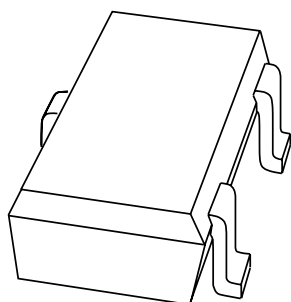


DATA SHEET



PRF947 UHF wideband transistor

Product specification
Supersedes data of 1999 Mar 01

1999 Jul 23

UHF wideband transistor

PRF947

FEATURES

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

APPLICATIONS

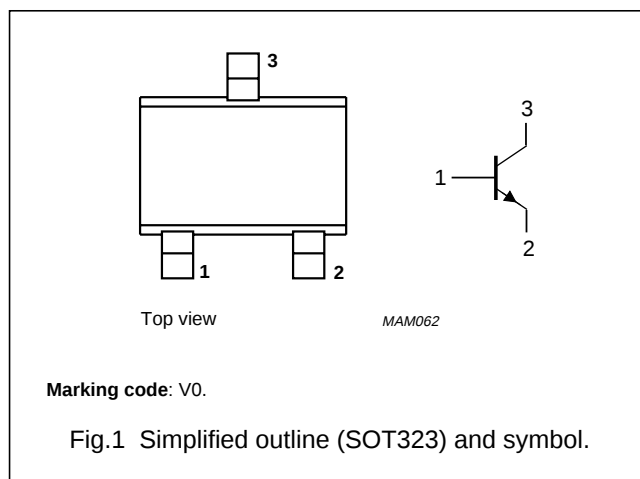
- Communication and instrumentation systems.

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



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = 6$ V; $f = 1$ MHz	–	0.3	–	pF
f_T	transition frequency	$I_C = 15$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz	–	8.5	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; $f = 1$ GHz	–	16	–	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $f = 1$ GHz	–	1.5	–	dB
P_{tot}	total power dissipation	$T_S = 60$ °C; note 1	–	–	250	mW
$R_{th\ j-s}$	thermal resistance from junction to soldering point	$P_{tot} = 250$ mW	–	–	460	K/W

Note

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

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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		–	50	mA
$I_{C(AV)}$	average collector current		–	50	mA
P_{tot}	total power dissipation	$T_s = 60\text{ °C}$; note 1	–	250	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
$R_{th\ j-s}$	thermal resistance from junction to soldering point	$P_{tot} = 250\text{ mW}$; $T_s = 60\text{ °C}$; note 1	460	K/W

Note

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

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CHARACTERISTICS

 $T_j = 25\text{ °C}$ 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	—	0.3	—	pF
f _T	transition frequency	I _C = 15 mA; V _{CE} = 6 V; f _m = 1 GHz	—	8.5	—	GHz
S ₂₁ ²	insertion gain	I _C = 15 mA; V _{CE} = 6 V; f = 1 GHz	—	14.5	—	dB
G _{UM}	maximum unilateral power gain; note 1	I _C = 15 mA; V _{CE} = 6 V; T _{amb} = 25 °C; f = 1 GHz	—	16	—	dB
		I _C = 15 mA; V _{CE} = 6 V; T _{amb} = 25 °C; f = 2 GHz	—	10	—	dB
NF	noise figure	Γ _S = Γ _{opt} ; I _C = 5 mA; V _{CE} = 6 V; f = 1 GHz	—	1.5	—	dB
		Γ _S = Γ _{opt} ; I _C = 5 mA; V _{CE} = 6 V; f = 2 GHz	—	2.1	—	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

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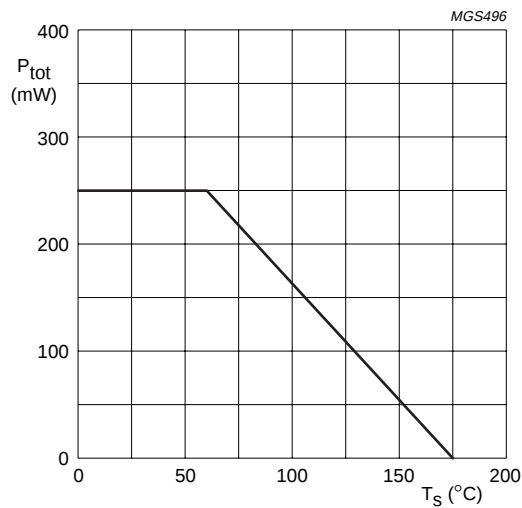
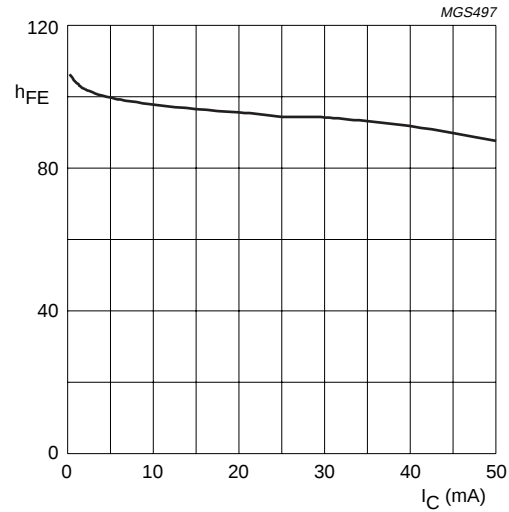
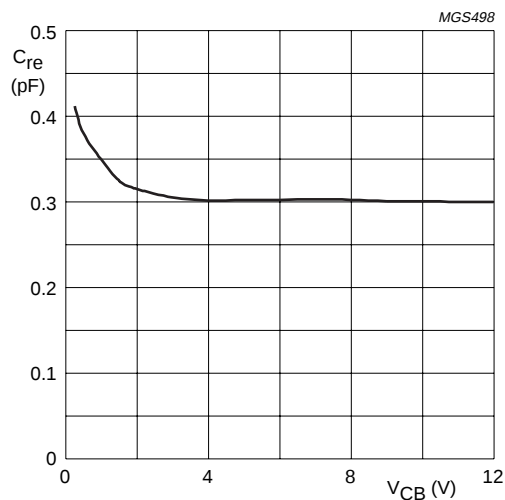


Fig. 2 Power derating as a function of soldering point temperature.



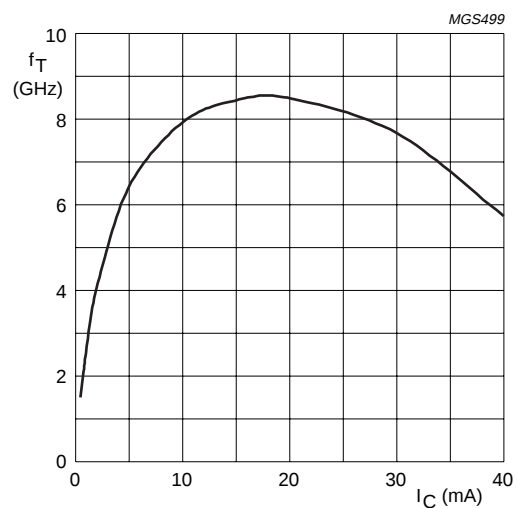
$V_{CE} = 6\text{ V}$.

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



$I_C = I_c = 0$; $f = 1\text{ MHz}$.

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

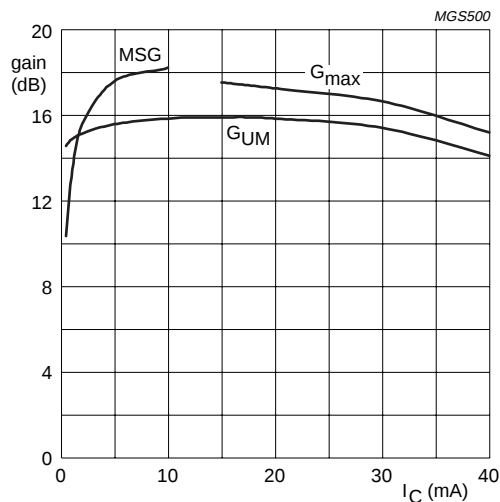


$V_{CE} = 6\text{ V}$; $f_m = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$.

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

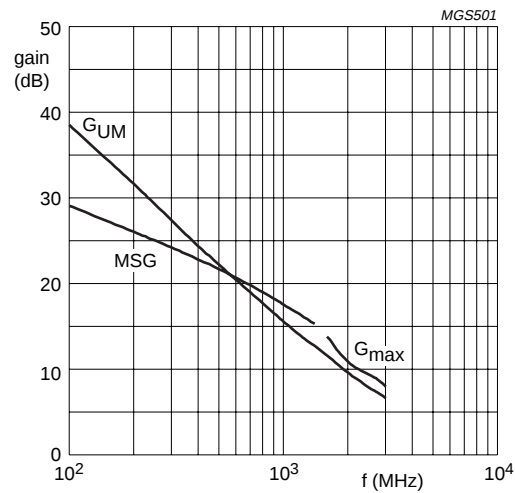
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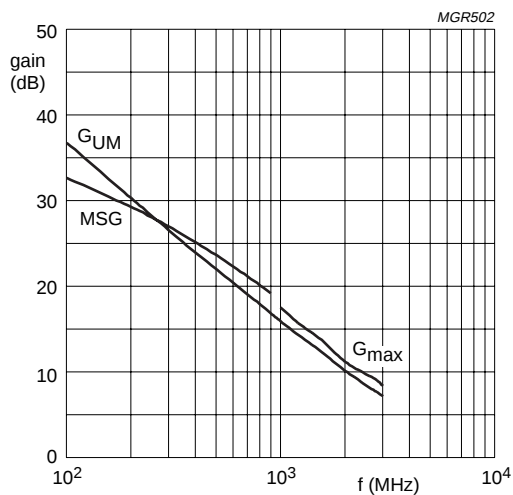
$f = 1 \text{ GHz}$; $V_{CE} = 6 \text{ V}$.

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



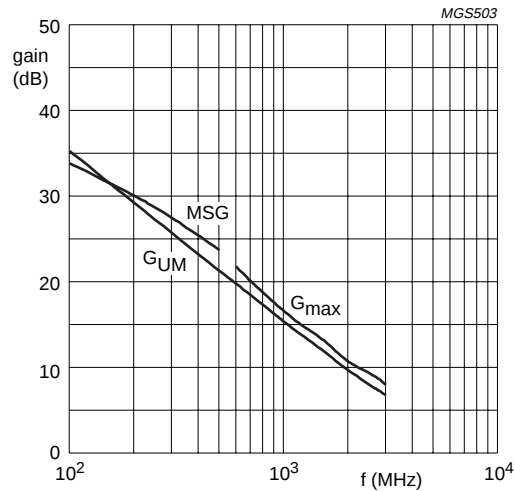
$I_C = 5 \text{ mA}$; $V_{CE} = 6 \text{ V}$.

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



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

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

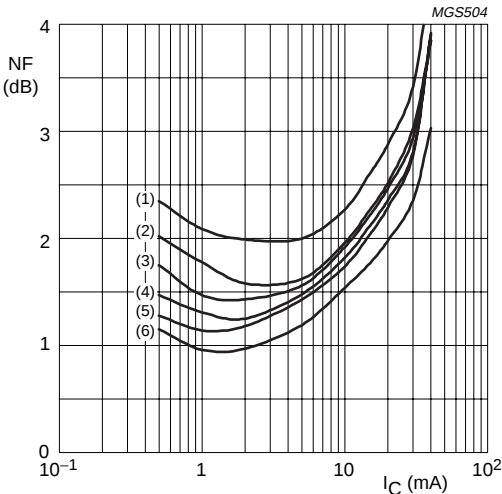


$I_C = 30 \text{ mA}$; $V_{CE} = 6 \text{ V}$.

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

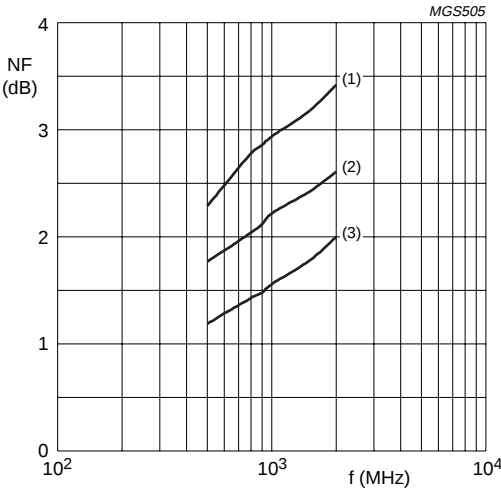
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$V_{CE} = 6\text{ V.}$
(1) $f = 2\text{ GHz}$ (4) $f = 900\text{ MHz}$
(2) $f = 1.5\text{ GHz}$ (5) $f = 800\text{ MHz}$
(3) $f = 1\text{ GHz}$ (6) $f = 500\text{ MHz.}$

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



$V_{CE} = 6\text{ V.}$
(1) $I_C = 30\text{ mA}$
(2) $I_C = 15\text{ mA}$
(3) $I_C = 5\text{ mA.}$

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

UHF wideband transistor

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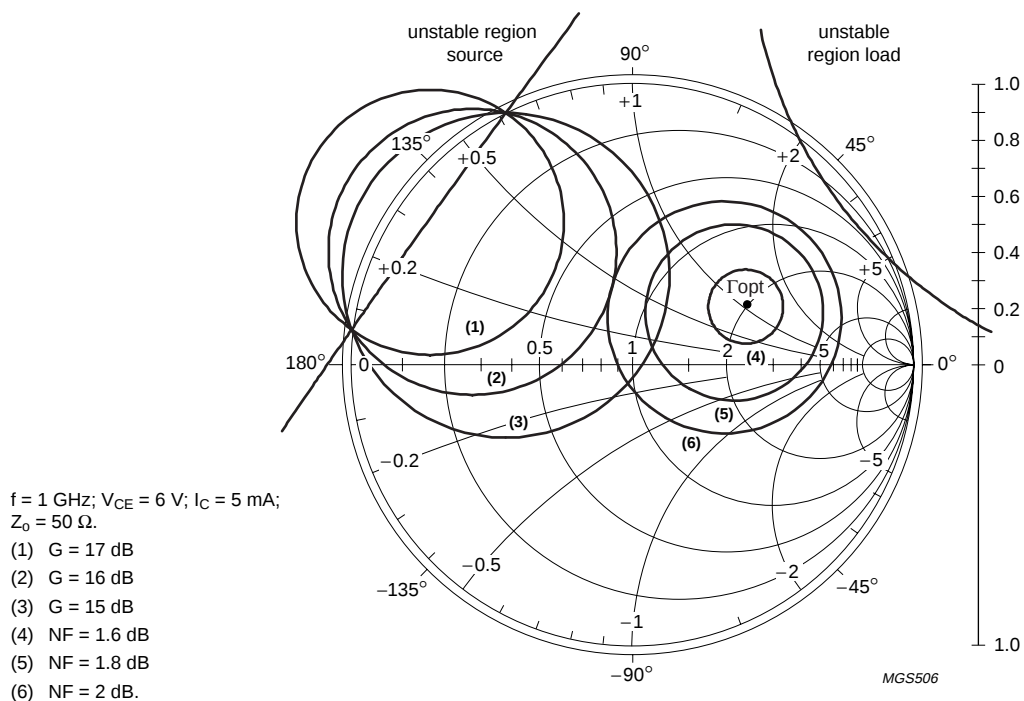


Fig.12 Common emitter available gain, noise and stability circles; typical values.

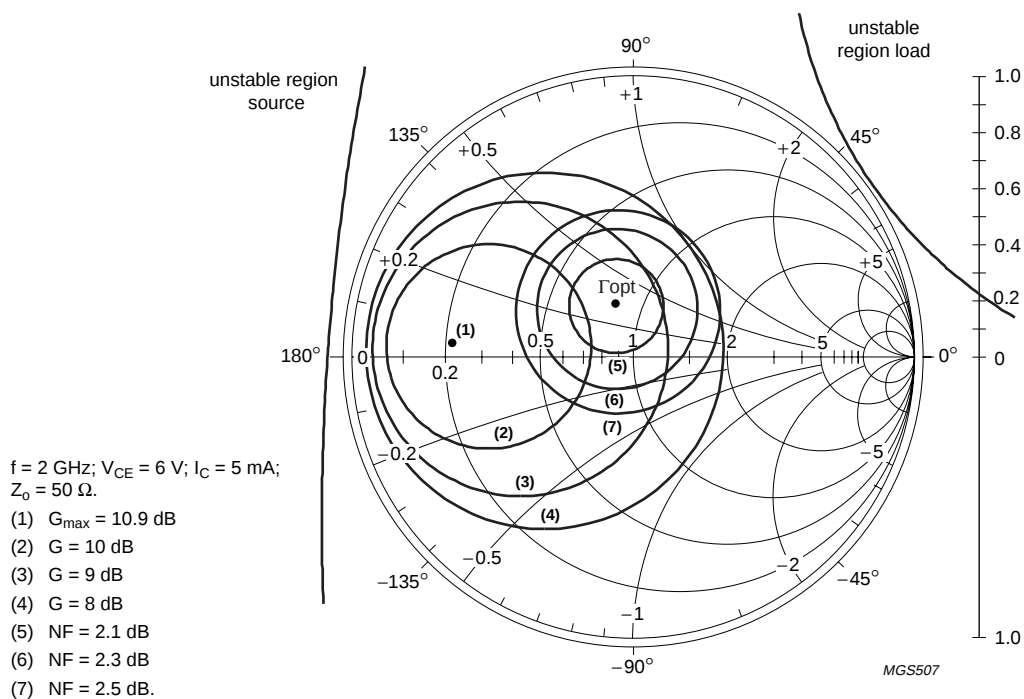


Fig.13 Common emitter available gain, noise and stability circles; typical values.

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APPLICATION INFORMATION

SPICE parameters for the PRF947 die.

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	0.466	fA
2	BF	150.4	—
3	NF	1.000	—
4	VAF	53.06	V
5	IKF	180.0	mA
6	ISE	57.30	fA
7	NE	2.000	—
8	BR	27.68	—
9	NR	1.000	—
10	VAR	1.976	V
11	IKR	9.943	mA
12	ISC	1.420	aA
13	NC	1.000	—
14	RB	12.14	Ω
15	IRB	0.000	μ A
16	RBM	4.957	Ω
17	RE	0.597	Ω
18	RC	1.988	Ω
19 ⁽¹⁾	XTB	0.000	—
20 ⁽¹⁾	EG	1.110	eV
21 ⁽¹⁾	XTI	3.000	—
22	CJE	0.568	pF
23	VJE	600.0	mV
24	MJE	0.412	—
25	TF	2.037	ps
26	XTF	30.90	—
27	VTF	3.148	V
28	ITF	131.8	mA
29	PTF	0.000	deg
30	CJC	205.8	fF
31	VJC	296.2	mV
32	MJC	0.118	—
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	0.943	—
39 ⁽²⁾	C _{bpb}	83.00	fF

SEQUENCE No.	PARAMETER	VALUE	UNIT
40 ⁽²⁾	C _{bpe}	84.00	fF
41	AF	1.000	—
42	KF	4 x 10 ⁻¹⁶	—

Notes

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

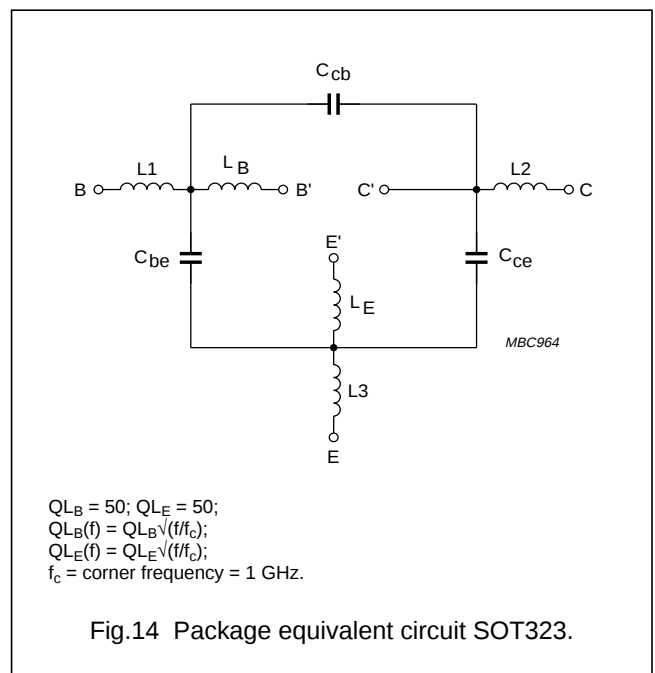


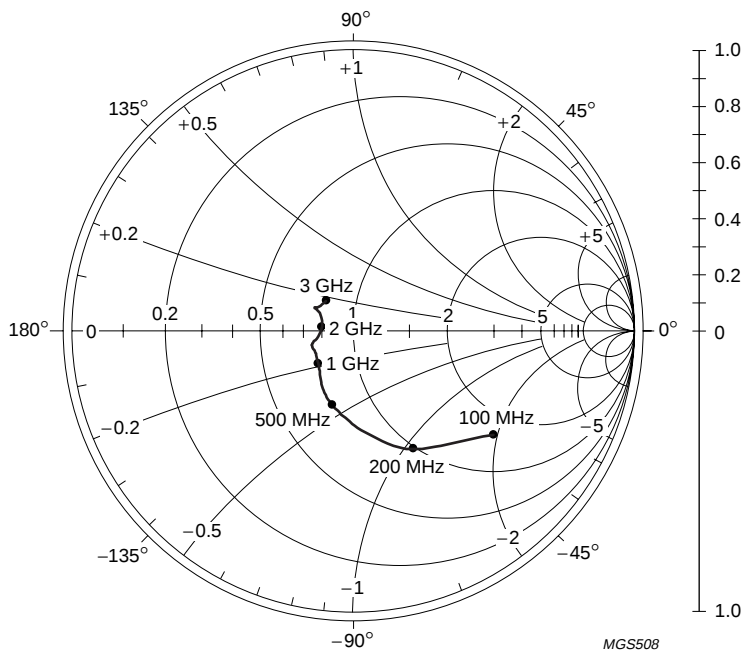
Fig.14 Package equivalent circuit SOT323.

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

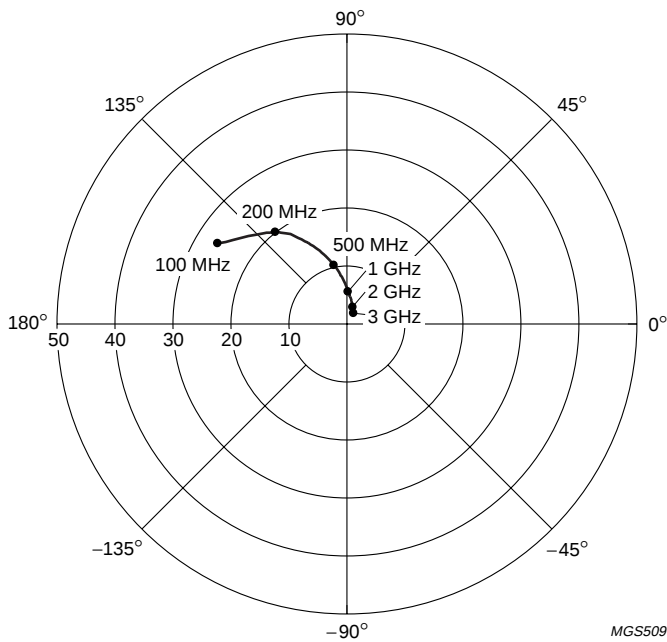
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$V_{CE} = 6\text{ V}$; $I_C = 15\text{ mA}$; $Z_0 = 50\ \Omega$.

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

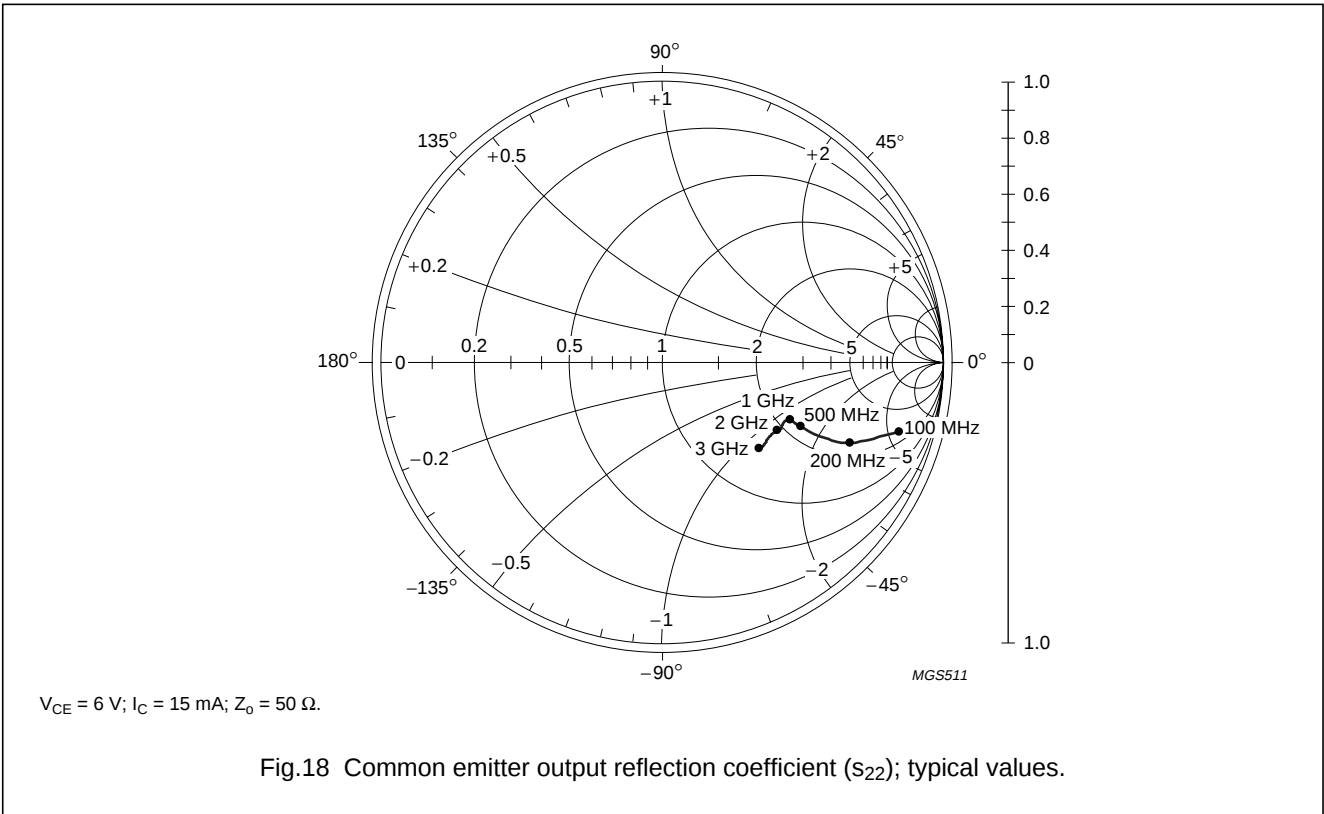
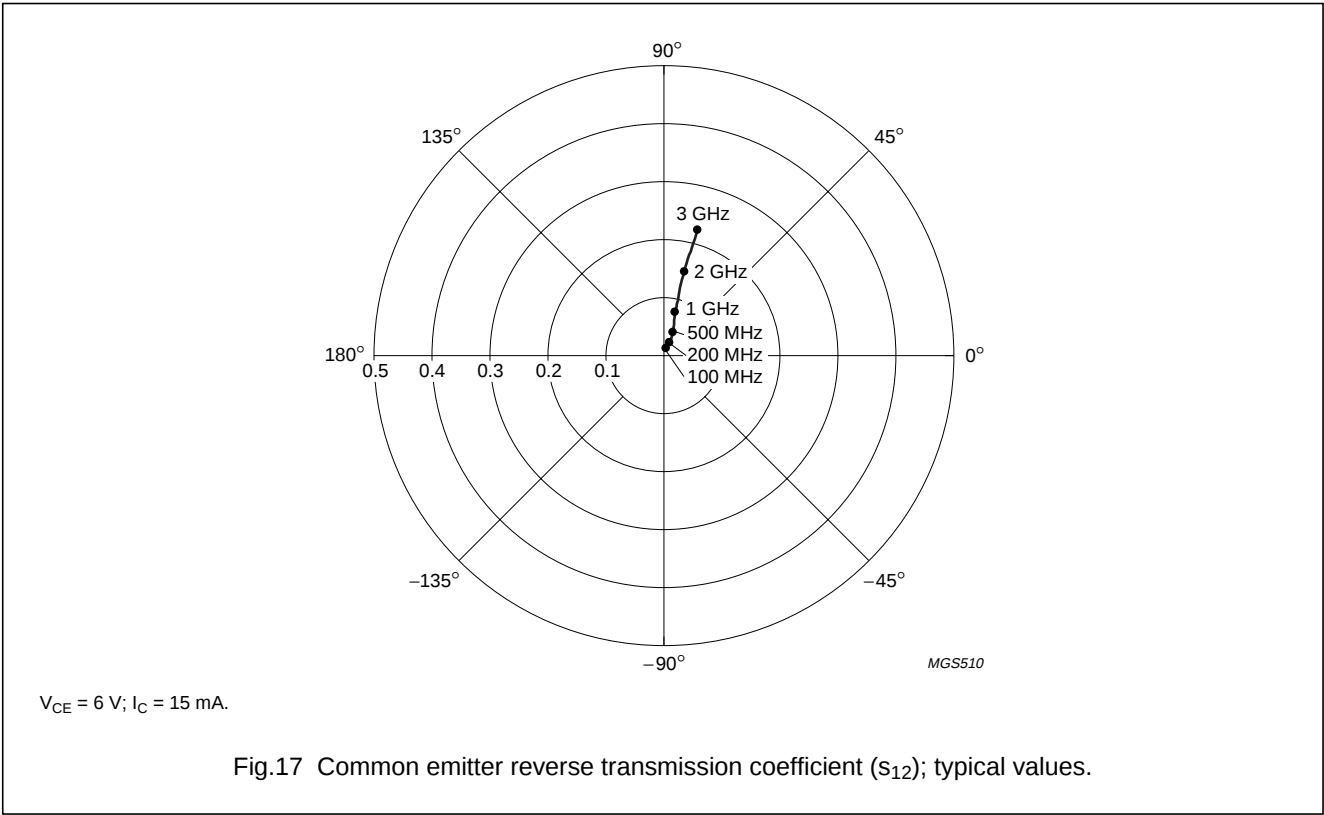


$V_{CE} = 6\text{ V}$; $I_C = 15\text{ mA}$.

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

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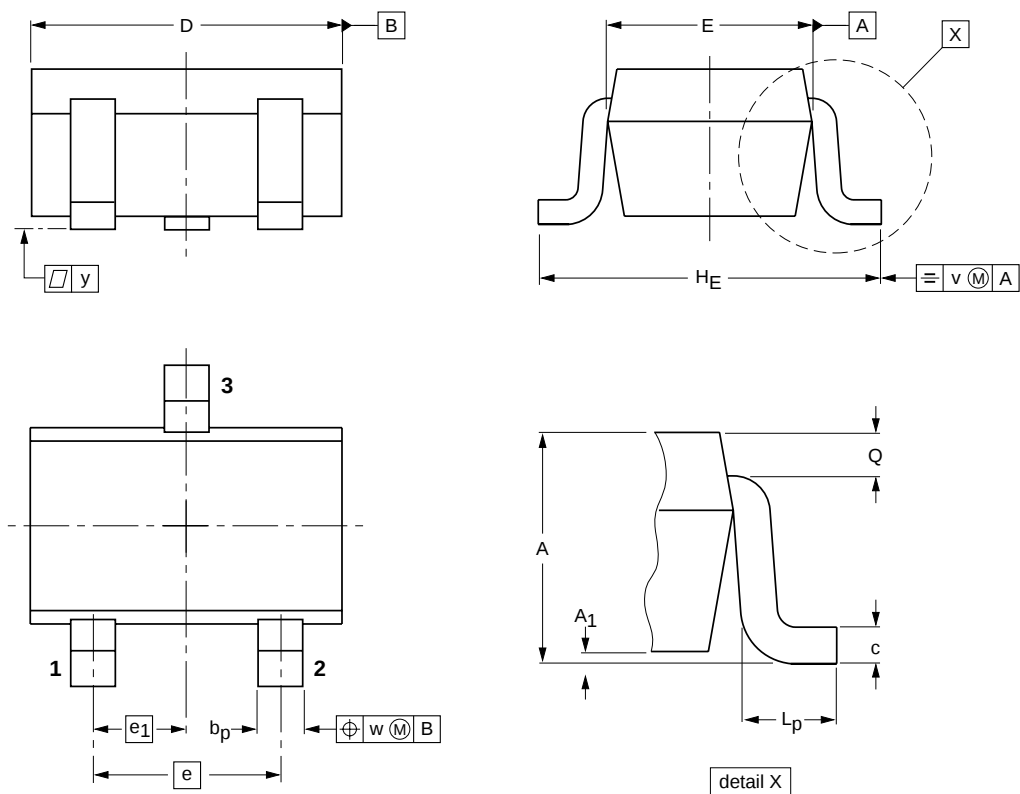
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PACKAGE OUTLINE

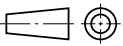
Plastic surface mounted package; 3 leads

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

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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.	

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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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NOTES

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