

DATA SHEET

BFG94

NPN 6 GHz wideband transistor

Product specification

September 1995



NPN 6 GHz wideband transistor

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FEATURES

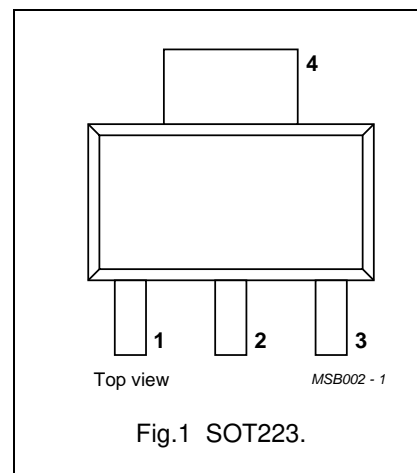
- High power gain
- Low noise figure
- Low intermodulation distortion
- Gold metallization ensures excellent reliability.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

DESCRIPTION

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



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 $T_s = 140\text{ °C}$ (note 1)	—	—	700	mW
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 10\text{ V}$; $f = 1\text{ MHz}$	—	—	0.8	pF
f_T	transition frequency	$I_C = 45\text{ mA}$; $V_{CE} = 10\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$	4	6	—	GHz
G_{UM}	maximum unilateral power gain	$I_C = 45\text{ mA}$; $V_{CE} = 10\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$	11.5	13.5	—	dB
V_O	output voltage	$I_C = 45\text{ mA}$; $V_{CE} = 10\text{ V}$; $d_{im} = -60\text{ dB}$; $R_L = 75\text{ }\Omega$; $f = 800\text{ MHz}$; $T_{amb} = 25\text{ °C}$	—	500	—	mV
P_{L1}	output power at 1 dB gain compression	$I_C = 45\text{ mA}$; $V_{CE} = 10\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$	—	21.5	—	dBm

Note

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

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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 $T_s = 140\text{ °C}$ (note 1)	–	700	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

THERMAL RESISTANCE

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

Note

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

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CHARACTERISTICS

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

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

Notes

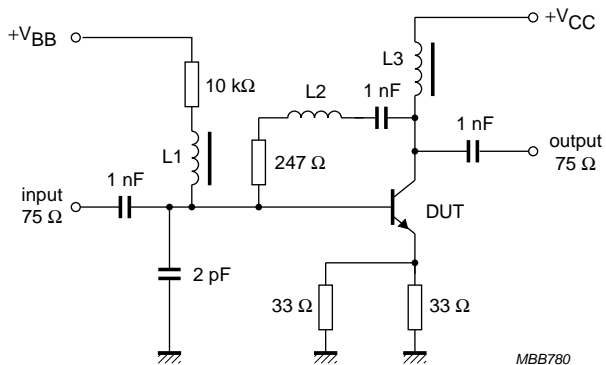
1. G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and

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

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

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$L1 = L3 = 5 \mu\text{H}$ 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.

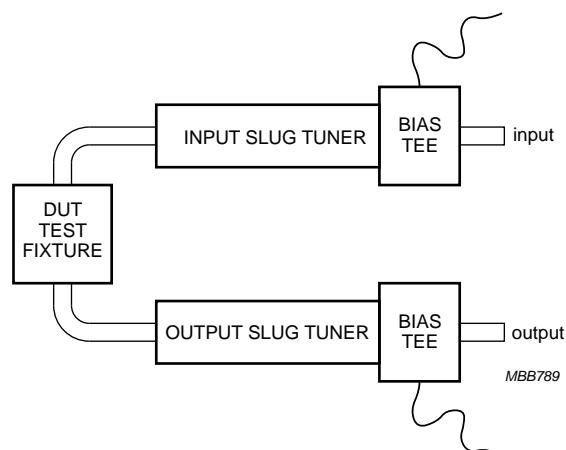


Fig.3 Measurement set-up for third order intercept point and 1 dB gain compression.

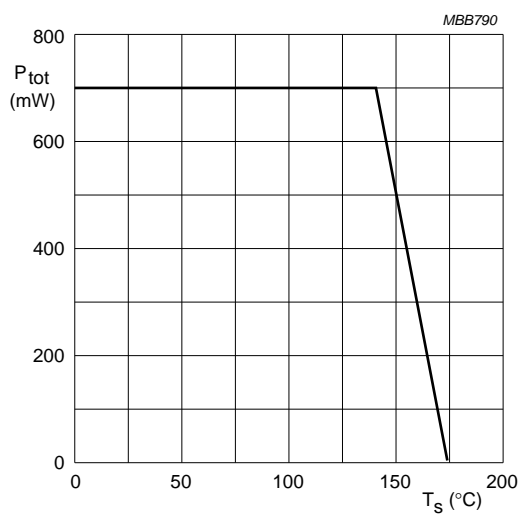


Fig.4 Power derating curve.

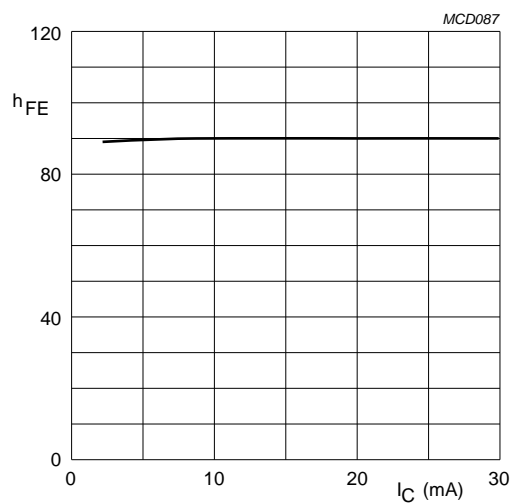
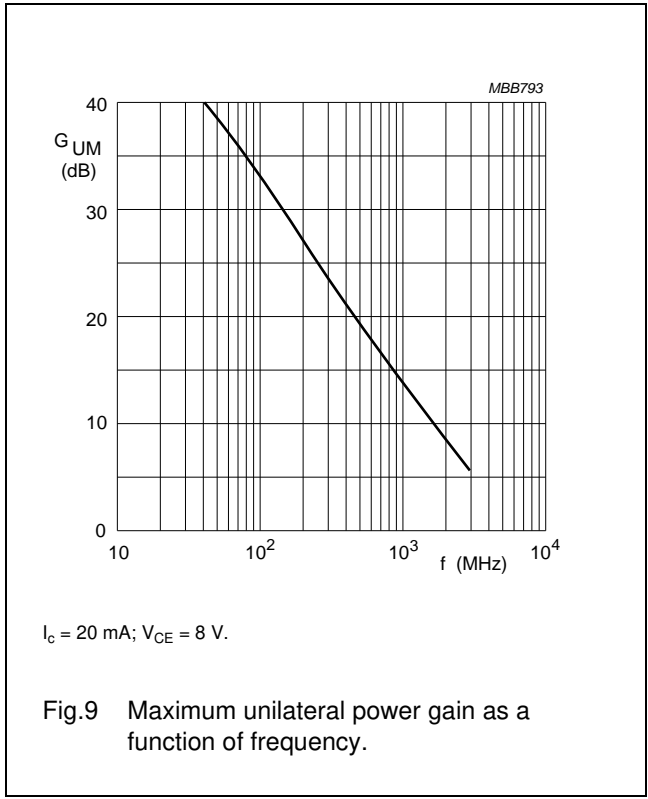
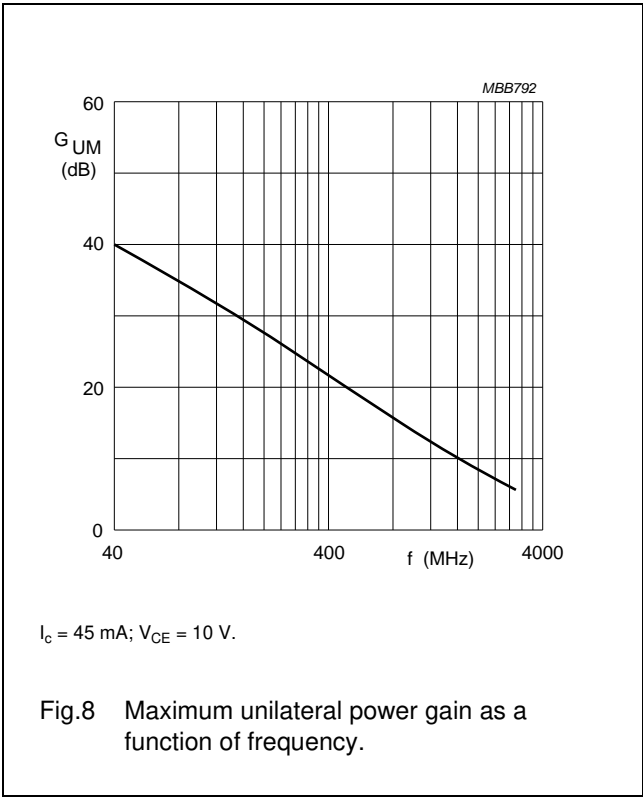
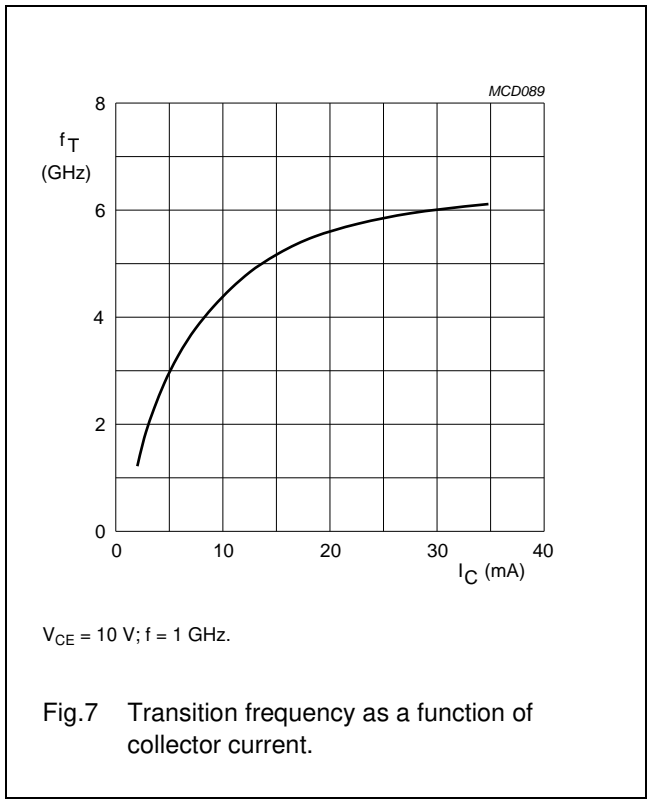
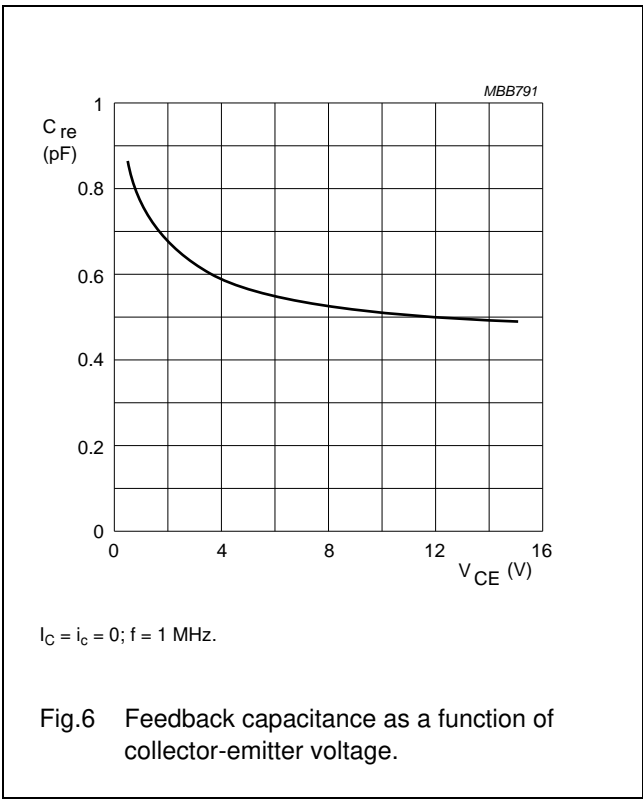
 $V_{CE} = 10 \text{ V}; T_j = 25^\circ \text{C}$

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

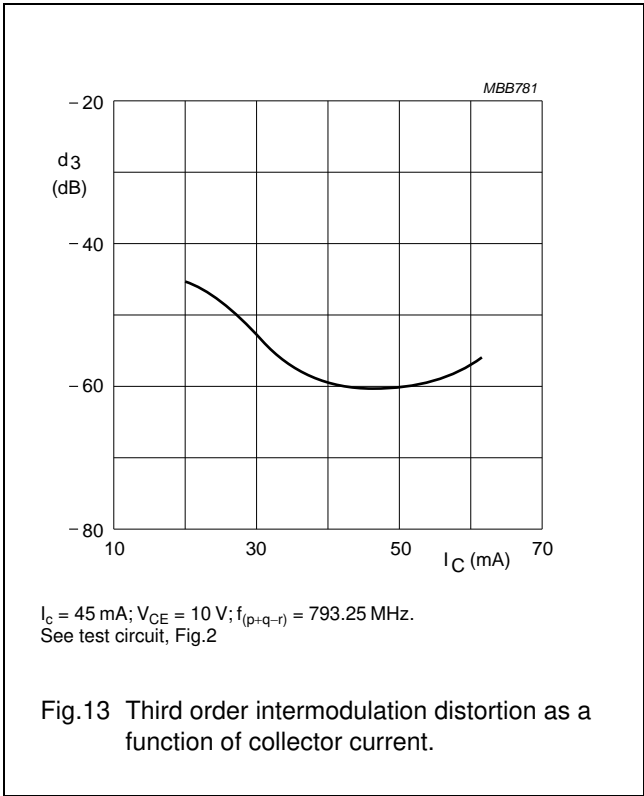
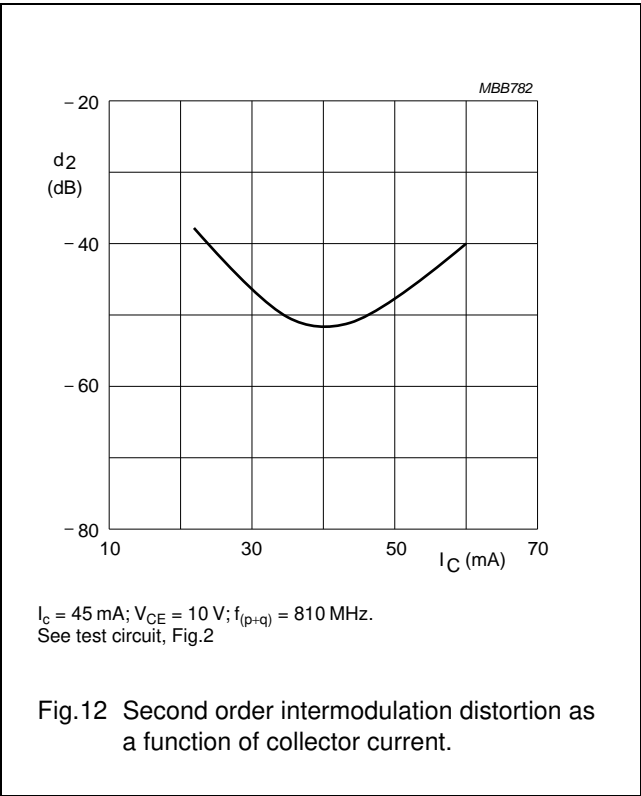
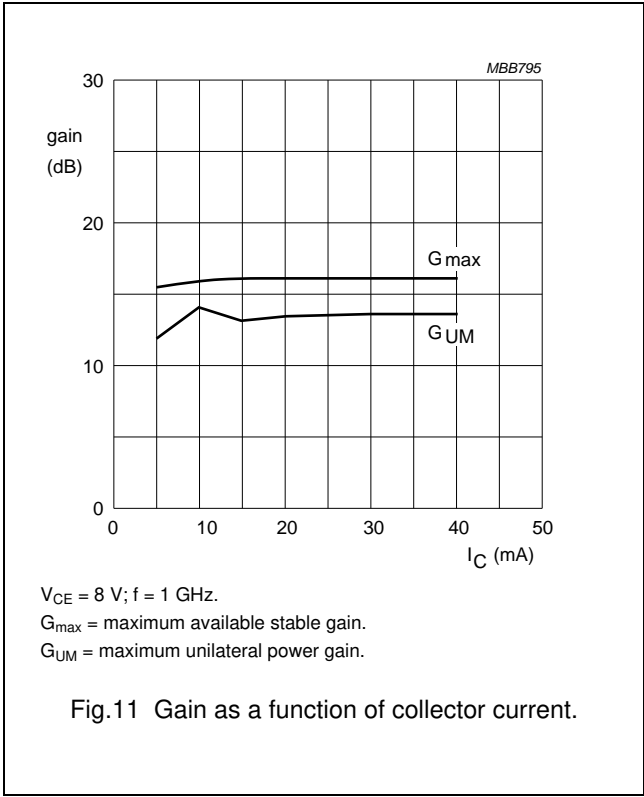
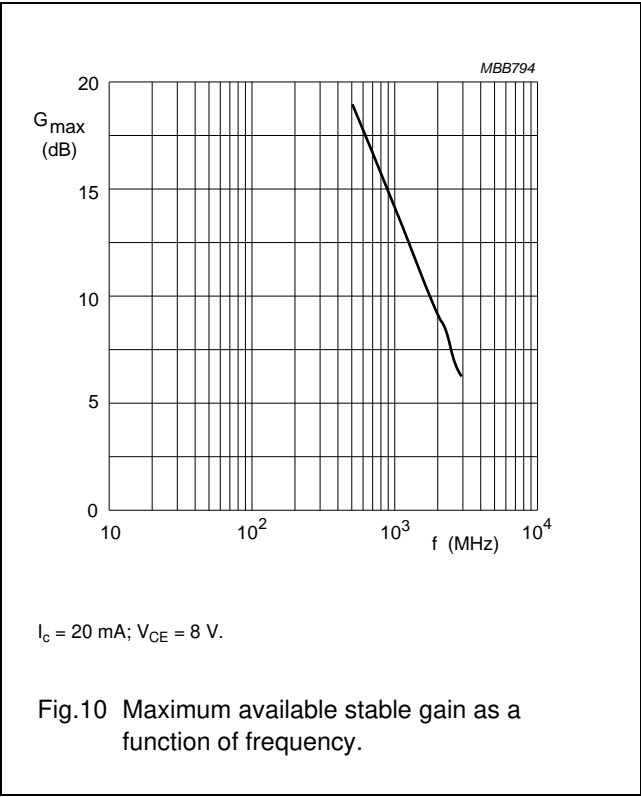
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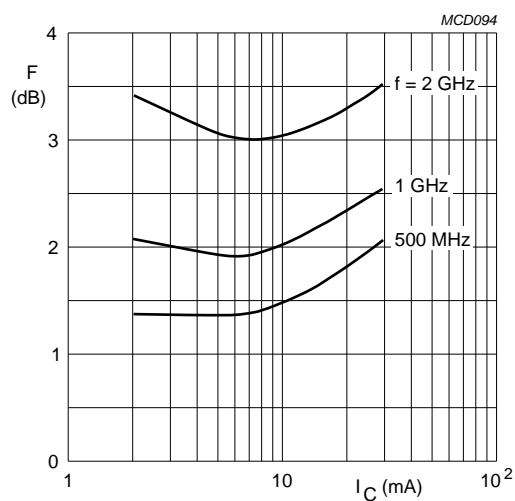
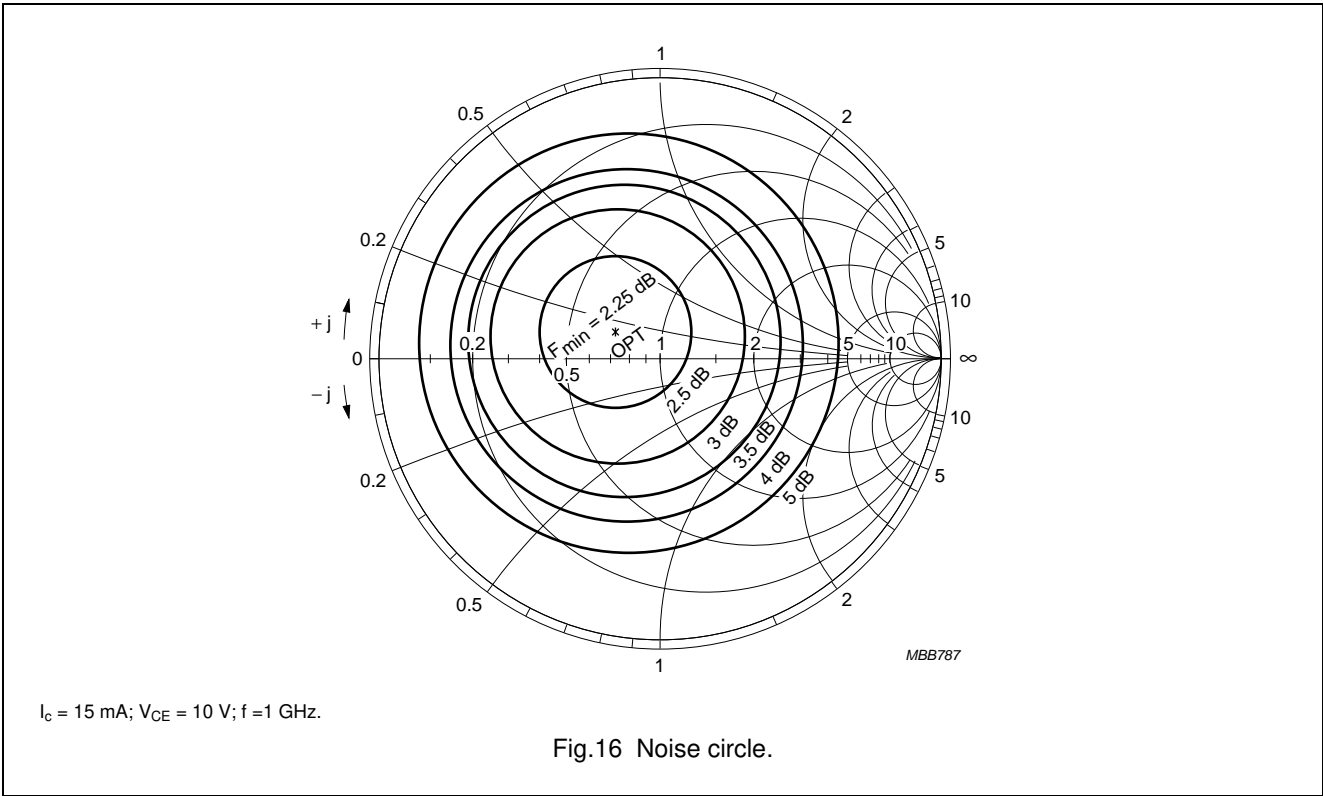
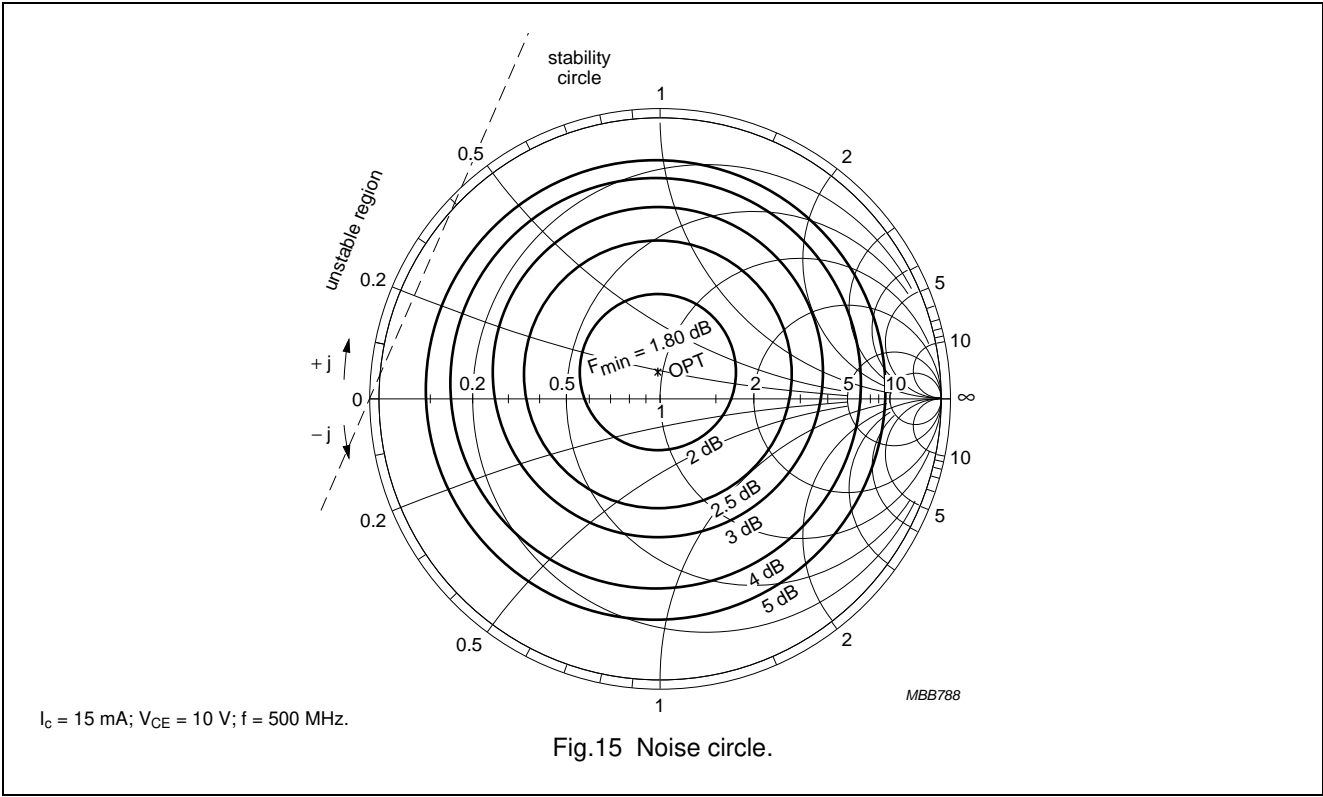
 $V_{CE} = 8 \text{ V.}$

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

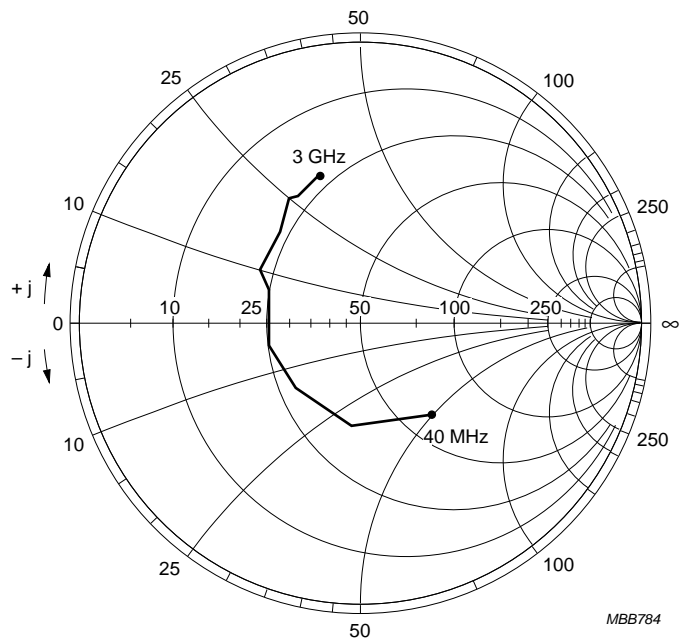
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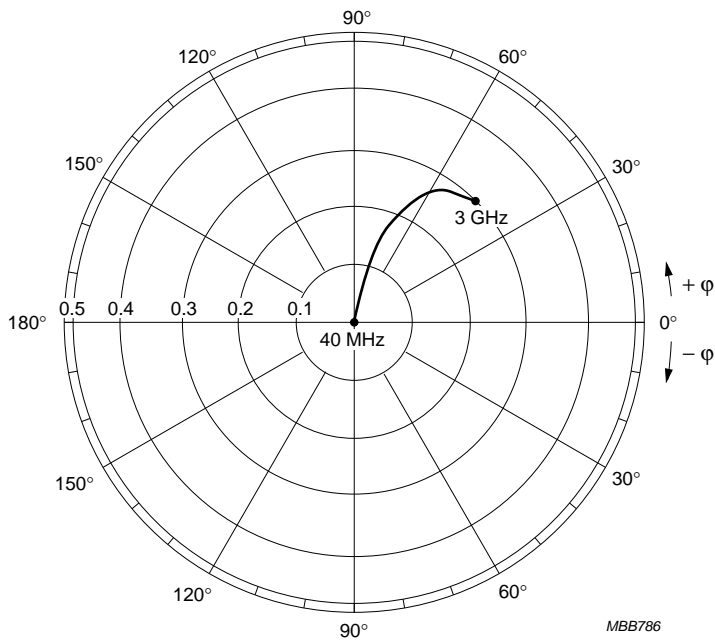
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$I_C = 45\text{ mA}$; $V_{CE} = 10\text{ V}$.
 $Z_O = 50\ \Omega$.

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

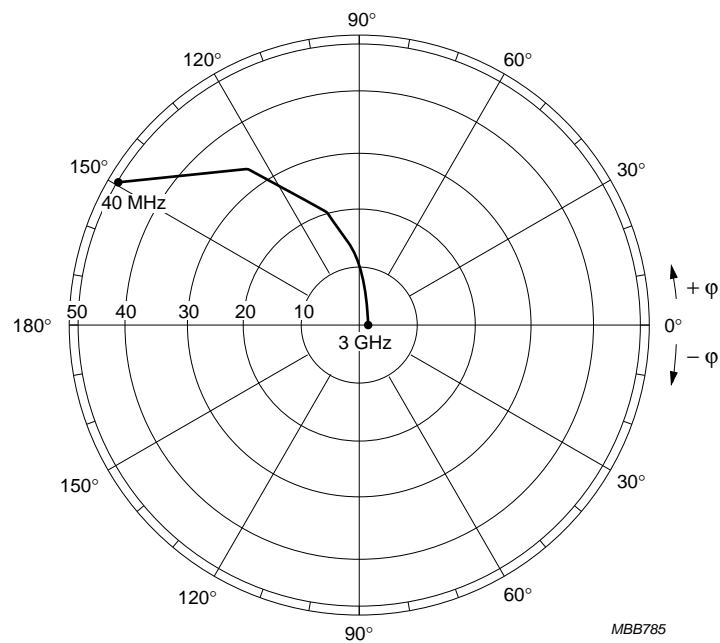


$I_C = 45\text{ mA}$; $V_{CE} = 10\text{ V}$.

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

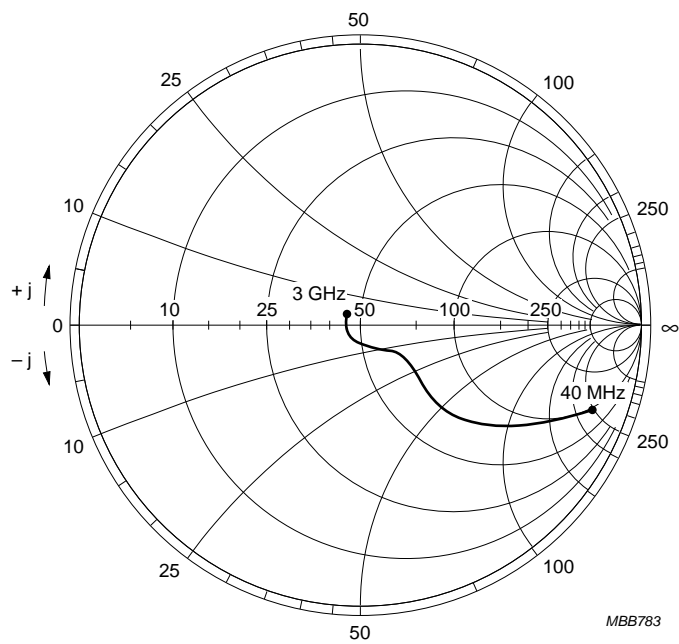
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$I_C = 45 \text{ mA}$; $V_{CE} = 10 \text{ V}$.

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



$I_C = 45 \text{ mA}$; $V_{CE} = 10 \text{ V}$.
 $Z_O = 50 \Omega$.

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

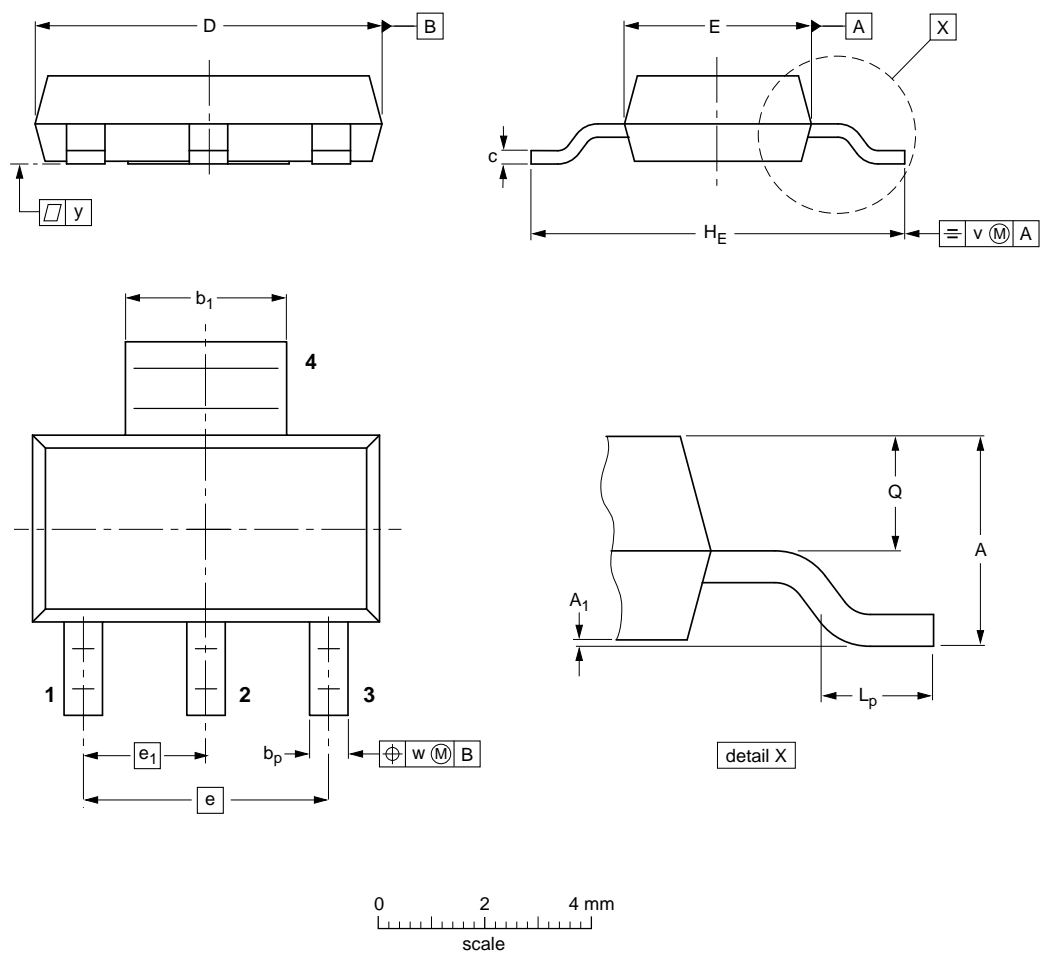
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PACKAGE OUTLINE

Plastic surface-mounted package with increased heatsink; 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	JEITA			
SOT223			SC-73			04-11-10 06-03-16

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DATA SHEET STATUS

DOCUMENT STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾	DEFINITION
Objective data sheet	Development	This document contains data from the objective specification for product development.
Preliminary data sheet	Qualification	This document contains data from the preliminary specification.
Product data sheet	Production	This document contains the product specification.

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