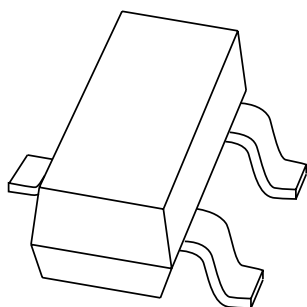


DATA SHEET



PBR941 UHF wideband transistor

Product specification
Supersedes data of 1998 May 08
File under Discrete Semiconductors, SC14

1998 Aug 10

UHF wideband transistor

PBR941

FEATURES

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

APPLICATIONS

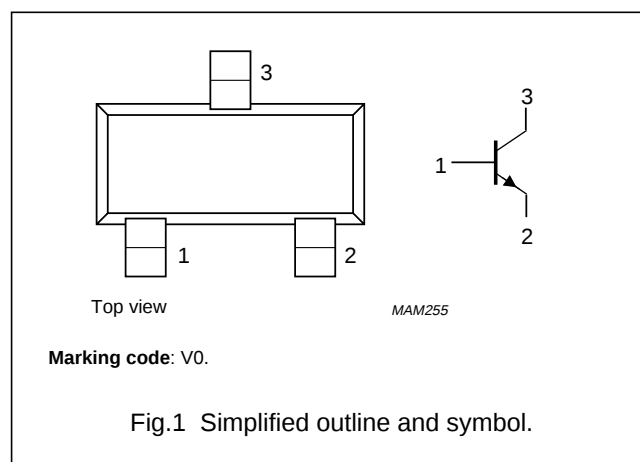
- Communication and instrumentation systems.

DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT23 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 - SOT23

PIN	DESCRIPTION
1	base
2	emitter
3	collector



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	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	—	GHz
G_{UM}	maximum unilateral power gain	$I_C = 15$ mA; $V_{CE} = 6$ V; $f = 1$ GHz; $T_{amb} = 25$ °C	15	—	dB
F	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 5$ mA; $V_{CE} = 6$ V; $f = 1$ GHz	1.4	—	dB
P_{tot}	total power dissipation	$T_S = 60$ °C; note 1	—	360	mW
$R_{th\ j-s}$	thermal resistance from junction to soldering point	$P_{tot} = 360$ mW	—	320	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	collector current (DC)		–	50	mA
$I_{C(AV)}$	average collector current		–	50	mA
P_{tot}	total power dissipation	$T_s = 60\text{ °C}$; note 1	–	360	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; note 1	$P_{tot} = 360\text{ mW}$; $T_s = 60\text{ °C}$; note 1	320	K/W

Note

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

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CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$; 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 = 1 GHz	–	8	–	GHz
G _{UM}	maximum unilateral power gain; note 1	I _C = 15 mA; V _{CE} = 6 V; T _{amb} = 25 °C; f = 1 GHz	–	15	–	dB
		I _C = 15 mA; V _{CE} = 6 V; T _{amb} = 25 °C; f = 2 GHz	–	9.5	–	dB
F	noise figure	Γ _S = Γ _{opt} ; I _C = 5 mA; V _{CE} = 6 V; f = 1 GHz	–	1.4	–	dB
		Γ _S = Γ _{opt} ; I _C = 5 mA; V _{CE} = 6 V; f = 2 GHz	–	2	–	dB

Note

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)} \text{ dB}$

UHF wideband transistor

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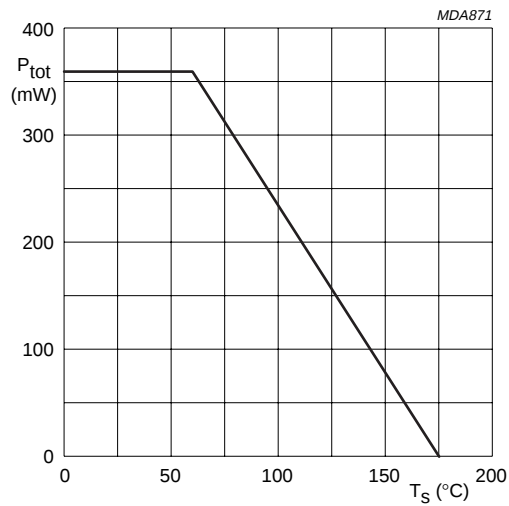
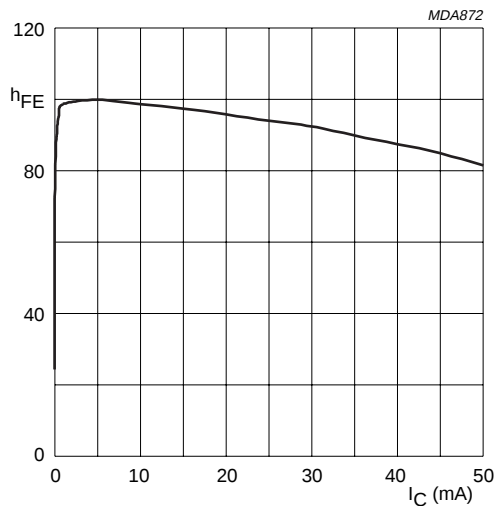
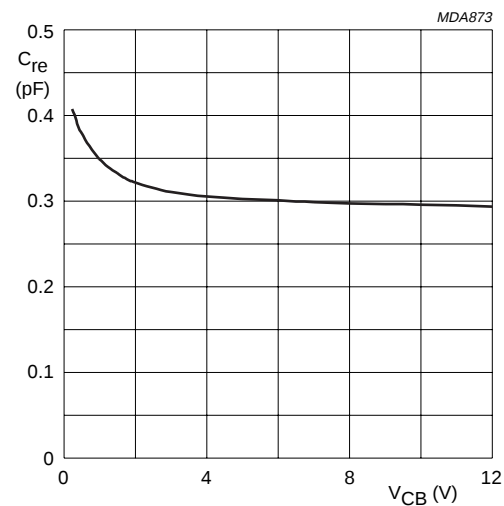


Fig.2 Power derating as a function of soldering point temperature.



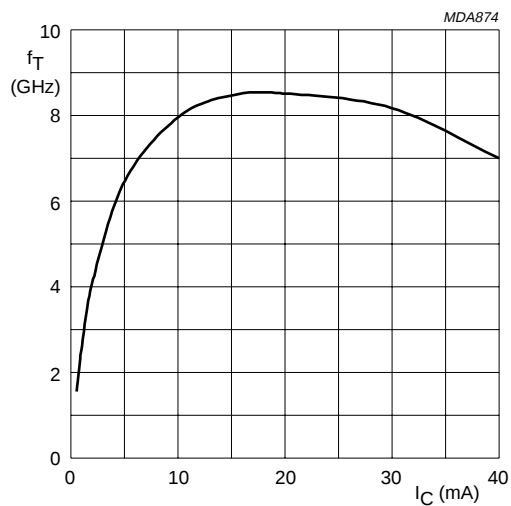
$V_{CE} = 6\text{ V}$.

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



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

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

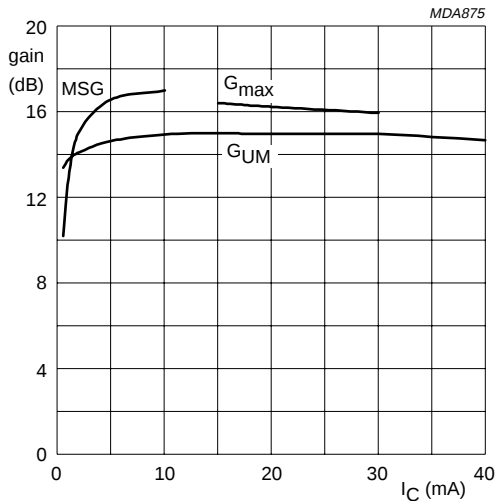


$V_{CE} = 6\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$.

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

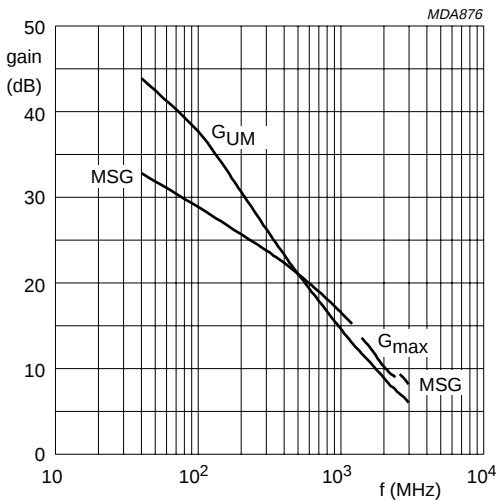
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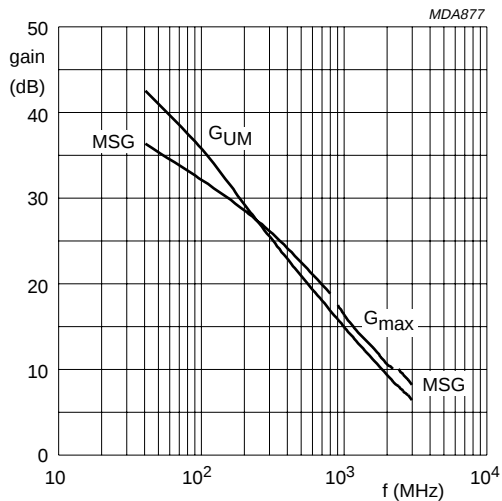
$f = 1 \text{ GHz}$; $V_{CE} = 6 \text{ V}$.

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



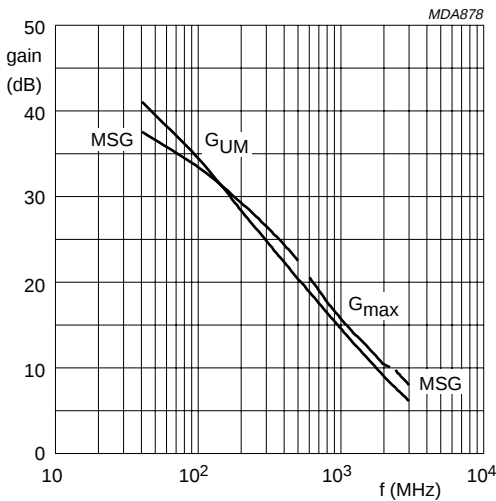
$I_C = 5 \text{ mA}$; $V_{CE} = 6 \text{ V}$.

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.

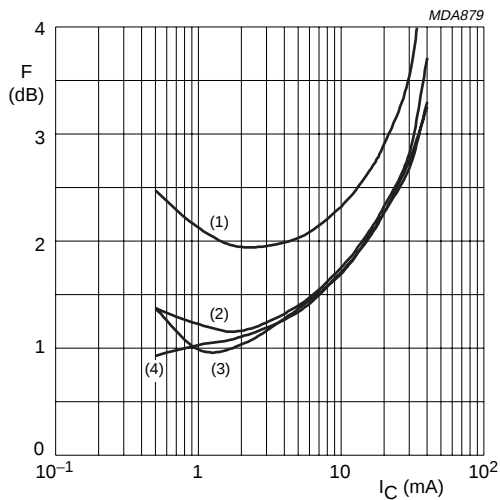


$I_C = 30 \text{ mA}$; $V_{CE} = 6 \text{ V}$.

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

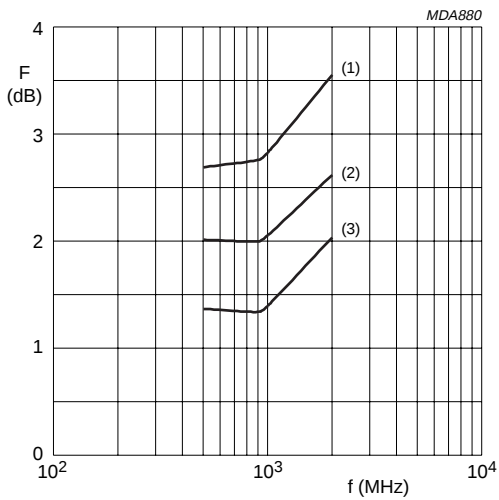
UHF wideband transistor

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$V_{CE} = 6\text{ V.}$
(1) $f = 2000\text{ MHz.}$ (3) $f = 500\text{ MHz.}$
(2) $f = 1000\text{ MHz.}$ (4) $f = 900\text{ MHz.}$

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



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

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

UHF wideband transistor

PBR941

APPLICATION INFORMATION

SPICE parameters for the PBR941 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	–

SEQUENCE No.	PARAMETER	VALUE	UNIT
39 ⁽²⁾	C_{bbp}	83.00	fF
40 ⁽²⁾	C_{bpe}	84.00	fF
41	AF	1.000	–
42	KF	4×10^{-16}	–

Notes

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

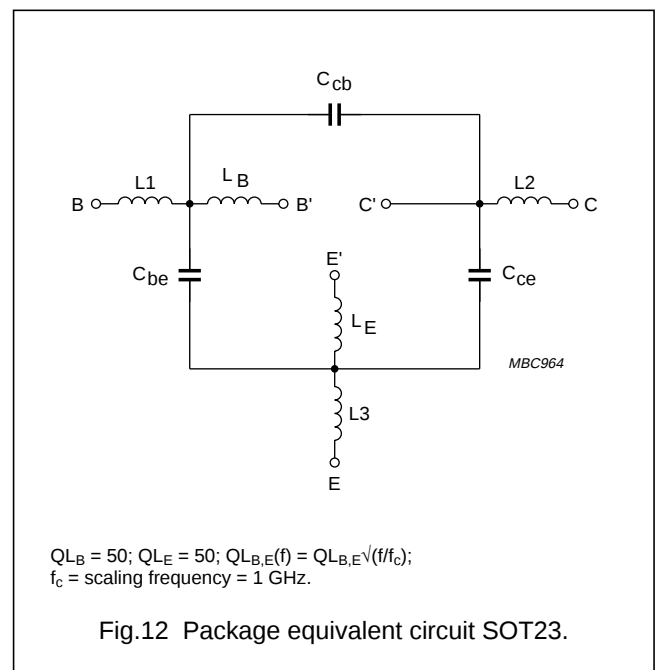


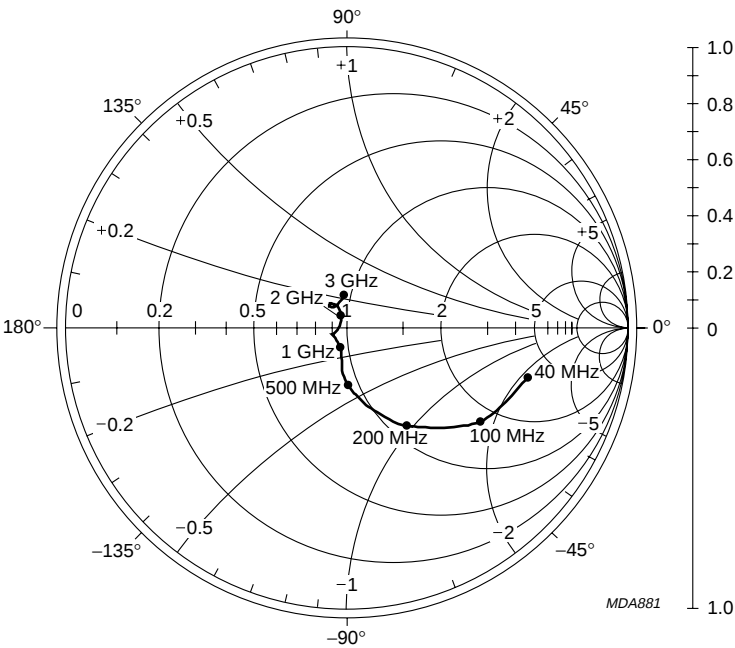
Fig.12 Package equivalent circuit SOT23.

List of components (see Fig.12)

DESIGNATION	VALUE	UNIT
C_{bbe}	7	fF
C_{cb}	80	fF
C_{cce}	80	fF
L1	0.35	nH
L2	0.17	nH
L3	0.35	nH
L_B	0.40	nH
L_E	0.83	nH

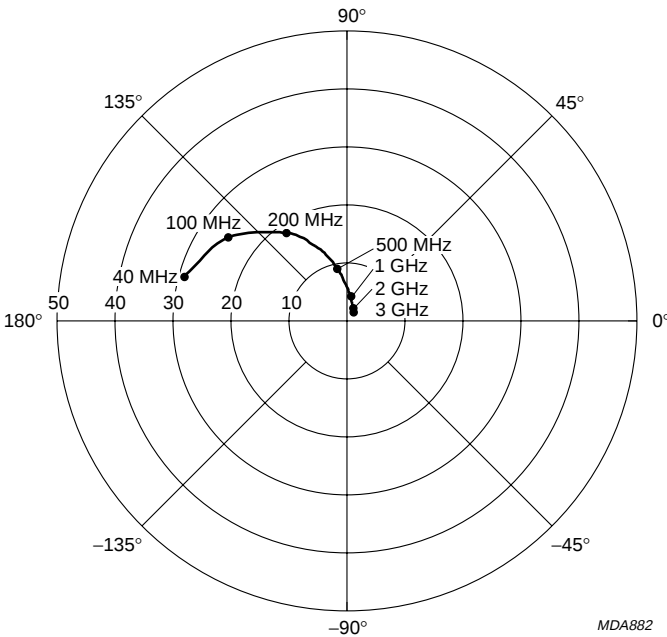
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$V_{CE} = 6\text{ V}; I_C = 15\text{ mA}; Z_0 = 50\ \Omega.$

Fig.13 Common emitter input reflection coefficient (S_{11}); typical values.

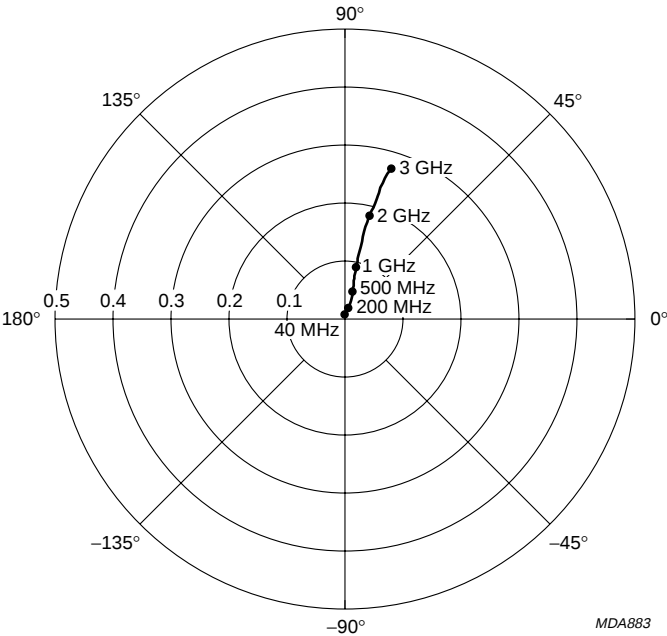


$V_{CE} = 6\text{ V}; I_C = 15\text{ mA}.$

Fig.14 Common emitter forward transmission coefficient (S_{21}); typical values.

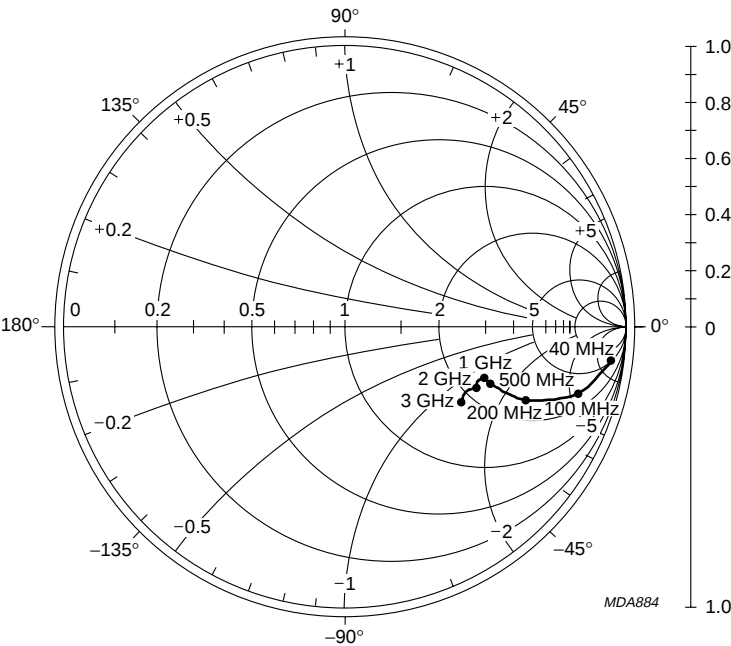
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$V_{CE} = 6\text{ V}; I_C = 15\text{ mA}$.

Fig.15 Common emitter reverse transmission coefficient (S_{12}); typical values.

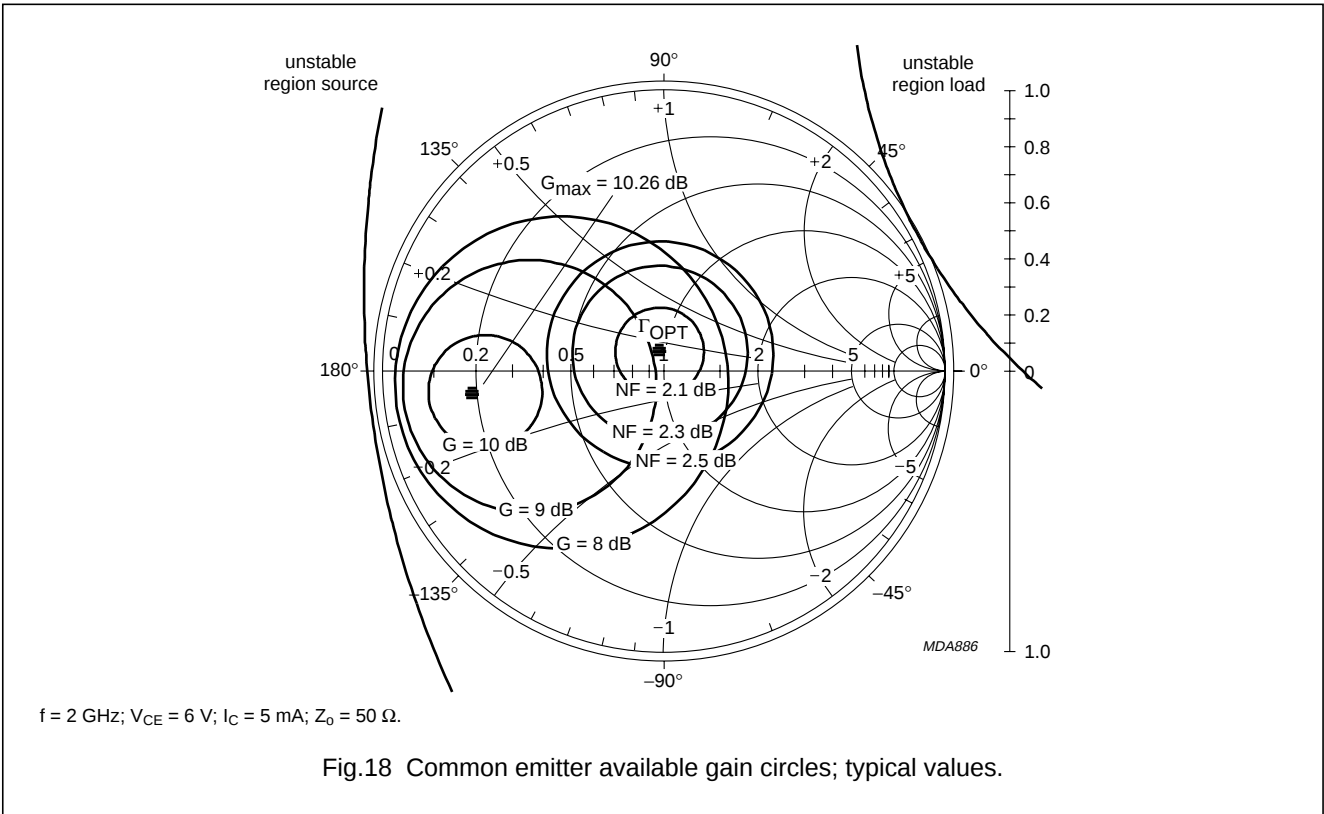
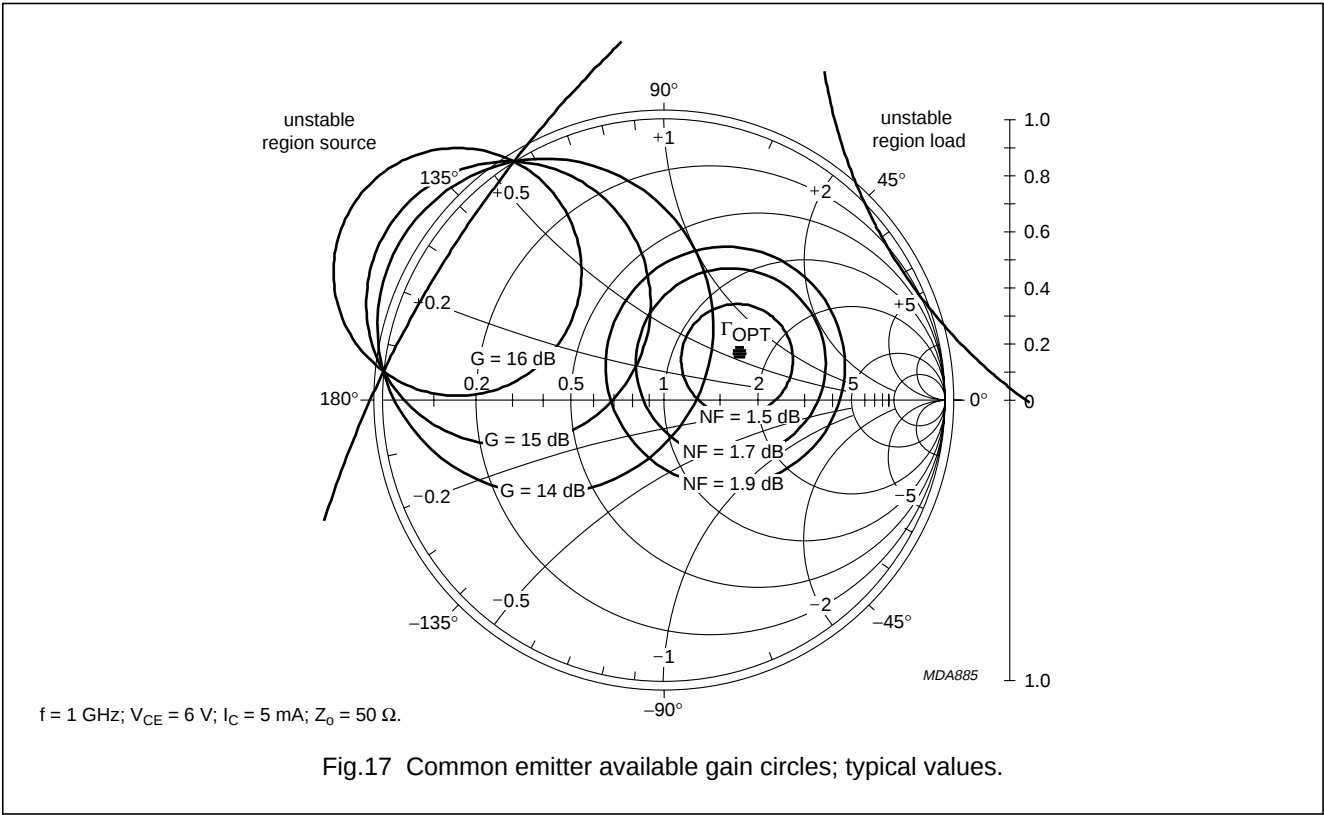


$V_{CE} = 6\text{ V}; I_C = 15\text{ mA}; Z_0 = 50\text{ }\Omega$.

Fig.16 Common emitter output reflection coefficient (S_{22}); typical values.

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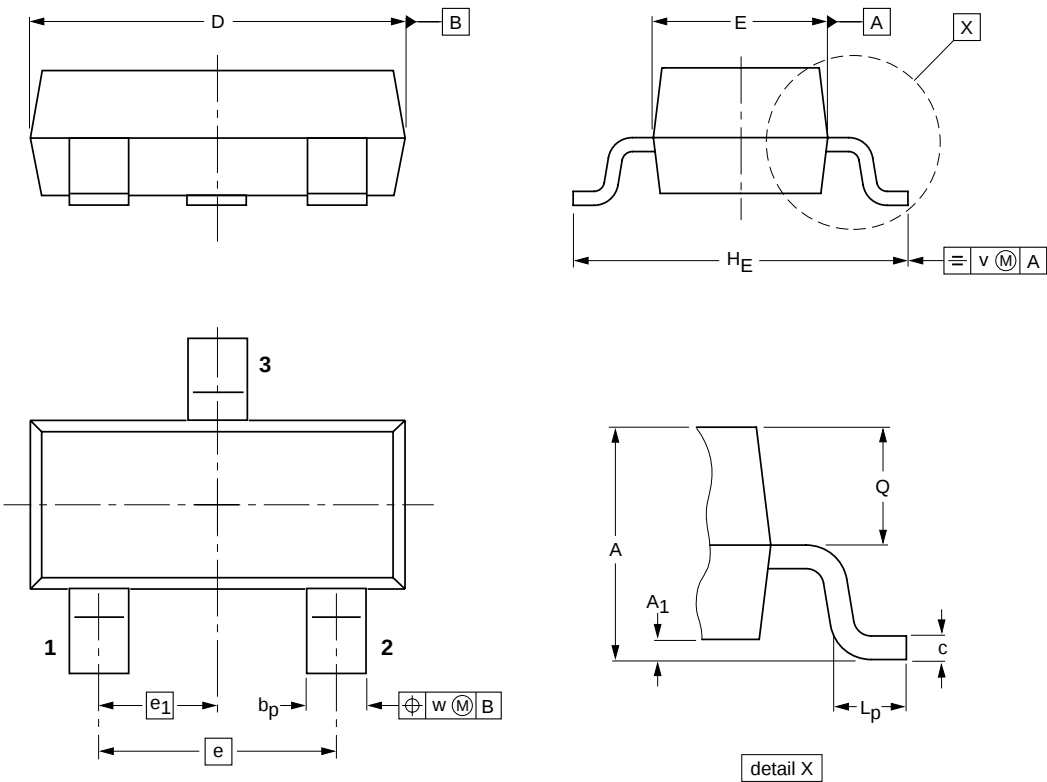
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PACKAGE OUTLINE

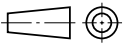
Plastic surface mounted package; 3 leads

SOT23



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 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT23						97-02-28

UHF wideband transistor

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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.
Short-form specification	The data in this 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	
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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NOTES

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