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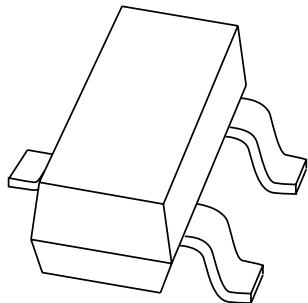
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# **DATA SHEET**



## **PBR941**

### **UHF wideband transistor**

Product specification

1998 Aug 10

Supersedes data of 1998 May 08

File under Discrete Semiconductors, SC14

**UHF wideband transistor****PBR941****FEATURES**

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

**APPLICATIONS**

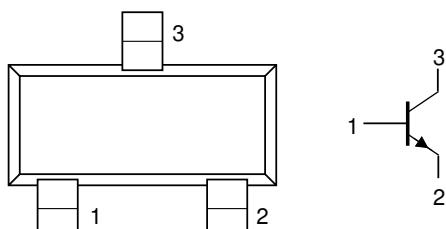
- Communication and instrumentation systems.

**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



Marking code: V0.

Fig.1 Simplified outline and symbol.

**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	$T_s = 60^\circ\text{C}$ ; note 1	–	360	mW
$T_{stg}$	storage temperature		–65	+150	$^\circ\text{C}$
$T_j$	junction temperature		–	175	$^\circ\text{C}$

**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; note 1	$P_{tot} = 360 \text{ mW}; T_s = 60^\circ\text{C}$ ; note 1	320	K/W

**Note**

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

## UHF wideband transistor

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**CHARACTERISTICS** $T_j = 25^\circ\text{C}$ ; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>DC characteristics</b>						
$V_{(\text{BR})\text{CBO}}$	collector-base breakdown voltage	$I_C = 100 \mu\text{A}; I_E = 0$	20	—	—	V
$V_{(\text{BR})\text{CEO}}$	collector-emitter breakdown voltage	$I_C = 100 \mu\text{A}; I_B = 0$	10	—	—	V
$V_{(\text{BR})\text{EBO}}$	emitter-base breakdown voltage	$I_E = 10 \mu\text{A}; I_C = 0$	1.5	—	—	V
$I_{\text{CBO}}$	collector-base leakage current	$V_{\text{CB}} = 10 \text{ V}; I_E = 0$	—	—	100	nA
$I_{\text{EBO}}$	emitter-base leakage current	$V_{\text{EB}} = 1 \text{ V}; I_C = 0$	—	—	100	nA
$h_{\text{FE}}$	DC current gain	$I_C = 5 \text{ mA}; V_{\text{CE}} = 6 \text{ V}$	50	100	200	
		$I_C = 15 \text{ mA}; V_{\text{CE}} = 6 \text{ V}$	—	100	—	
<b>AC characteristics</b>						
$C_{\text{re}}$	feedback capacitance	$I_C = 0; V_{\text{CB}} = 6 \text{ V}; f = 1 \text{ MHz}$	—	0.3	—	pF
$f_T$	transition frequency	$I_C = 15 \text{ mA}; V_{\text{CE}} = 6 \text{ V}; f = 1 \text{ GHz}$	—	8	—	GHz
$G_{\text{UM}}$	maximum unilateral power gain; note 1	$I_C = 15 \text{ mA}; V_{\text{CE}} = 6 \text{ V};$ $T_{\text{amb}} = 25^\circ\text{C}; f = 1 \text{ GHz}$	—	15	—	dB
		$I_C = 15 \text{ mA}; V_{\text{CE}} = 6 \text{ V};$ $T_{\text{amb}} = 25^\circ\text{C}; f = 2 \text{ GHz}$	—	9.5	—	dB
$F$	noise figure	$\Gamma_S = \Gamma_{\text{opt}}; I_C = 5 \text{ mA}; V_{\text{CE}} = 6 \text{ V};$ $f = 1 \text{ GHz}$	—	1.4	—	dB
		$\Gamma_S = \Gamma_{\text{opt}}; I_C = 5 \text{ mA}; V_{\text{CE}} = 6 \text{ V};$ $f = 2 \text{ GHz}$	—	2	—	dB

**Note**

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

## UHF wideband transistor

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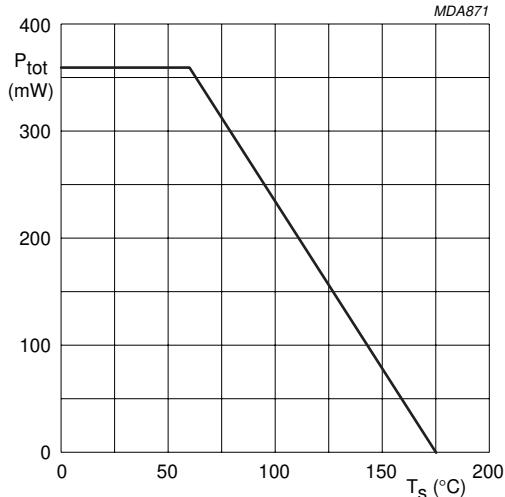
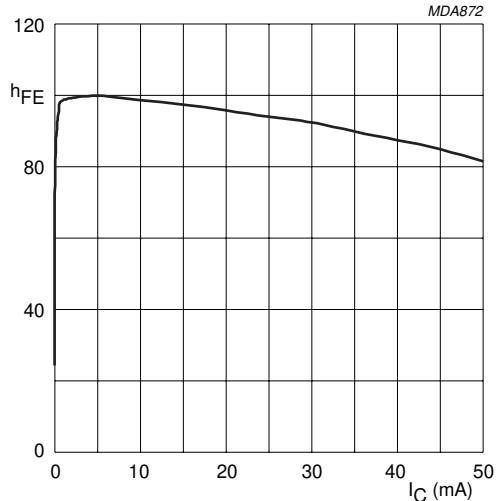
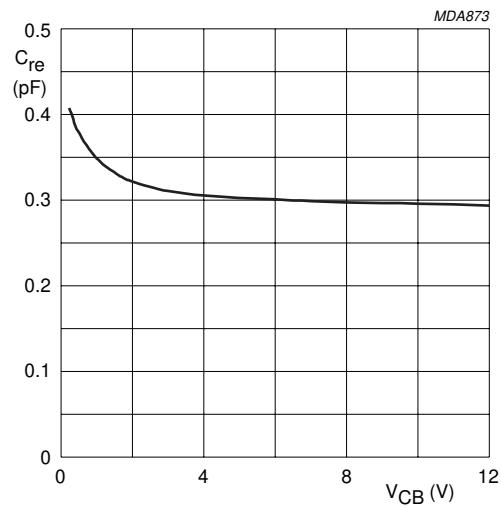


Fig.2 Power derating as a function of soldering point temperature.



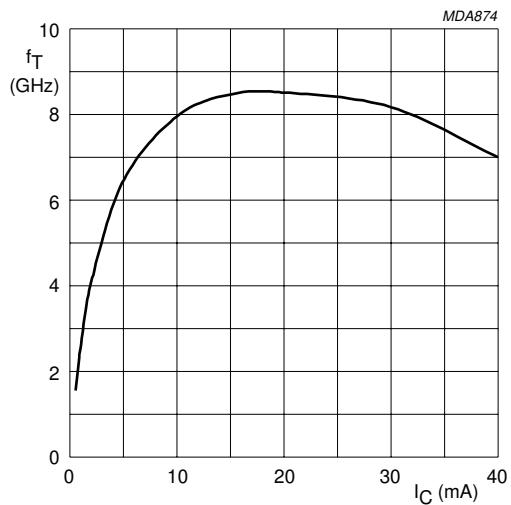
$V_{CE} = 6$  V.

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;  $f = 1$  GHz;  $T_{amb} = 25$  °C.

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

## UHF wideband transistor

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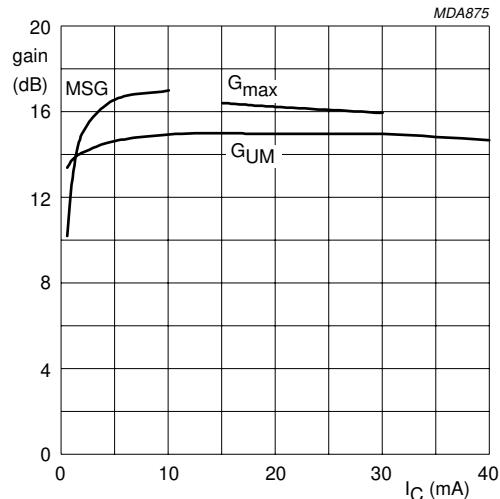
 $f = 1 \text{ GHz}; V_{CE} = 6 \text{ V.}$ 

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

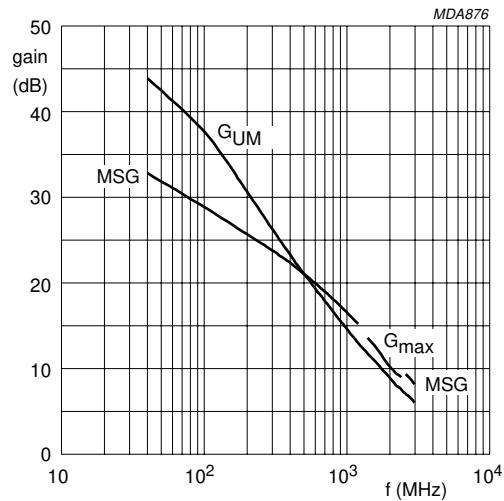
 $I_C = 5 \text{ mA}; V_{CE} = 6 \text{ V.}$ 

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

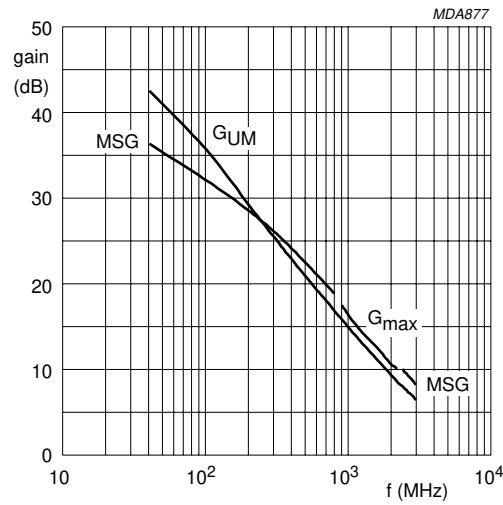
 $I_C = 15 \text{ mA}; V_{CE} = 6 \text{ V.}$ 

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

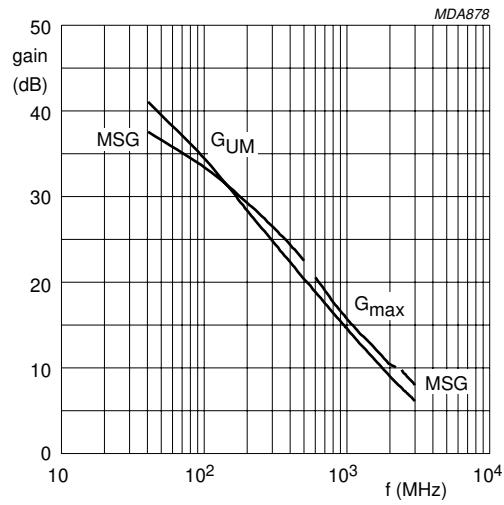
 $I_C = 30 \text{ mA}; V_{CE} = 6 \text{ V.}$ 

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

## UHF wideband transistor

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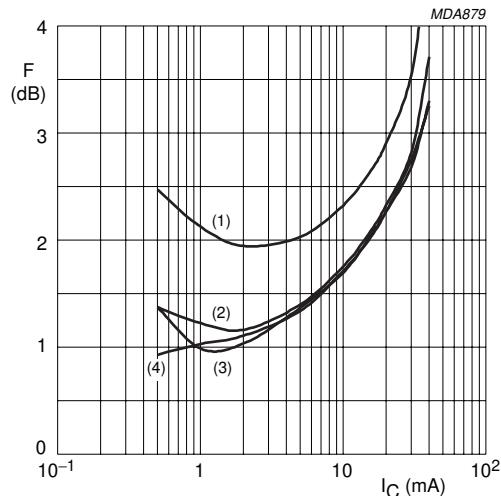
 $V_{CE} = 6$  V.(1)  $f = 2000$  MHz.(2)  $f = 1000$  MHz.(3)  $f = 500$  MHz.(4)  $f = 900$  MHz.

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

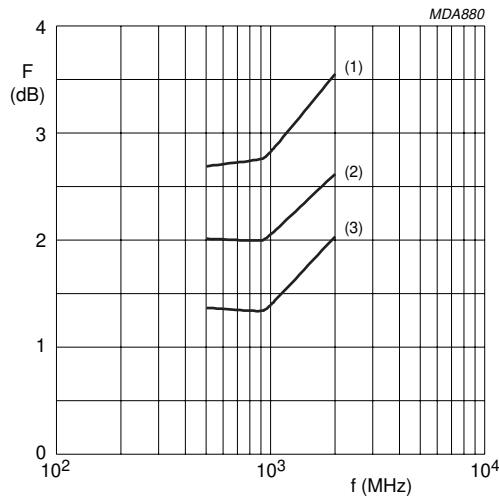
 $V_{CE} = 6$  V.(1)  $I_C = 30$  mA.(2)  $I_C = 15$  mA.(3)  $I_C = 5$  mA.

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

## UHF wideband transistor

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## 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	μA
16	RBM	4.957	Ω
17	RE	0.597	Ω
18	RC	1.988	Ω
19 <sup>(1)</sup>	XTB	0.000	–
20 <sup>(1)</sup>	EG	1.110	eV
21 <sup>(1)</sup>	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 <sup>(1)</sup>	CJS	0.000	F
36 <sup>(1)</sup>	VJS	700.0	mV
37 <sup>(1)</sup>	MJS	0.000	–
38	FC	0.943	–

SEQUENCE No.	PARAMETER	VALUE	UNIT
39 <sup>(2)</sup>	$C_{bpb}$	83.00	fF
40 <sup>(2)</sup>	$C_{bpe}$	84.00	fF
41	AF	1.000	–
42	KF	$4 \times 10^{-16}$	–

## 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.

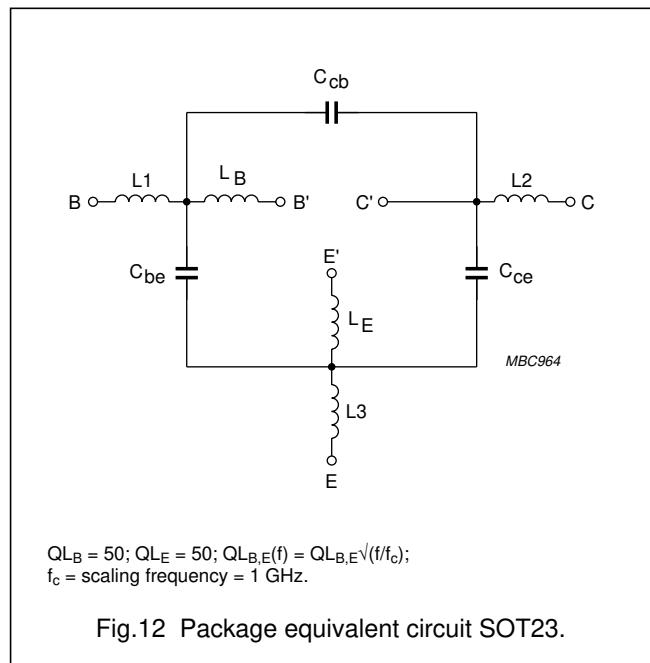


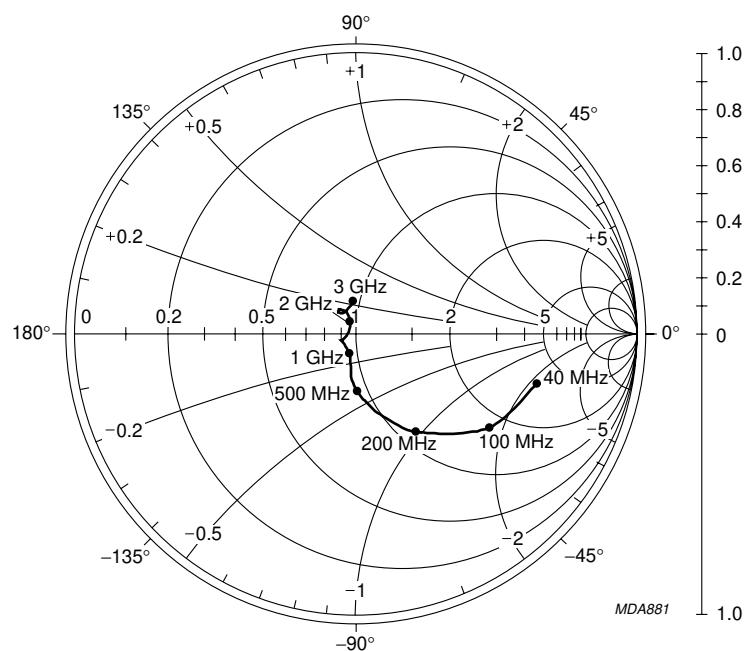
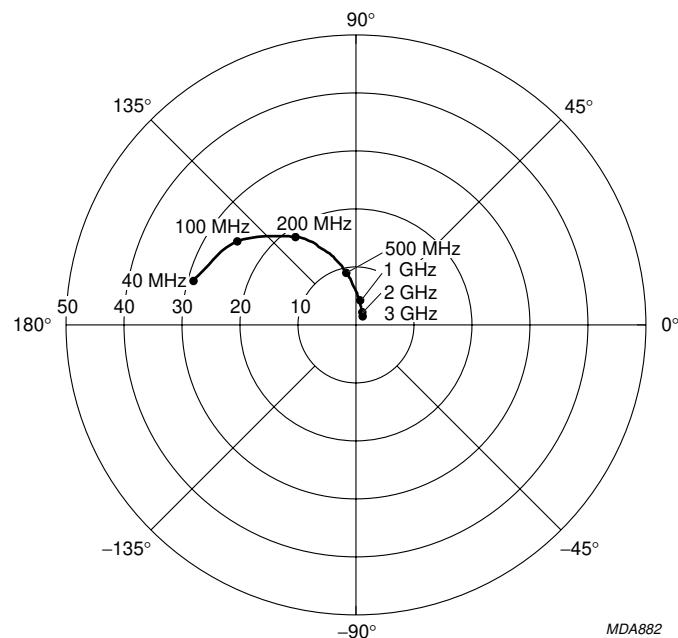
Fig.12 Package equivalent circuit SOT23.

## List of components (see Fig.12)

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

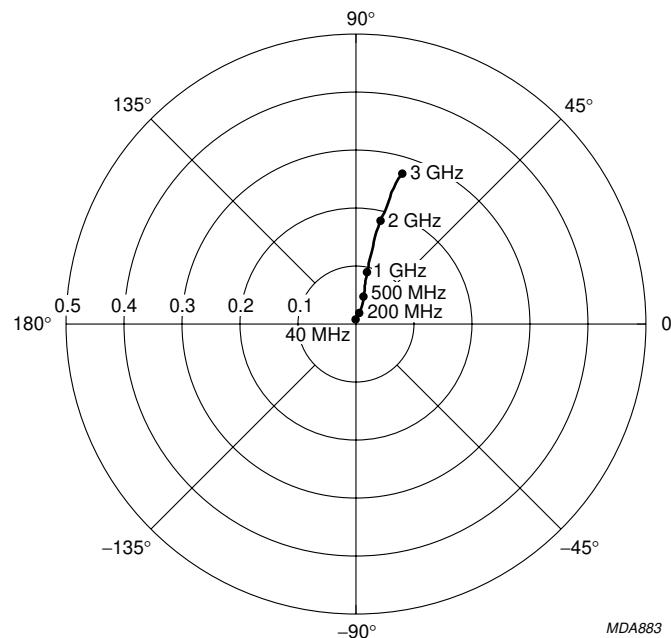
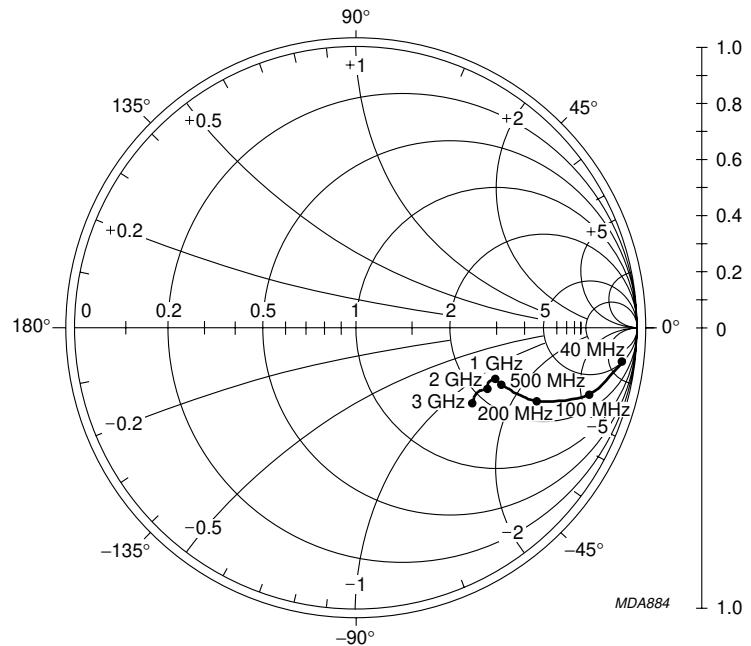
## UHF wideband transistor

PBR941

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

## UHF wideband transistor

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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. $V_{CE} = 6 \text{ V}$ ;  $I_C = 15 \text{ mA}$ ;  $Z_0 = 50 \Omega$ .Fig.16 Common emitter output reflection coefficient ( $S_{22}$ ); typical values.

## UHF wideband transistor

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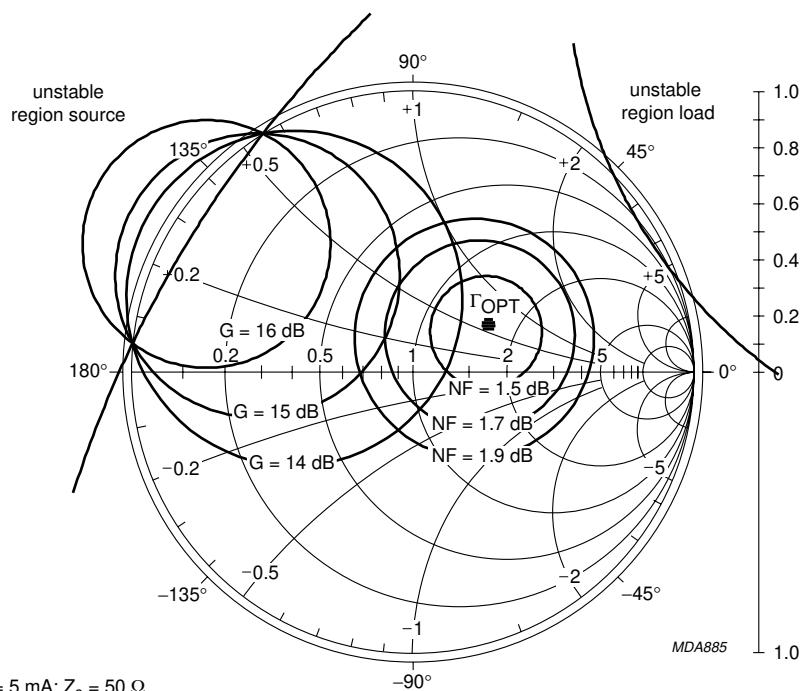


Fig.17 Common emitter available gain circles; typical values.

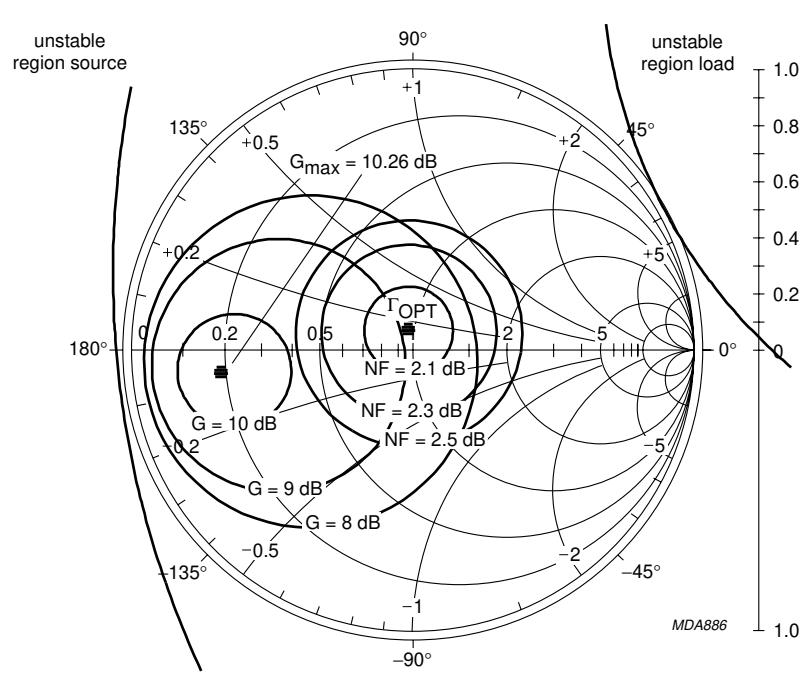


Fig.18 Common emitter available gain circles; typical values.

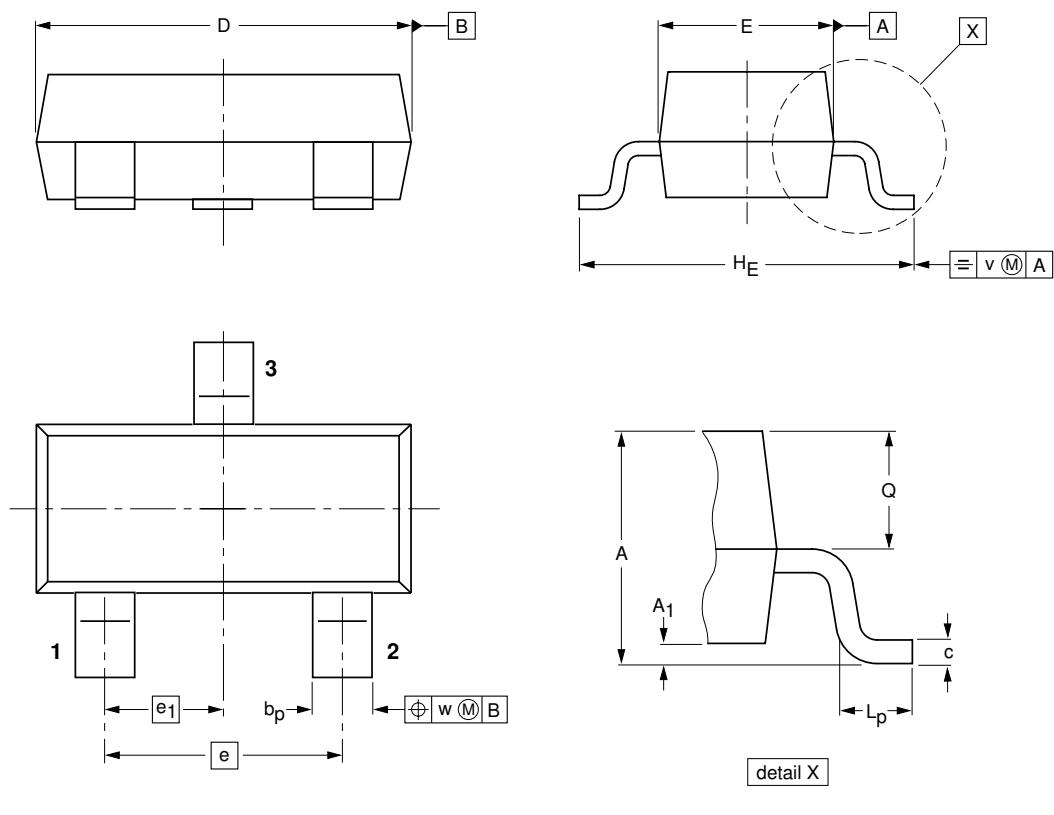
## UHF wideband transistor

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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****PBR941****DEFINITIONS**

<b>Data sheet status</b>	
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.
<b>Limiting values</b>	
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.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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UHF wideband transistor

PBR941

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**NOTES**

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**NOTES**

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