

DATA SHEET

BFR93A

NPN 6 GHz wideband transistor

Product specification
Supersedes data of September 1995
File under discrete semiconductors, SC14

1997 Oct 29

NPN 6 GHz wideband transistor

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FEATURES

- High power gain
- Low noise figure
- Very low intermodulation distortion.

APPLICATIONS

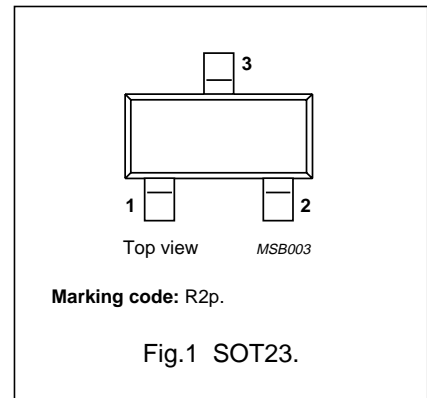
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT93.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95\text{ }^\circ\text{C}$	–	300	mW
C_{re}	feedback capacitance	$I_C = 0$; $V_{CE} = 5\text{ V}$; $f = 1\text{ MHz}$	0.6	–	pF
f_T	transition frequency	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$	6	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ }^\circ\text{C}$	13	–	dB
		$I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ }^\circ\text{C}$	7	–	dB
F	noise figure	$I_C = 5\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 1\text{ GHz}$; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25\text{ }^\circ\text{C}$	1.9	–	dB
V_O	output voltage	$d_{im} = -60\text{ dB}$; $I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $R_L = 75\text{ }\Omega$; $T_{amb} = 25\text{ }^\circ\text{C}$; $f_p + f_q - f_r = 793.25\text{ MHz}$	425	–	mV

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	–	15	V
V_{CEO}	collector-emitter voltage	open base	–	12	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	35	mA
P_{tot}	total power dissipation	$T_s \leq 95\text{ }^\circ\text{C}$; note 1	–	300	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.

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THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	$T_s \leq 95\text{ °C}$; note 1	260	K/W

Note

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

CHARACTERISTICS

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

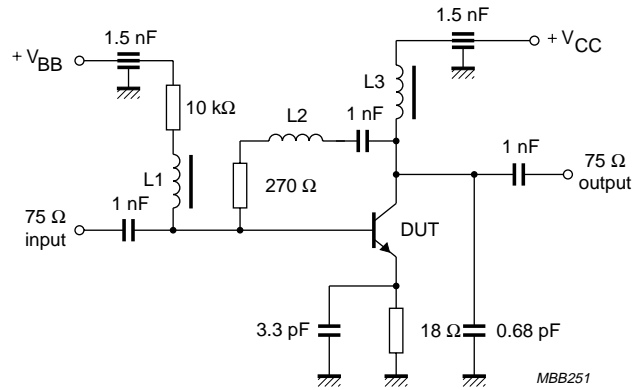
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 5\text{ V}$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$	40	90	–	
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 5\text{ V}$; $f = 1\text{ MHz}$	–	0.7	–	pF
C_e	emitter capacitance	$I_C = I_c = 0$; $V_{EB} = 0.5\text{ V}$; $f = 1\text{ MHz}$	–	1.9	–	pF
C_{re}	feedback capacitance	$I_C = I_c = 0$; $V_{CE} = 5\text{ V}$; $f = 1\text{ MHz}$; $T_{amb} = 25\text{ °C}$	–	0.6	–	pF
f_T	transition frequency	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$	4.5	6	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$	–	13	–	dB
		$I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ °C}$	–	7	–	dB
F	noise figure (note 2)	$I_C = 5\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 1\text{ GHz}$; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25\text{ °C}$	–	1.9	–	dB
		$I_C = 5\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 2\text{ GHz}$; $\Gamma_s = \Gamma_{opt}$; $T_{amb} = 25\text{ °C}$	–	3	–	dB
V_O	output voltage	notes 2 and 3	–	425	–	mV
d_2	second order intermodulation distortion	notes 2 and 4	–	–50	–	dB

Notes

- G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
- Measured on the same die in a SOT37 package (BFR91A).
- $d_{im} = -60\text{ dB}$ (DIN 45004B); $I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $R_L = 75\ \Omega$; $T_{amb} = 25\text{ °C}$;
 $V_p = V_O$ at $d_{im} = -60\text{ dB}$; $f_p = 795.25\text{ MHz}$;
 $V_q = V_O - 6\text{ dB}$ at $f_q = 803.25\text{ MHz}$;
 $V_r = V_O - 6\text{ dB}$ at $f_r = 805.25\text{ MHz}$;
measured at $f_p + f_q - f_r = 793.25\text{ MHz}$.
- $I_C = 30\text{ mA}$; $V_{CE} = 8\text{ V}$; $R_L = 75\ \Omega$; $T_{amb} = 25\text{ °C}$;
 $V_p = 200\text{ mV}$ at $f_p = 250\text{ MHz}$;
 $V_q = 200\text{ mV}$ at $f_q = 560\text{ MHz}$;
measured at $f_p + f_q = 810\text{ MHz}$.

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L1 = L3 = 5 μ H choke.
 L2 = 3 turns 0.4 mm copper wire; winding pitch 1 mm; internal diameter 3 mm.

Fig.2 Intermodulation distortion and second harmonic distortion MATV test circuit.

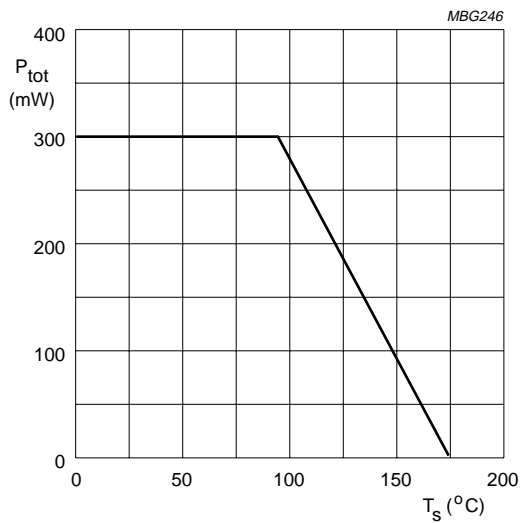
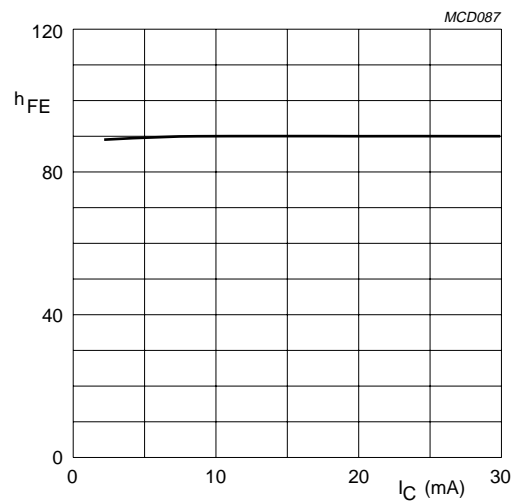


Fig.3 Power derating curve.

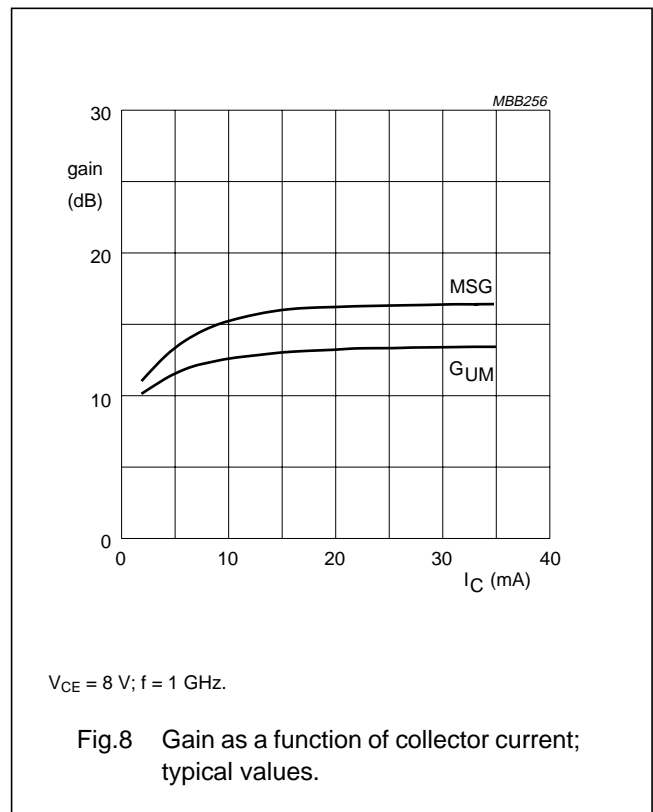
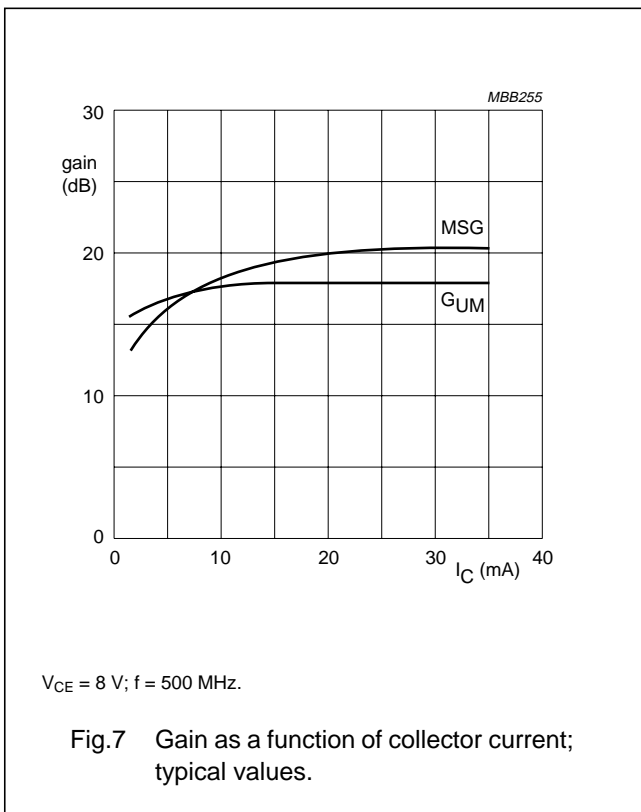
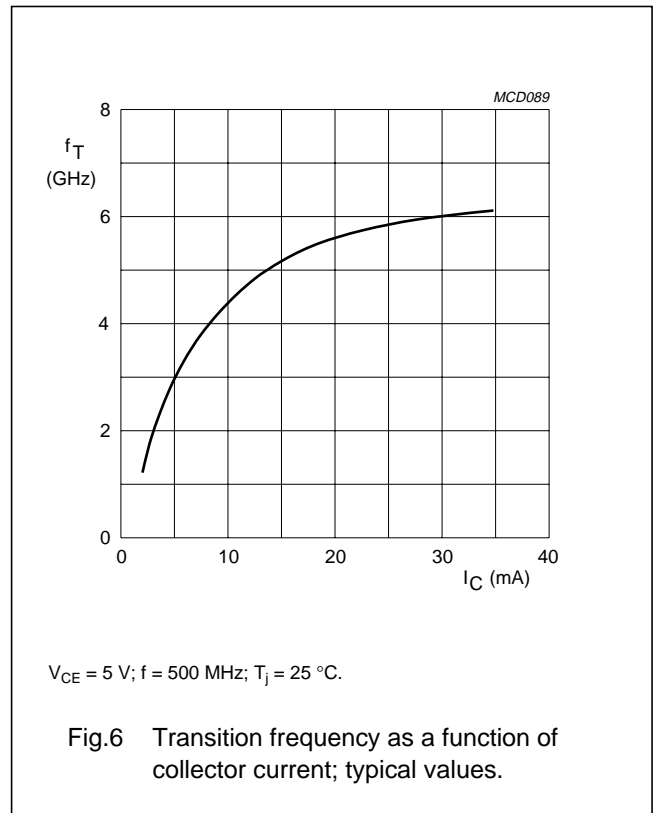
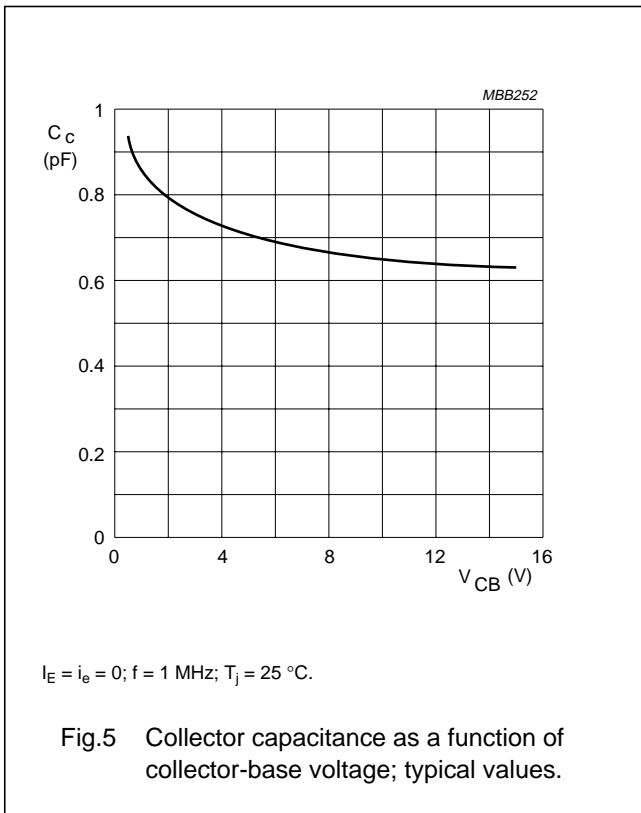


$V_{CE} = 5$ V; $T_j = 25$ $^{\circ}$ C.

Fig.4 DC current gain as a function of collector current.

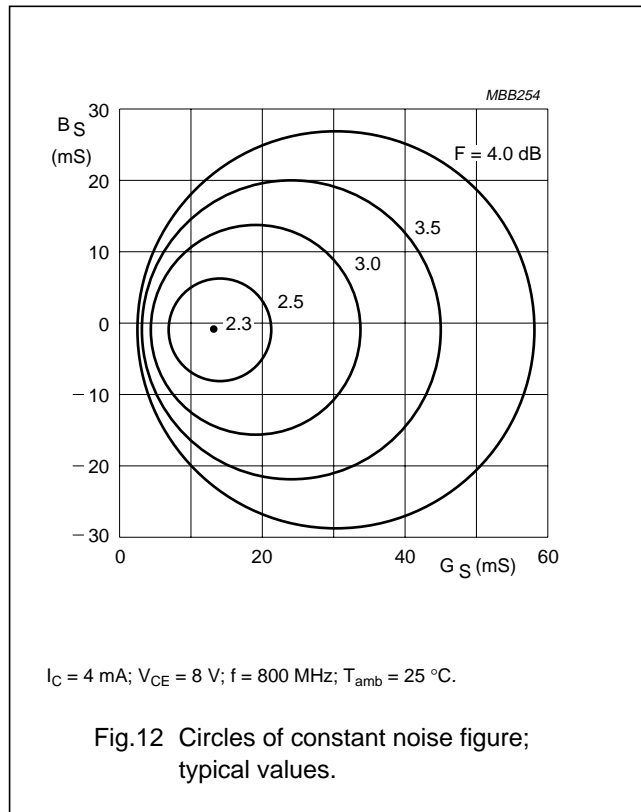
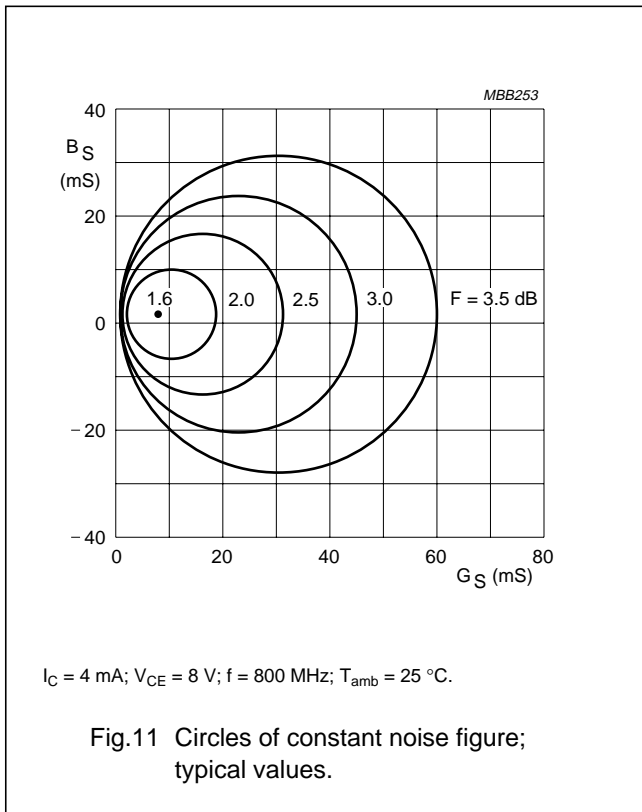
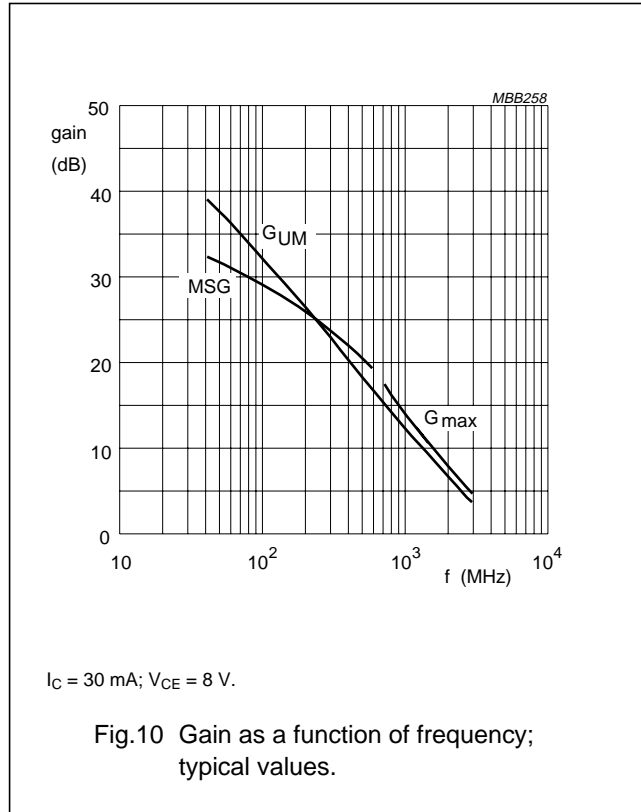
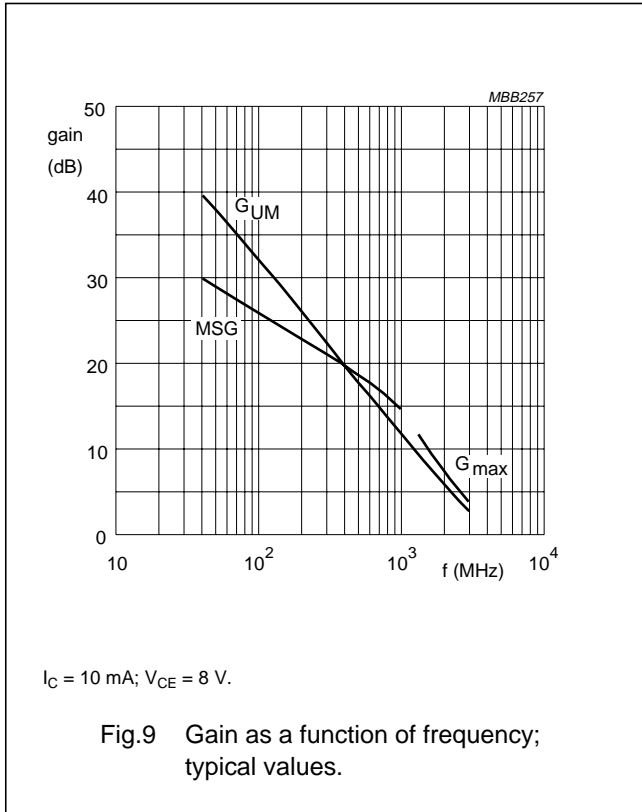
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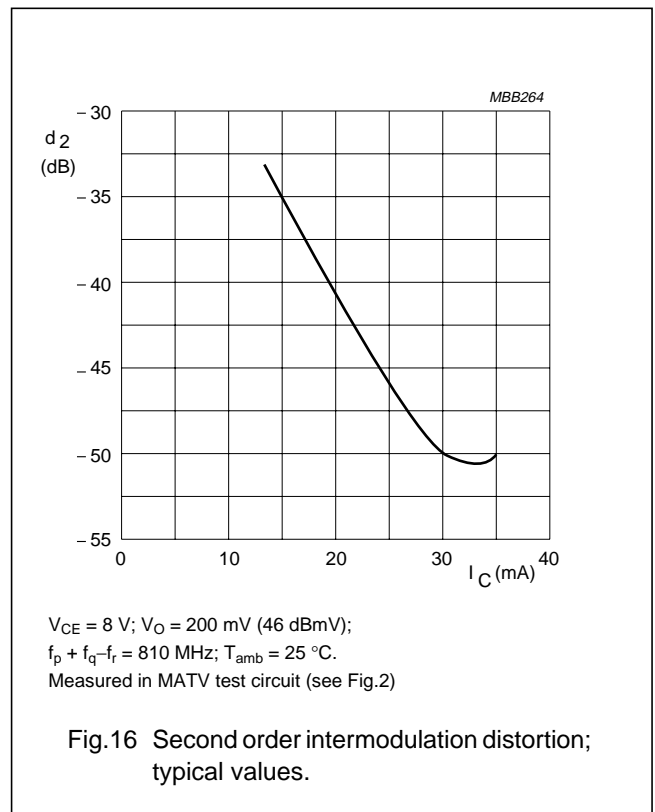
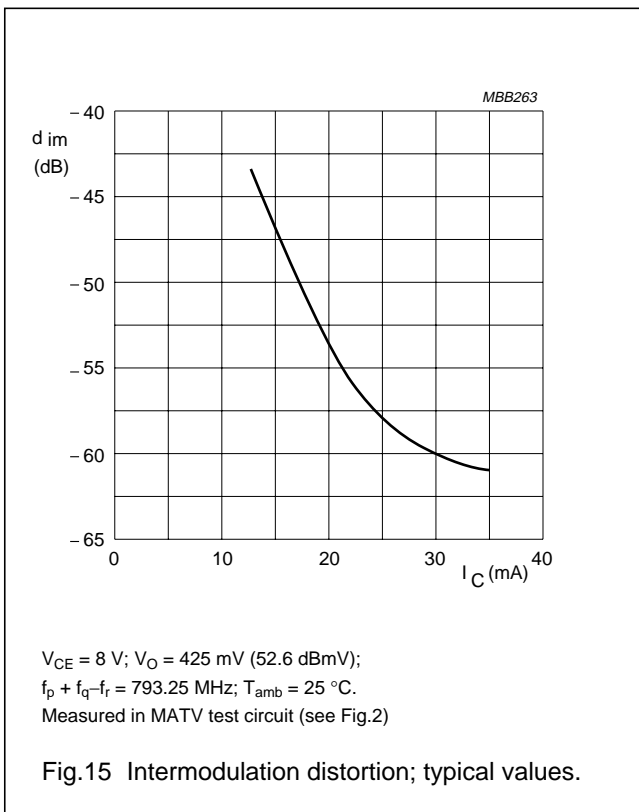
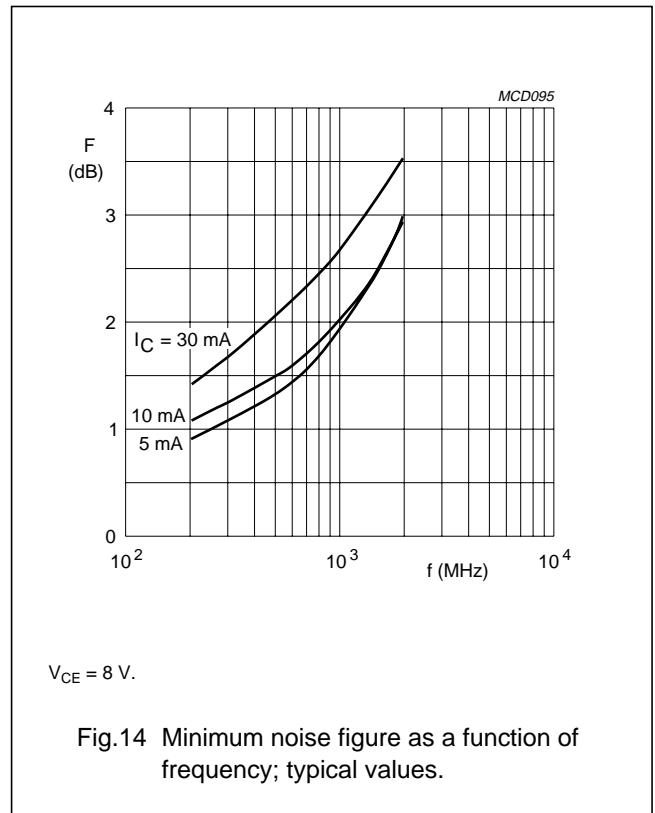
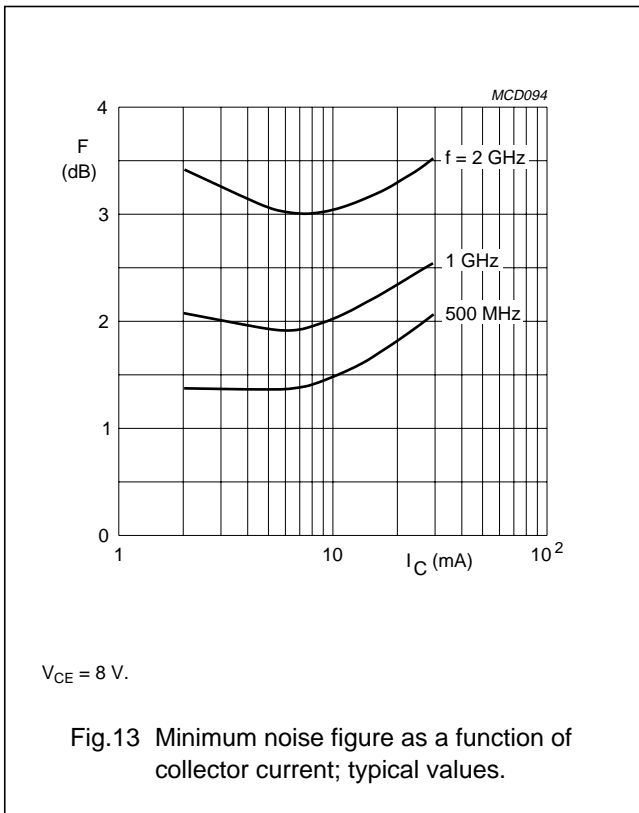
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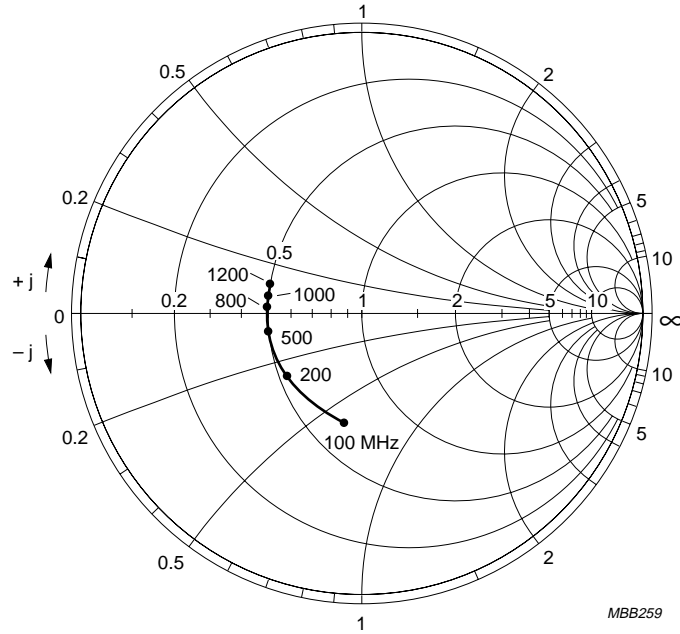
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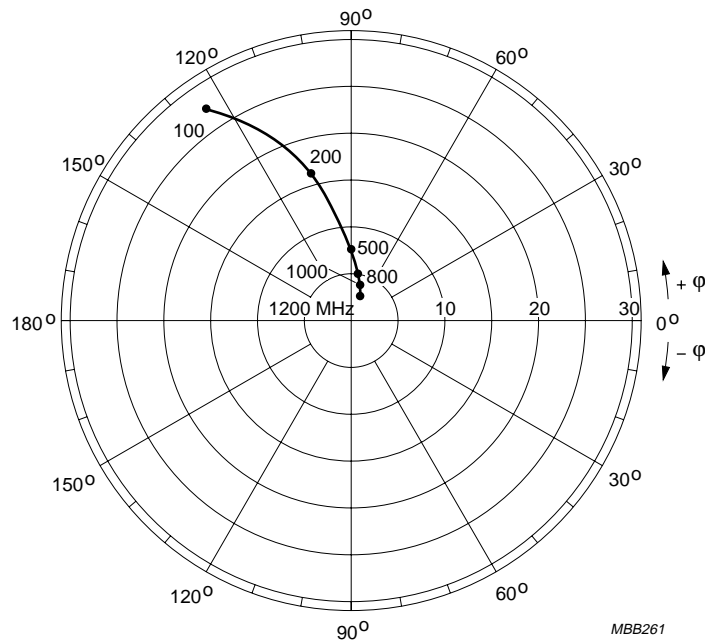
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$I_C = 30 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $Z_0 = 50 \Omega$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

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

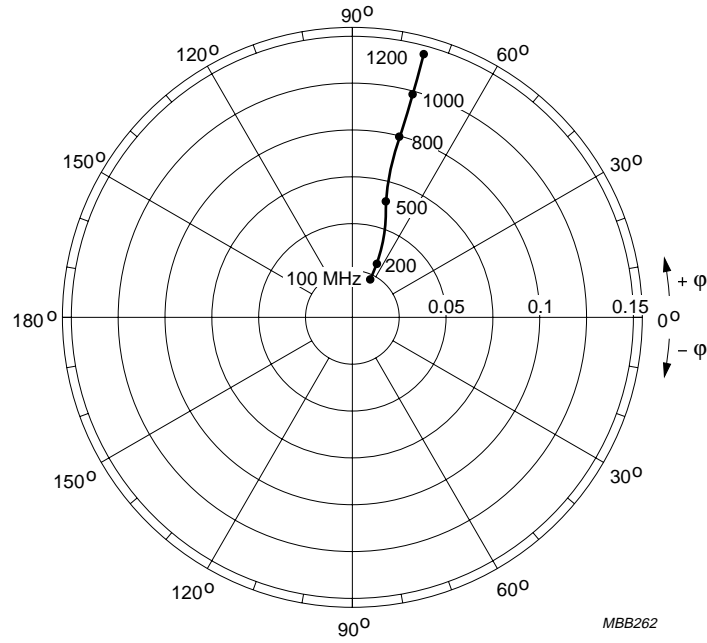


$I_C = 30 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

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

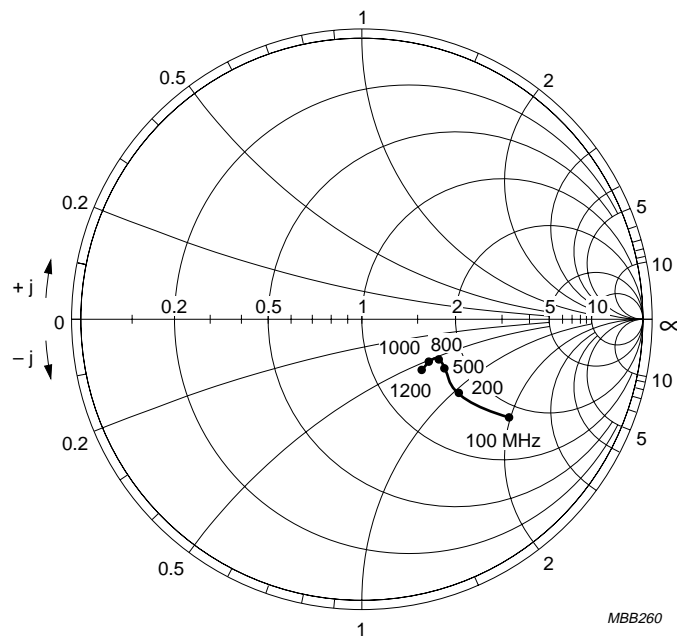
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$I_C = 30 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

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



$I_C = 30 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $Z_0 = 50 \text{ } \Omega$; $T_{amb} = 25 \text{ }^\circ\text{C}$.

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

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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

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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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微波光电部专业代理经销高频、微波、光纤、光电元器件、组件、部件、模块、整机；电磁兼容元器件、材料、设备；微波 CAD、EDA 软件、开发测试仿真工具；微波、光纤仪器仪表。欢迎国外高科技微波、光纤厂商将优秀产品介绍到中国、共同开拓市场。长期大量现货专业批发高频、微波、卫星、光纤、电视、CATV 器件：晶振、VCO、连接器、PIN 开关、变容二极管、开关二极管、低噪晶体管、功率电阻及电容、放大器、功率管、MMIC、混频器、耦合器、功分器、振荡器、合成器、衰减器、滤波器、隔离器、环行器、移相器、调制解调器；光电子元件和组件：红外发射管、红外接收管、光电开关、光敏管、发光二极管和发光二极管组件、半导体激光二极管和激光器组件、光电探测器和光接收组件、光发射接收模块、光纤激光器和光放大器、光调制器、光开关、DWDM 用光发射和接收器件、用户接入系统光收发器件与模块、光纤连接器、光纤跳线/尾纤、光衰减器、光纤适配器、光隔离器、光耦合器、光环行器、光复用器/转换器；无线收发芯片和模组、蓝牙芯片和模组。

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