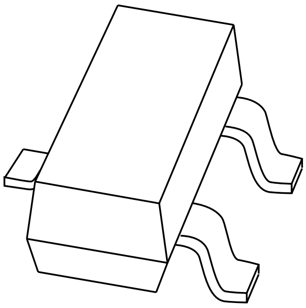
DATA SHEET



BFR540
NPN 9 GHz wideband transistor

Product specification
Supersedes data of 1999 Aug 23

2000 May 30

Philips
Semiconductors

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NPN 9 GHz wideband transistor — BFR540

FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

APPLICATIONS

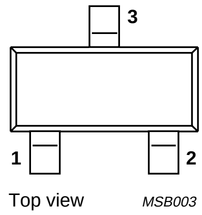
RF front end wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, satellite TV tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optic systems.

DESCRIPTION

NPN silicon planar epitaxial transistor in a SOT23 plastic package.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



Marking code: N29.

Fig.1 SOT23.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	–	15	V
I_C	DC collector current		–	–	120	mA
P_{tot}	total power dissipation	$T_s \leq 70$ °C; note 1	–	–	500	mW
h_{FE}	DC current gain	$I_C = 40$ mA; $V_{CE} = 8$ V	100	120	250	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 8$ V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	$I_C = 40$ mA; $V_{CE} = 8$ V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	14	–	dB
		$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	7	–	dB
$\|s_{21}\|^2$	insertion power gain	$I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 40$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 900 MHz	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; $I_C = 10$ mA; $V_{CE} = 8$ V; $T_{amb} = 25$ °C; f = 2 GHz	–	2.1	–	dB

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 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	20	V
V_{CES}	collector-emitter voltage	R_{BE} = 0	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	DC collector current		–	120	mA
P_{tot}	total power dissipation	$T_s \leq 70$ °C; note 1	–	500	mW
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	from junction to soldering point	see note 1	260	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} = 8 V	–	–	50	nA
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 8 V	100	120	250	
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	2	–	pF
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 8 V; f = 1 MHz	–	0.9	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 8 V; f = 1 MHz	–	0.6	–	pF
f_T	transition frequency	I_C = 40 mA; V_{CE} = 8 V; f = 1 GHz	–	9	–	GHz
G_{UM}	maximum unilateral power gain; note 1	I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 900 MHz	–	14	–	dB
		I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz	–	7	–	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 900 MHz	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 900 MHz	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 40 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 900 MHz	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$; I_C = 10 mA; V_{CE} = 8 V; T_{amb} = 25 °C; f = 2 GHz	–	2.1	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω; T_{amb} = 25 °C; f = 900 MHz	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V_o	output voltage; note 3	I_C = 40 mA; V_{CE} = 8 V; $Z_L = Z_S$ = 75 Ω; T_{amb} = 25 °C	–	550	–	mV

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. I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω;
   T_{amb} = 25 °C; f = 900 MHz;
   f_p = 900 MHz; f_q = 902 MHz;
   measured at $f_{(2p-q)}$ = 898 MHz and $f_{(2q-p)}$ = 904 MHz.
3. d_{im} = –60 dB (DIN 45004B);
   $V_p = V_O$; $V_q = V_O$ –6 dB; f_p = 795.25 MHz;
   $V_R = V_O$ –6 dB; f_q = 803.25 MHz; f_r = 805.25 MHz;
   measured at $f_{(p+q-r)}$ = 793.25 MHz; preliminary data.

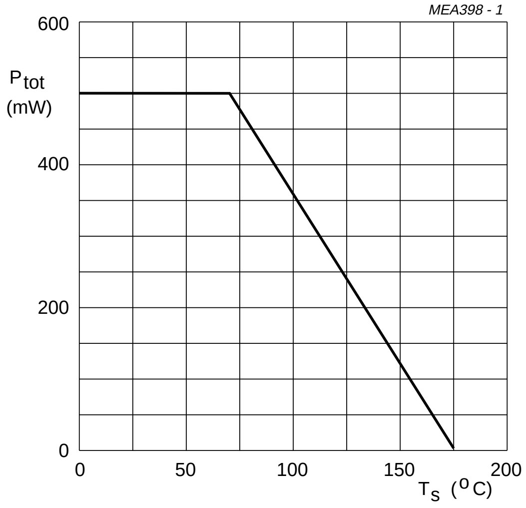
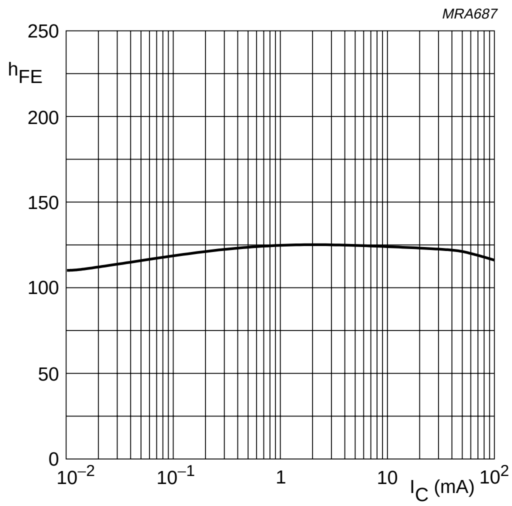
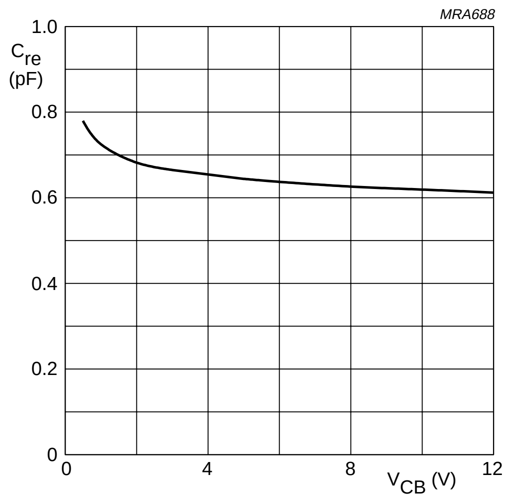


Fig.2 Power derating curve.



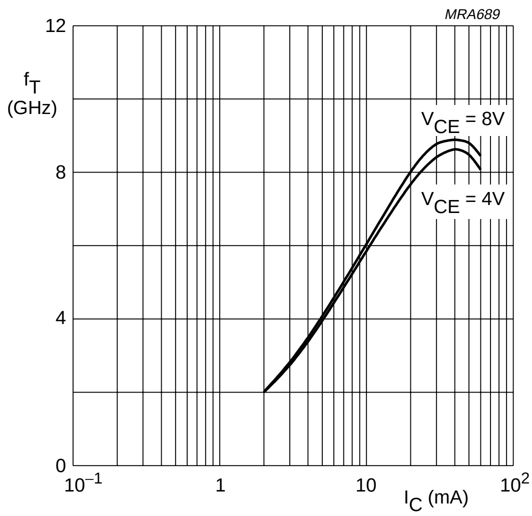
V_{CE} = 8 V.

Fig.3 DC current gain as a function of collector current.



I_C = 0; f = 1 MHz.

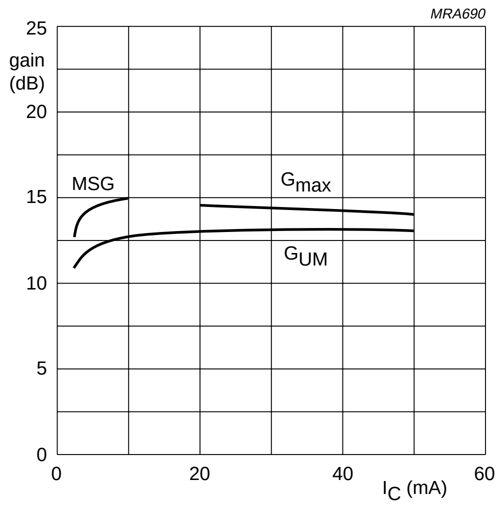
Fig.4 Feedback capacitance as a function of collector-base voltage.



T_{amb} = 25 °C; f = 1 GHz.

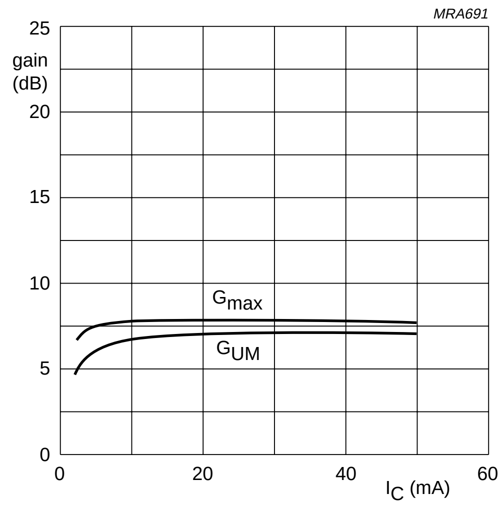
Fig.5 Transition frequency as a function of collector current.

In Figs 6 to 9, G_{UM} = maximum unilateral power gain; MSG = maximum stable gain; G_{max} = maximum available gain.



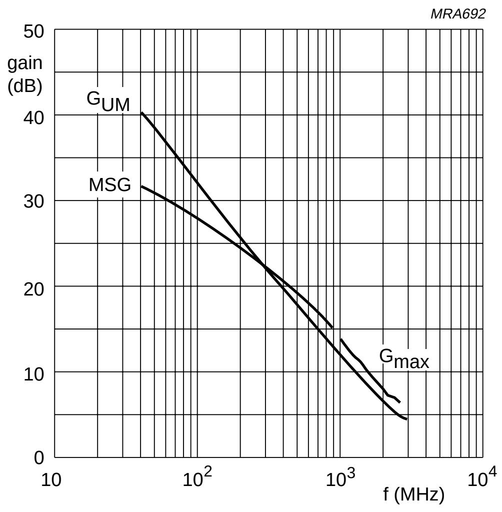
V_{CE} = 8 V; f = 900 MHz.

Fig.6 Gain as a function of collector current.



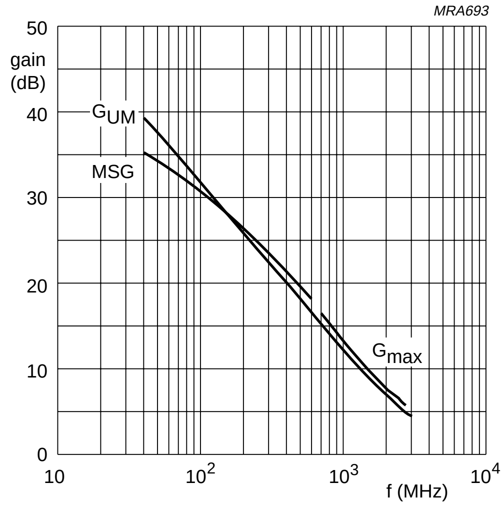
V_{CE} = 8 V; f = 2 GHz.

Fig.7 Gain as a function of collector current.



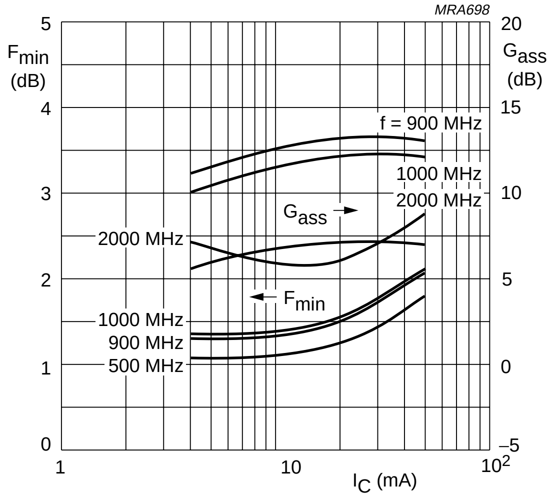
V_{CE} = 8 V; I_c = 10 mA.

Fig.8 Gain as a function of frequency.



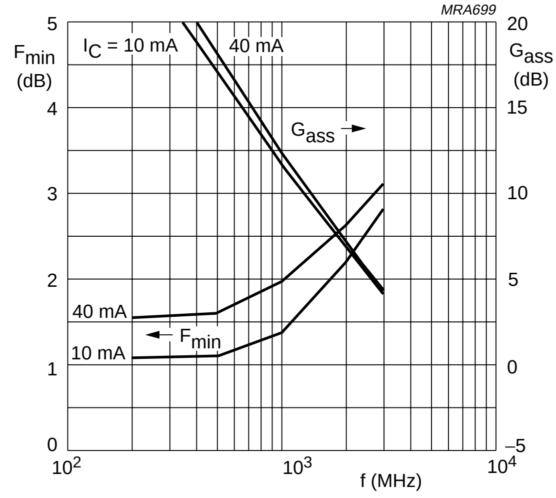
V_{CE} = 8 V; I_c = 40 mA.

Fig.9 Gain as a function of frequency.



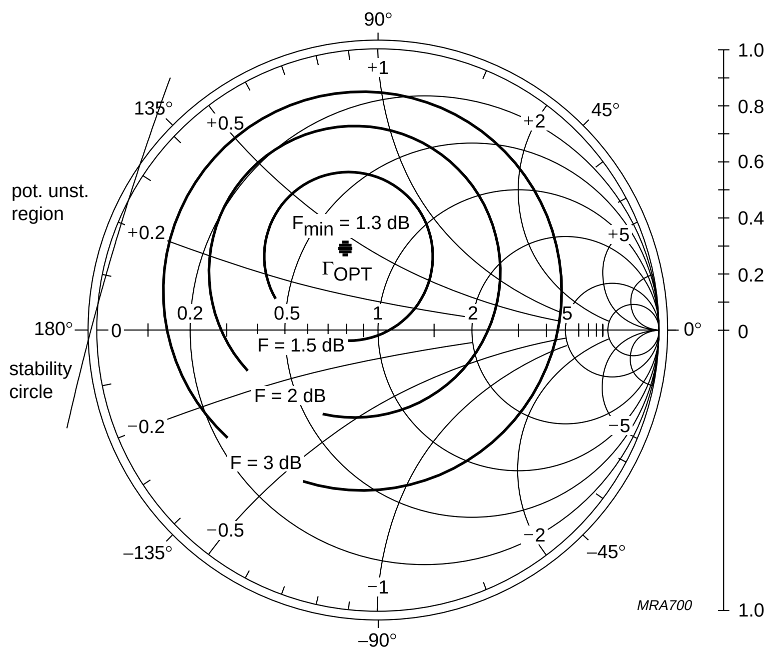
V_{CE} = 8 V.

Fig.10 Minimum noise figure and associated available gain as functions of collector current.



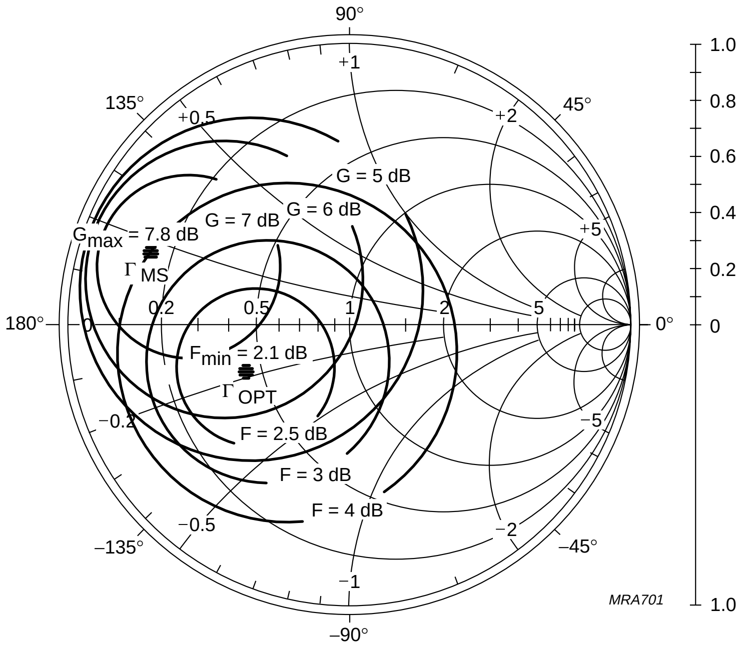
V_{CE} = 8 V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



Z_o = 50 Ω.
V_{CE} = 8 V; I_C = 10 mA; f = 900 MHz.

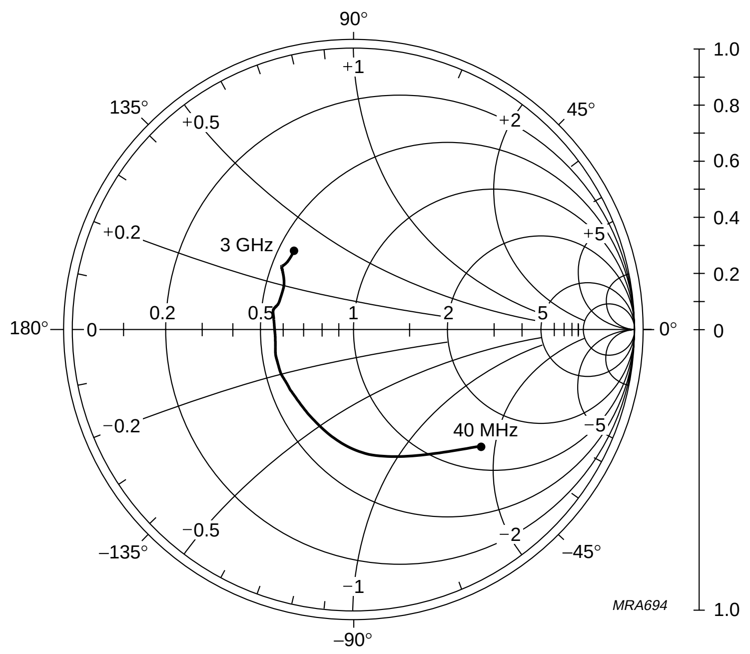
Fig.12 Noise circle figure.



Z_o = 50 Ω.

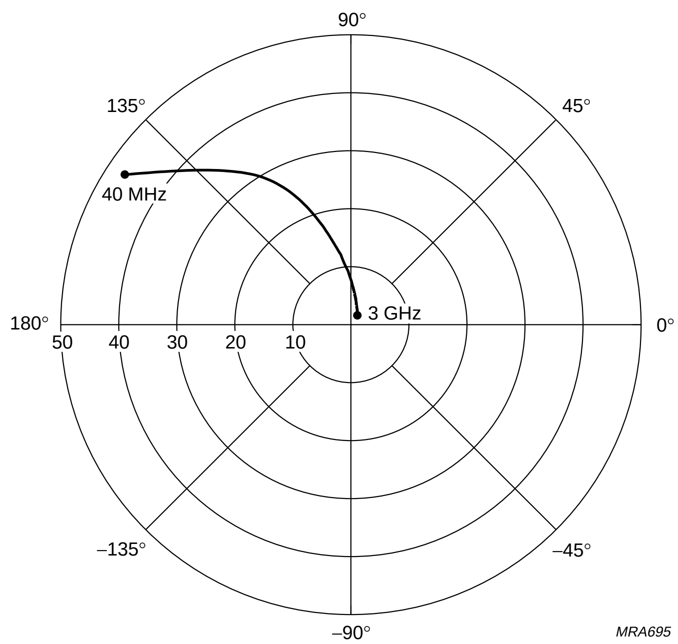
V_{CE} = 8 V; I_C = 10 mA; f = 2000 MHz.

Fig.13 Noise circle figure.



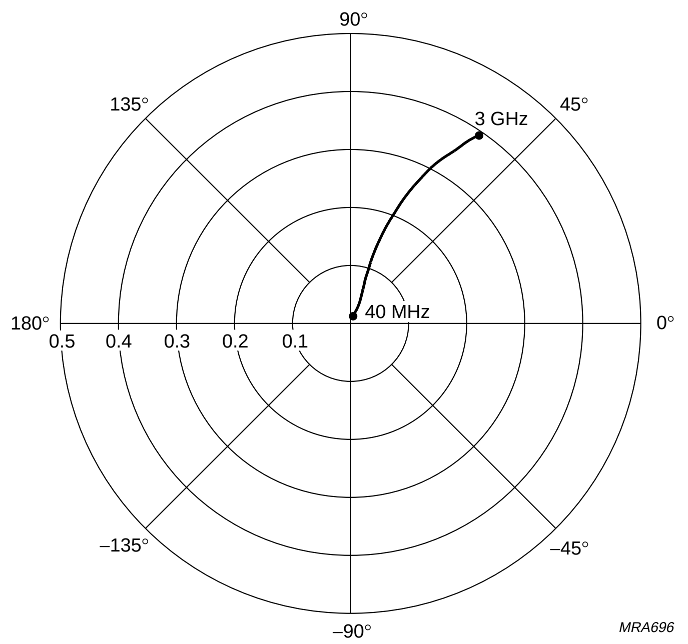
V_{CE} = 8 V; I_C = 40 mA.
Z_o = 50 Ω.

Fig.14 Common emitter input reflection coefficient (s_{11}).



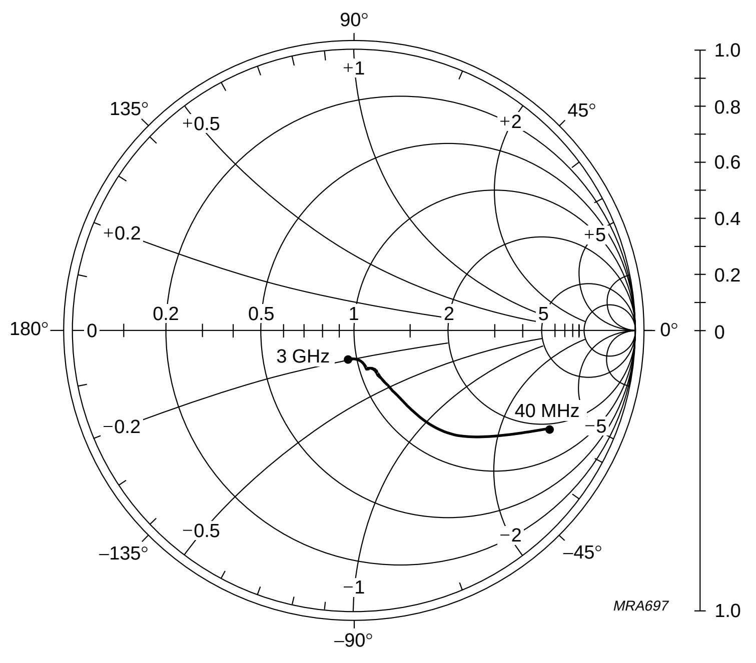
V_{CE} = 8 V; I_C = 40 mA.

Fig.15 Common emitter forward transmission coefficient (s_{21}).



V_{CE} = 8 V; I_C = 40 mA.

Fig.16 Common emitter reverse transmission coefficient (s_{12}).

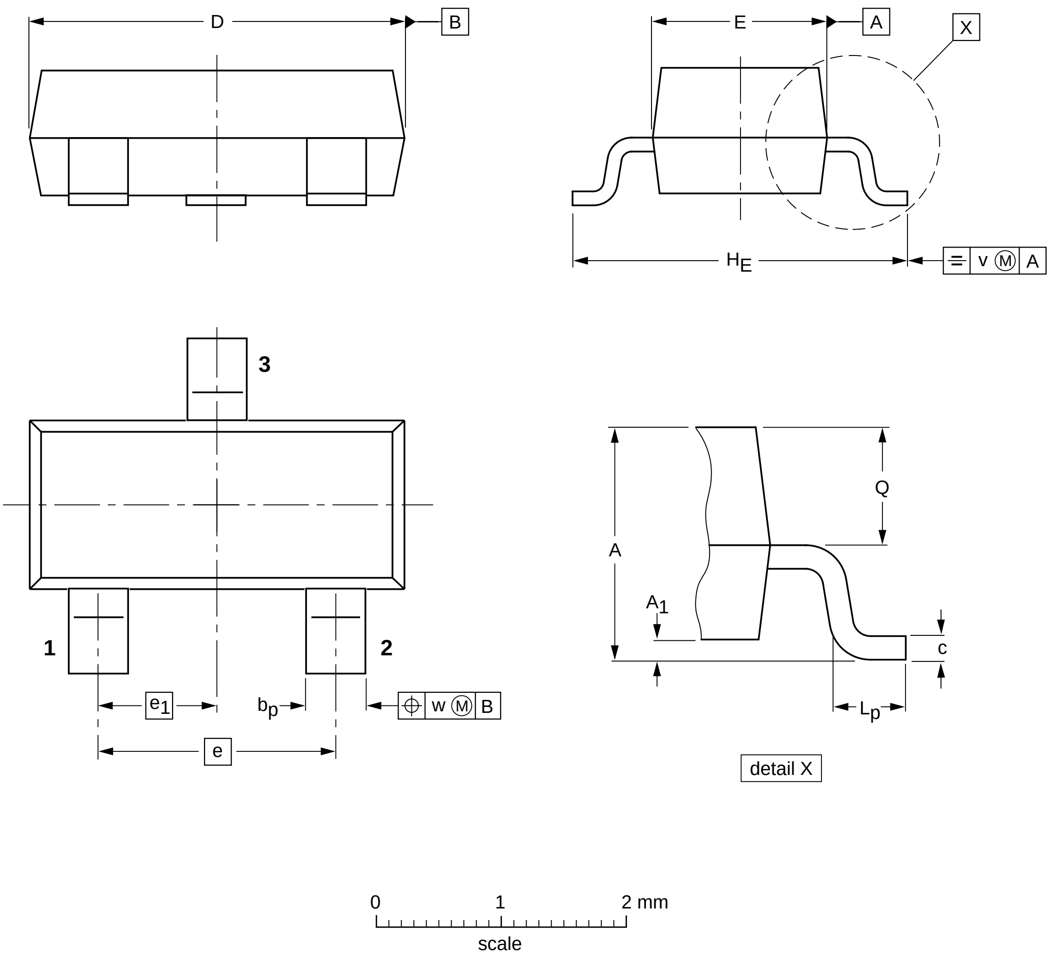


V_{CE} = 8 V; I_C = 40 mA.
Z_o = 50 Ω.

Fig.17 Common emitter output reflection coefficient (s_{22}).

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		TO-236AB				~~97-02-28~~ 99-09-13

DATA SHEET STATUS

DATA SHEET STATUS	PRODUCT STATUS	DEFINITIONS (1)
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

Note

1. Please consult the most recently issued data sheet before initiating or completing a design.

DEFINITIONS

Short-form specification — The data in a short-form 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 definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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