.9 Gain as a function of frequency; typical values.



V_{CE} = 6 V.

(1) f = 2 GHz
(2) f = 1.5 GHz
(3) f = 1 GHz
(4) f = 900 MHz
(5) f = 800 MHz
(6) f = 500 MHz.

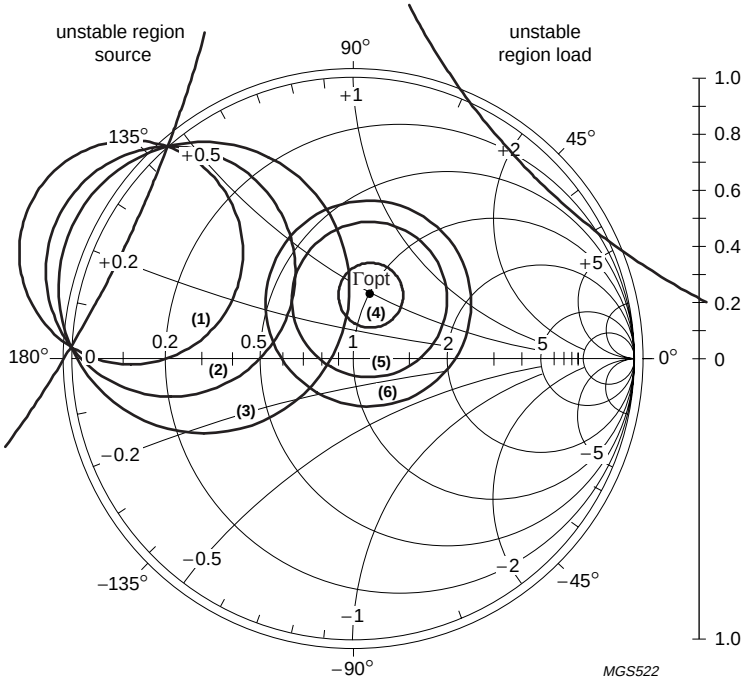
Fig.10 Minimum noise figure as a function of collector current; typical values.



V_{CE} = 6 V.

(1) I_C = 30 mA
(2) I_C = 15 mA
(3) I_C = 5 mA.

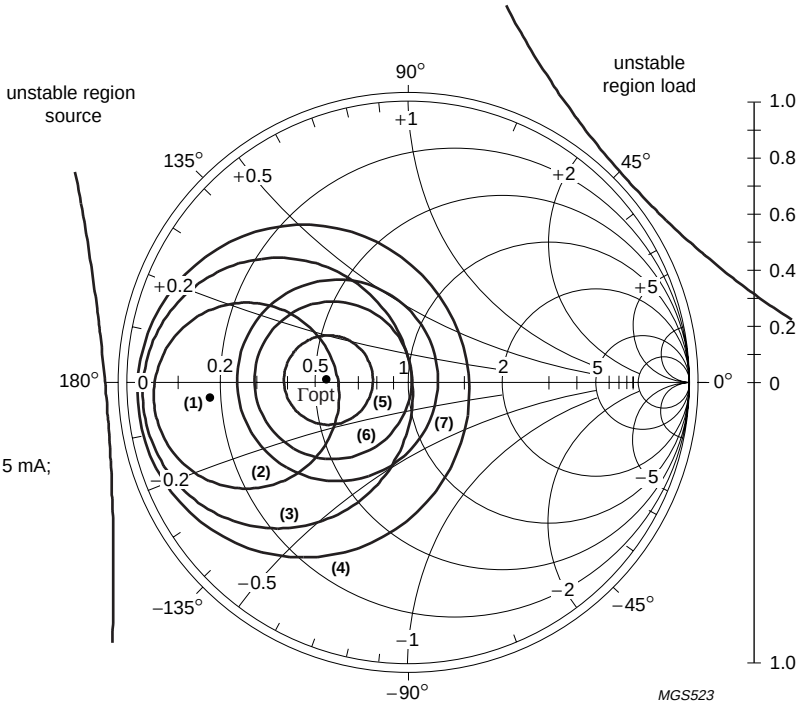
Fig.11 Minimum noise figure as a function of frequency; typical values.



f = 1 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

(1) G = 16 dB
(2) G = 15 dB
(3) G = 14 dB
(4) NF = 1.3 dB
(5) NF = 1.5 dB
(6) NF = 1.7 dB.

Fig.12 Common emitter available gain, noise and stability circles; typical values.



f = 2 GHz; V_{CE} = 6 V; I_C = 5 mA; Z_o = 50 Ω.

(1) G_{max} = 9.95 dB
(2) G = 9 dB
(3) G = 8 dB
(4) G = 7 dB
(5) NF = 1.8 dB
(6) NF = 2 dB
(7) NF = 2.2 dB.

Fig.13 Common emitter available gain, noise and stability circles; typical values.

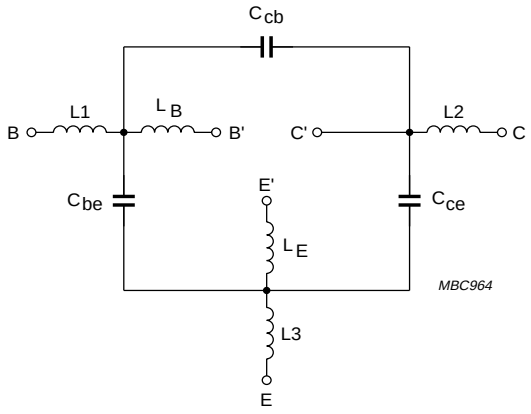
APPLICATION INFORMATION

SPICE parameters for the PRF957 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	0.963	fA
2	BF	102.3	–
3	NF	1.002	–
4	VAF	64.75	V
5	IKF	841.1	mA
6	ISE	35.77	fA
7	NE	2.138	–
8	BR	90.16	–
9	NR	1.000	–
10	VAR	3.198	V
11	IKR	25.77	mA
12	ISC	156.6	aA
13	NC	1.047	–
14	RB	6.071	Ω
15	IRB	0.000	μA
16	RBM	2.478	Ω
17	RE	0.164	Ω
18	RC	1.315	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	1.161	pF
23	VJE	600.0	mV
24	MJE	0.394	–
25	TF	3.073	ps
26	XTF	10.25	–
27	VTF	4.599	V
28	ITF	53.49	mA
29	PTF	0.000	deg
30	CJC	409.9	fF
31	VJC	287.1	mV
32	MJC	0.111	–
33	XCJC	0.104	–
34	TR	0.000	ps
35(1)	CJS	0.000	F
36(1)	VJS	700.0	mV
37(1)	MJS	0.000	–
38	FC	0.888	–
39(2)	C_{bpb}	73.00	fF
40(2)	C_{bpe}	131.00	fF

Notes

1. These parameters have not been extracted, the default values are shown.
2. C_{bpb}, C_{bpe}: base-bondpad and emitter-bondpad capacitance to collector.

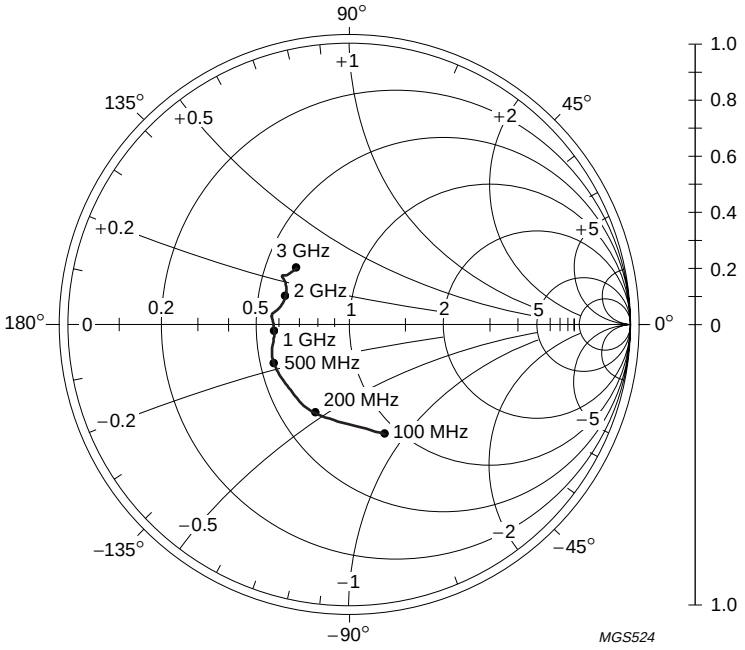


$QL_B = 50$; $QL_E = 50$;
$QL_B(f) = QL_B\sqrt{(f/f_c)}$;
$QL_E(f) = QL_E\sqrt{(f/f_c)}$;
f_c = corner frequency = 1 GHz.

Fig.14 Package equivalent circuit SOT323.

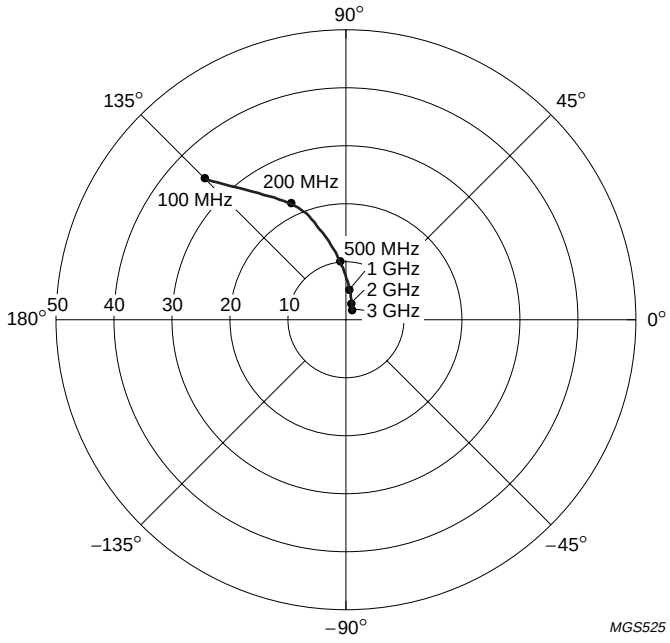
List of components (see Fig.14)

DESIGNATION	VALUE	UNIT
C_{be}	2	fF
C_{cb}	100	fF
C_{ce}	100	fF
L1	0.34	nH
L2	0.10	nH
L3	0.34	nH
L_B	0.60	nH
L_E	0.60	nH



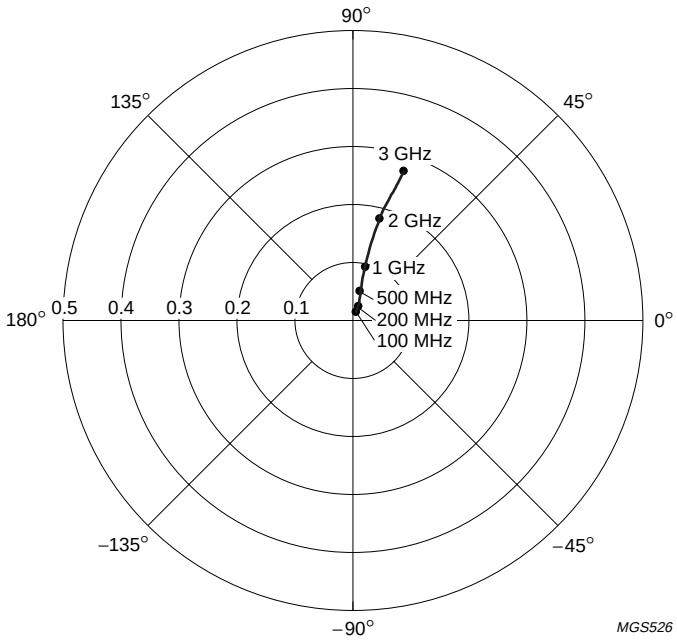
V_{CE} = 6 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.15 Common emitter input reflection coefficient (s_{11}); typical values.



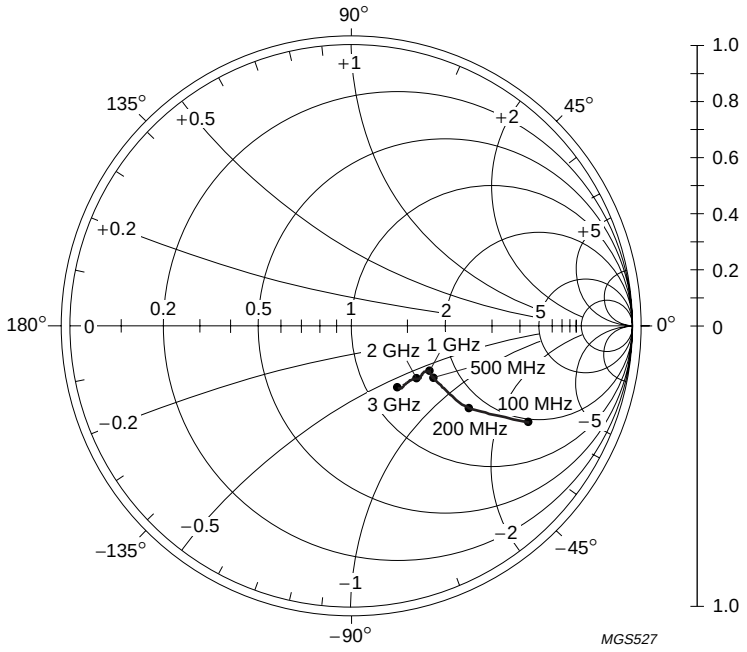
V_{CE} = 6 V; I_C = 30 mA.

Fig.16 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 6 V; I_C = 30 mA.

Fig.17 Common emitter reverse transmission coefficient (s_{12}); typical values.

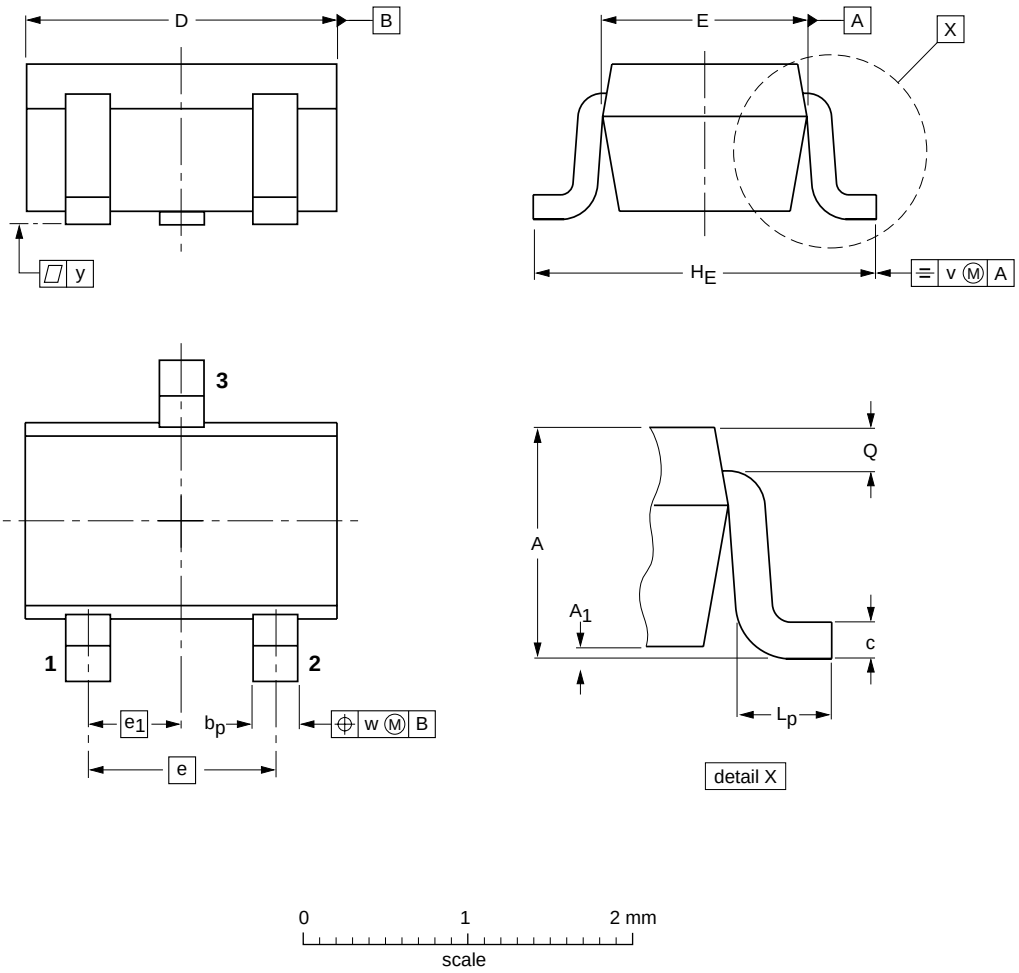


V_{CE} = 6 V; I_C = 30 mA; Z_o = 50 Ω.

Fig.18 Common emitter output reflection coefficient (s_{22}); typical values.

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	EIAJ			
SOT323			SC-70			97-02-28

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.

NOTES

NOTES

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