NPN 6 GHz wideband transistor — BFG94

FEATURES

- High power gain
- Low noise figure
- Low intermodulation distortion
- Gold metallization ensures excellent reliability.

DESCRIPTION

NPN transistor mounted in a plastic SOT223 envelope. It is primarily intended for use in communication and instrumentation systems.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

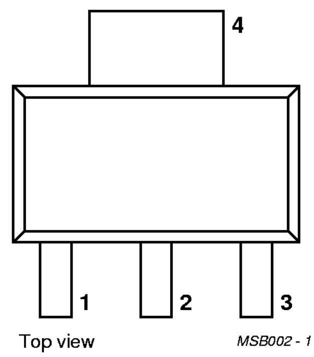


Fig.1 SOT223.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	–	12	V
I_C	DC collector current		–	–	60	mA
P_{tot}	total power dissipation	up to T_s = 140 °C (note 1)	–	–	700	mW
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; f = 1 MHz	–	–	0.8	pF
f_T	transition frequency	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	4	6	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	11.5	13.5	–	dB
V_O	output voltage	I_C = 45 mA; V_{CE} = 10 V; d_{im} = –60 dB; R_L = 75 Ω; f = 800 MHz; T_{amb} = 25 °C	–	500	–	mV
P_{L1}	output power at 1 dB gain compression	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	–	21.5	–	dBm

Note

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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	DC collector current		–	60	mA
P_{tot}	total power dissipation	up to T_s = 140 °C (note 1)	–	700	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	up to T_s = 140 °C (note 1)	50 K/W

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

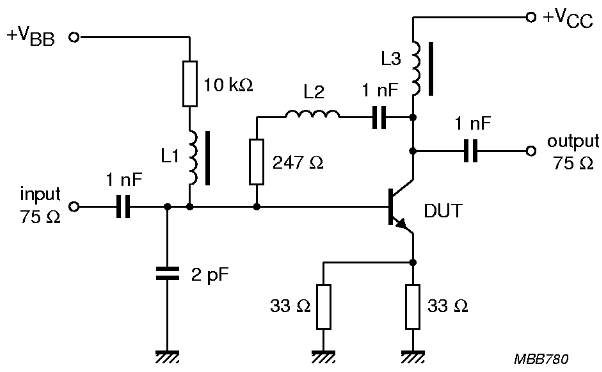
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 10 V	–	–	100	nA
h_{FE}	DC current gain	I_C = 30 mA; V_{CE} = 5 V	45	90	–	
		I_C = 45 mA; V_{CE} = 10 V	–	100	–	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 10 V; f = 1 MHz	–	0.9	2	pF
C_e	emitter capacitance	$I_C = i_e$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	2.9	4.5	pF
C_{re}	feedback capacitance	$I_C = i_c$ = 0; V_{CE} = 10 V; f = 1 MHz	–	0.5	0.8	pF
f_T	transition frequency	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	4	–	–	GHz
		I_C = 30 mA; V_{CE} = 5 V; f = 1 GHz; T_{amb} = 25 °C	4	6	–	GHz
G_{UM}	maximum unilateral power gain (note1)	I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C	11.5	13.5	–	dB
F	minimum noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 45 mA; V_{CE} = 10 V; f = 500 MHz	–	2.7	–	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 45 mA; V_{CE} = 10 V; f = 1 GHz	–	3	–	dB
V_O	output voltage	note 2	–	500	–	mV
d_2	second order intermodulation distortion	note 3	–	–51	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 45 mA; V_{CE} = 10 V; R_L = 50 Ω; T_{amb} = 25 °C; measured at f = 1 GHz	–	21.5	–	dBm
ITO	third order intercept point	note 4	–	34	–	dBm

Notes

1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

$$G_{UM} = 10 \log \frac{|S_{21}|^2}{\left(1-|S_{11}|^2\right)\left(1-|S_{22}|^2\right)} \text{dB}.$$

2. d_{im} = –60 dB (DIN 45004B, par 6.3: 3-tone); I_C = 45 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C;
$V_p = V_O$ at d_{im} = –60 dB; f_p = 795.25 MHz;
$V_q = V_O$ –6 dB; $V_r = V_O$ –6 dB;
f_q = 803.25 MHz; f_r = 805.25 MHz;
measured at $f_{(p+q-r)}$ = 793.25 MHz.
3. I_C = 45 mA; V_{CE} = 10 V; R_L = 75 Ω; T_{amb} = 25 °C;
$V_q = V_O$ = 280 mV;
f_p = 250 MHz; f_q = 560 MHz;
measured at $f_{(p+q)}$ = 810 MHz.
4. I_C = 45 mA; V_{CE} = 10 V; R_L = 50 Ω; T_{amb} = 25 °C;
f_p = 1000 MHz; f_q = 1001 MHz;
measured at $f_{(2p-q)}$ and $f_{(2q-p)}$.



L1 = L3 = 5 µH micro-choke.
L2 = 1 turn copper wire (0.4 mm), internal diameter 4 mm.

Fig.2 Test circuit for second and third order intermodulation distortion.

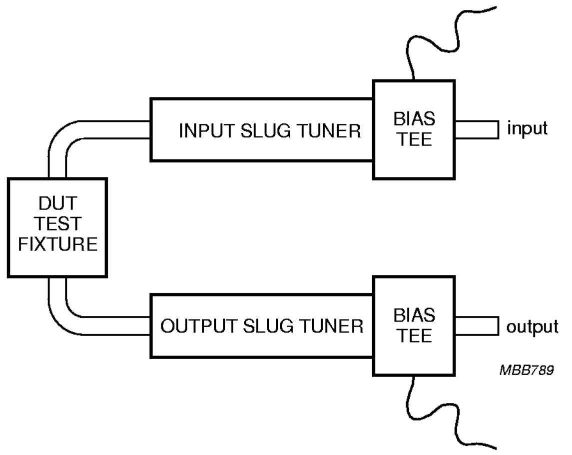


Fig.3 Measurement set-up for third order intercept point and 1 dB gain compression.

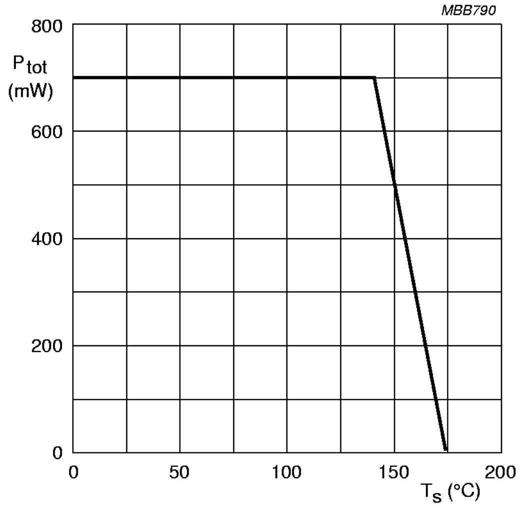
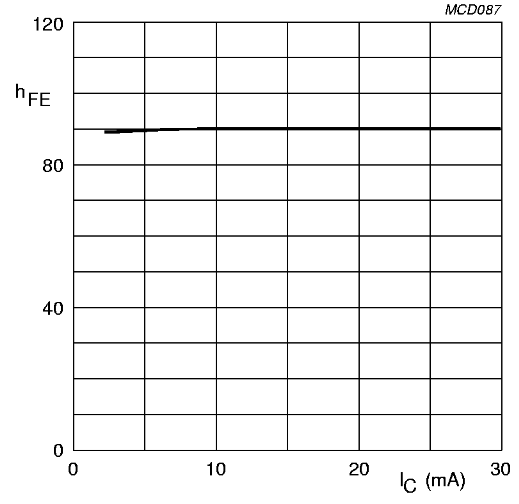
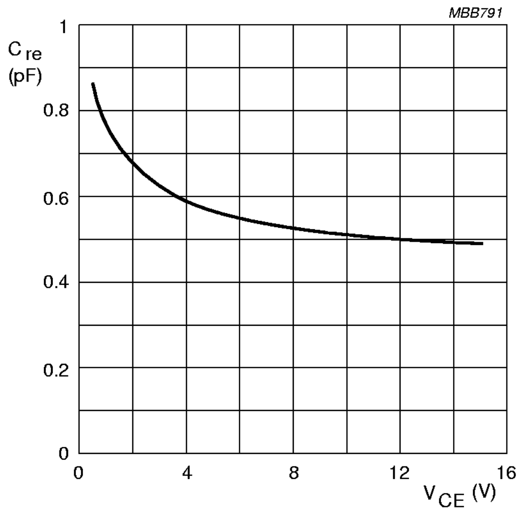


Fig.4 Power derating curve.



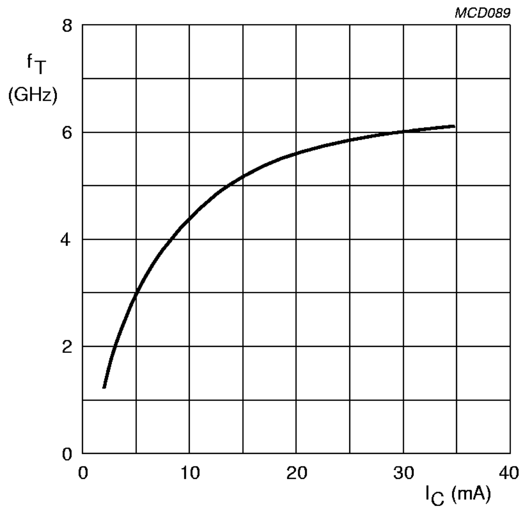
V_{CE} = 10 V; T_j = 25 °C

Fig.5 DC current gain as a function of collector current.



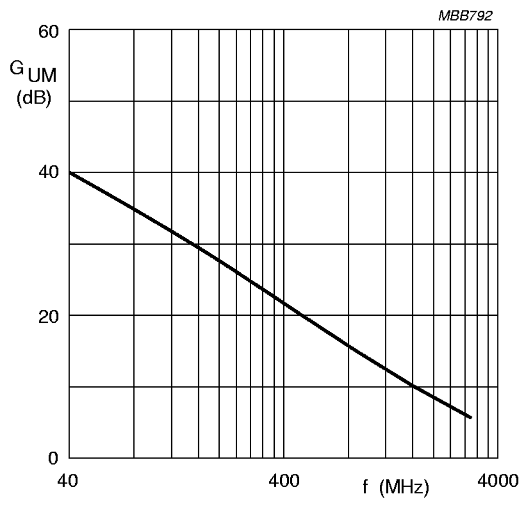
$I_C = i_c = 0$; f = 1 MHz.

Fig.6 Feedback capacitance as a function of collector-emitter voltage.



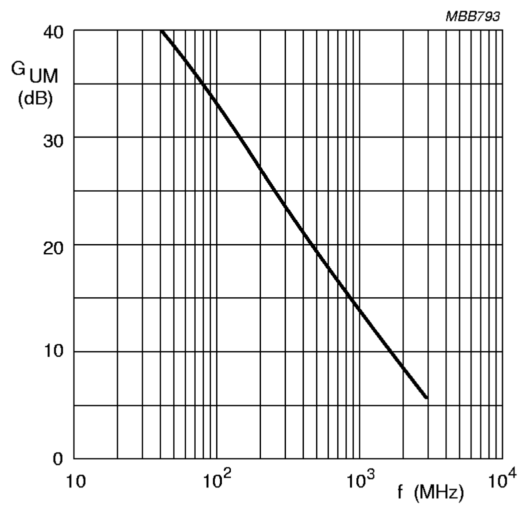
V_{CE} = 10 V; f = 1 GHz.

Fig.7 Transition frequency as a function of collector current.



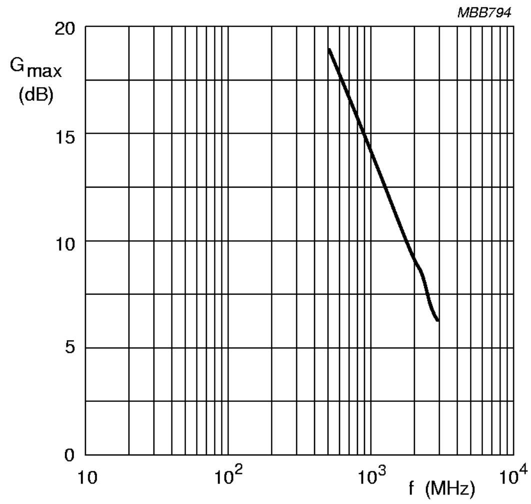
I_c = 45 mA; V_{CE} = 10 V.

Fig.8 Maximum unilateral power gain as a function of frequency.



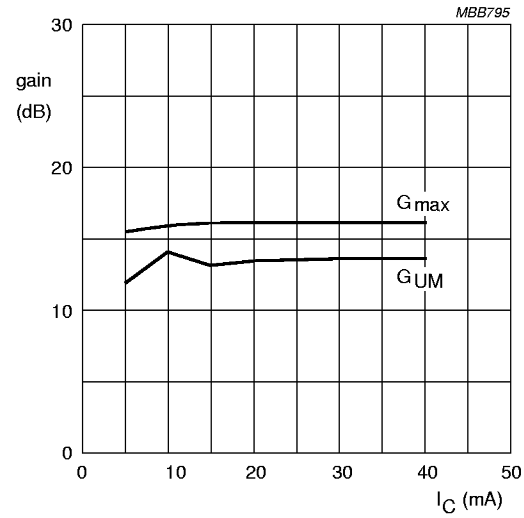
I_c = 20 mA; V_{CE} = 8 V.

Fig.9 Maximum unilateral power gain as a function of frequency.



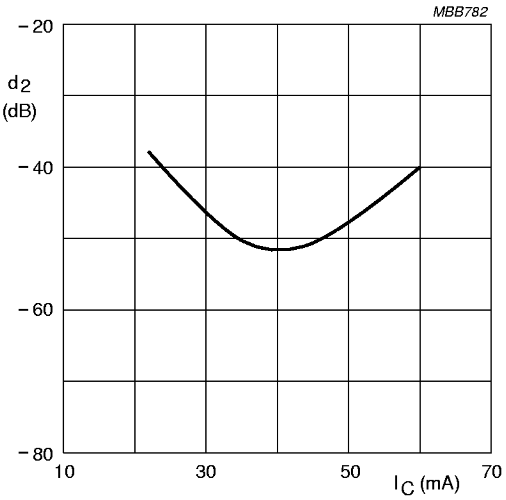
I_c = 20 mA; V_{CE} = 8 V.

Fig.10 Maximum available stable gain as a function of frequency.



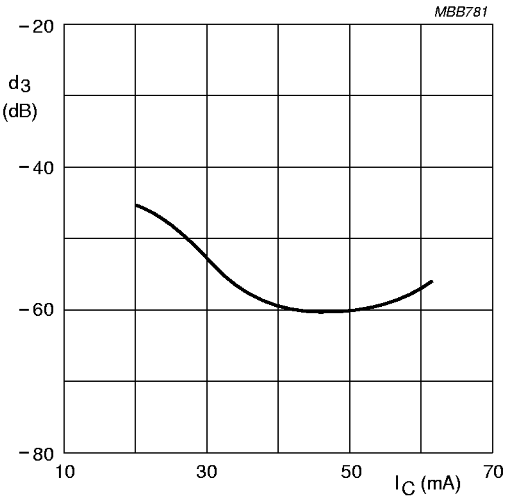
V_{CE} = 8 V; f = 1 GHz.
G_{max} = maximum available stable gain.
G_{UM} = maximum unilateral power gain.

Fig.11 Gain as a function of collector current.



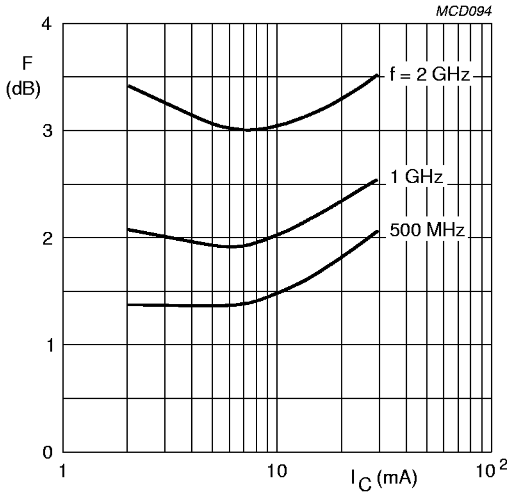
I_c = 45 mA; V_{CE} = 10 V; $f_{(p+q)}$ = 810 MHz.
See test circuit, Fig.2

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



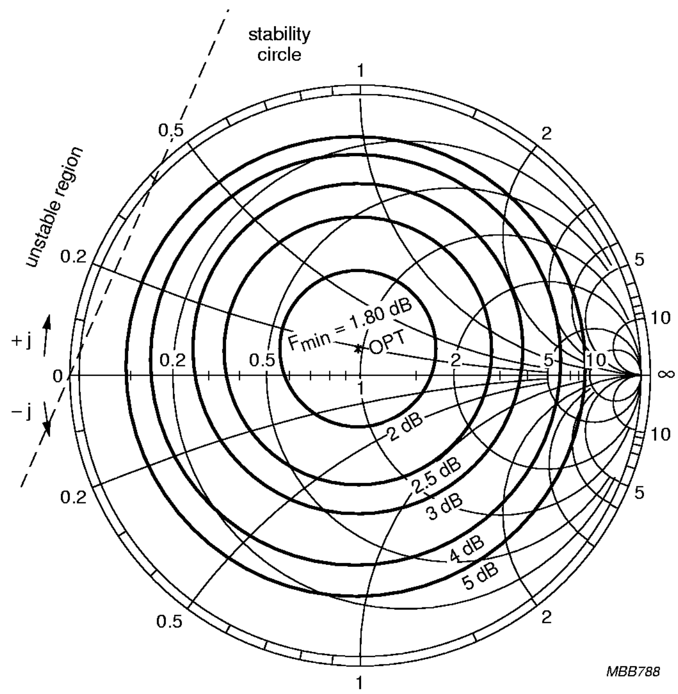
I_c = 45 mA; V_{CE} = 10 V; $f_{(p+q-r)}$ = 793.25 MHz.
See test circuit, Fig.2

Fig.13 Third order intermodulation distortion as a function of collector current.



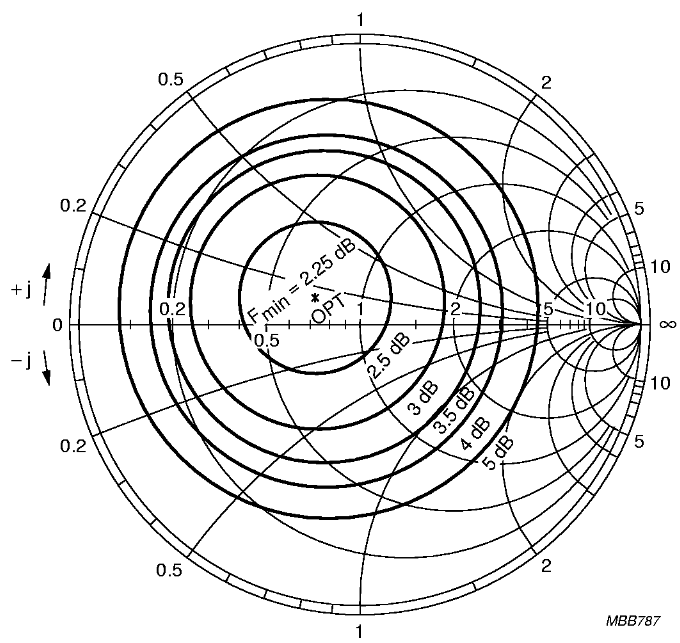
V_{CE} = 8 V.

Fig.14 Minimum noise figure as a function of collector current.



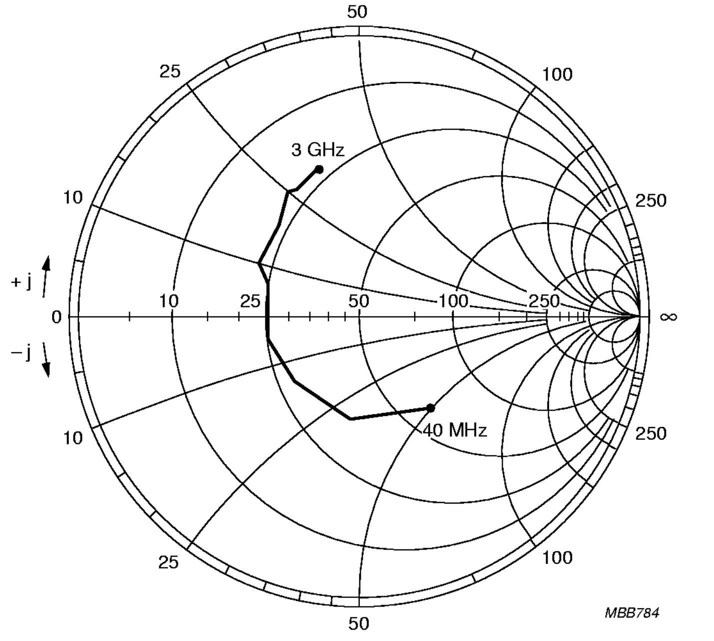
I_c = 15 mA; V_{CE} = 10 V; f = 500 MHz.

Fig.15 Noise circle.



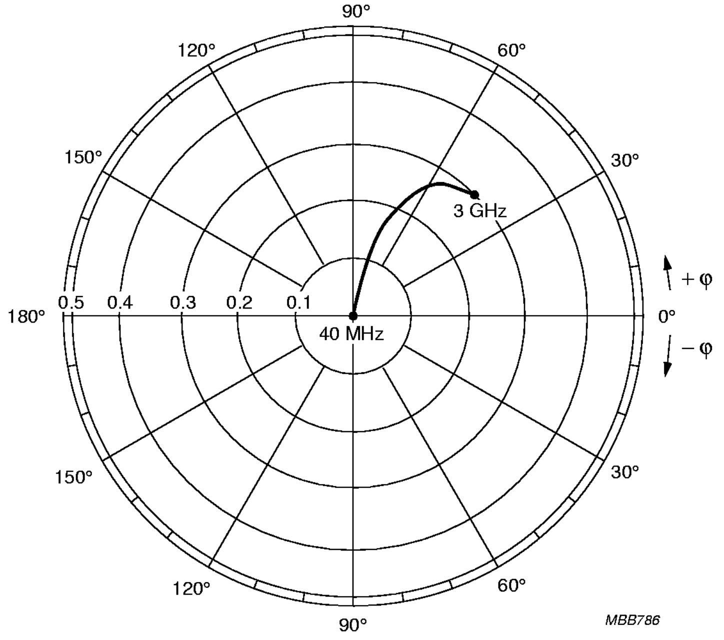
I_c = 15 mA; V_{CE} = 10 V; f =1 GHz.

Fig.16 Noise circle.



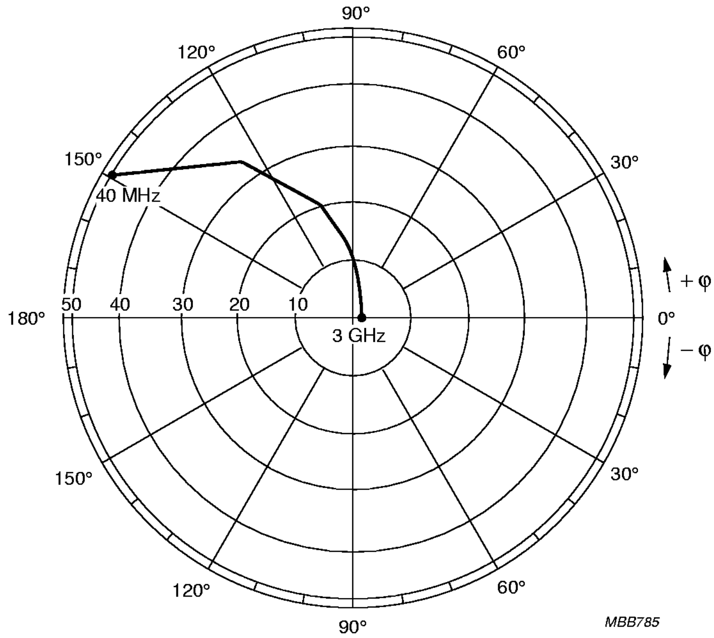
I_C = 45 mA; V_{CE} = 10 V.
Z_O = 50 Ω.

Fig.17 Common emitter input reflection coefficient (S_{11}).



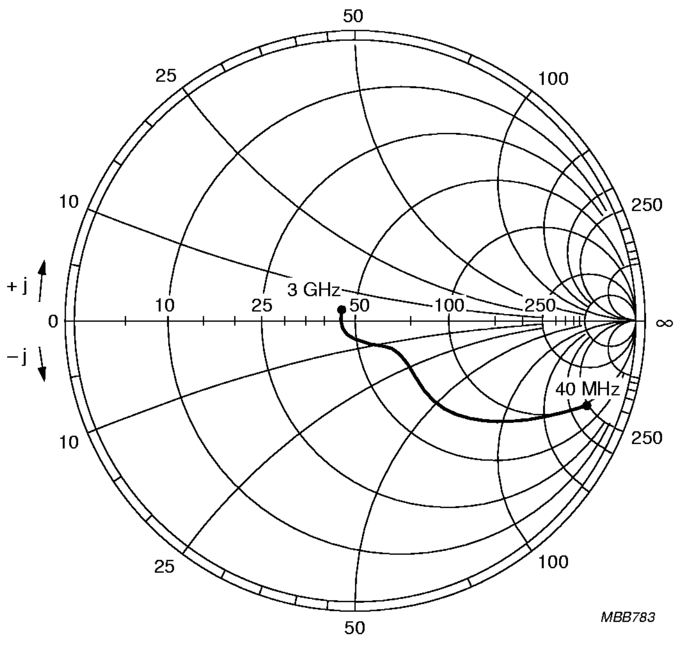
I_C = 45 mA; V_{CE} = 10 V.

Fig.18 Common emitter forward transmission coefficient (S_{21}).



I_C = 45 mA; V_{CE} = 10 V.

Fig.19 Common emitter reverse transmission coefficient (S_{12}).

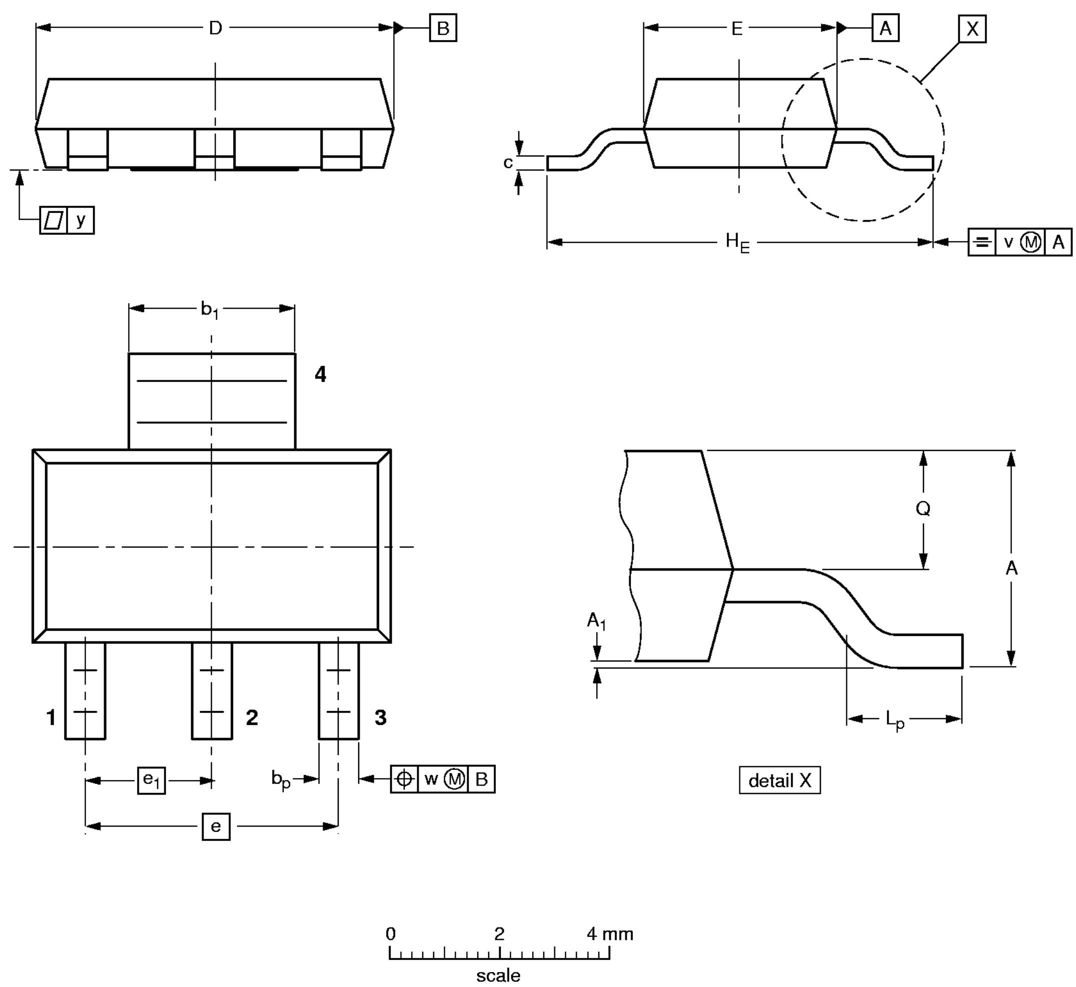


I_C = 45 mA; V_{CE} = 10 V.
Z_O = 50 Ω.

Fig.20 Common emitter output reflection coefficient (S_{22}).

PACKAGE OUTLINE

Plastic surface mounted package; collector pad for good heat transfer; 4 leads **SOT223**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.8 1.5	0.10 0.01	0.80 0.60	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	4.6	2.3	7.3 6.7	1.1 0.7	0.95 0.85	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT223						~~96-11-11~~ 97-02-28