

# DATA SHEET

**BFR540**

**NPN 9 GHz wideband transistor**

Product specification  
Supersedes data of 1995 September

1999 Aug 23

## NPN 9 GHz wideband transistor

## BFR540

## FEATURES

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

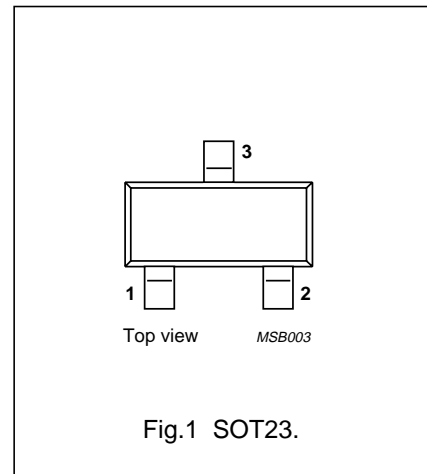
## DESCRIPTION

The BFR540 is an npn silicon planar epitaxial transistor, intended for applications in the RF frontend in 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.

The transistor is encapsulated in a plastic SOT23 envelope.

## PINNING

PIN	DESCRIPTION
Code: N29	
1	base
2	emitter
3	collector



## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CB0}$	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	up to $T_s = 70\text{ °C}$ ; note 1	–	–	500	mW
$h_{FE}$	DC current gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$	60	120	250	
$C_{re}$	feedback capacitance	$I_C = I_C = 0$ ; $V_{CB} = 8\text{ V}$ ; $f = 1\text{ MHz}$	–	0.6	–	pF
$f_T$	transition frequency	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ GHz}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $f = 900\text{ MHz}$	–	14	–	dB
		$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $f = 2\text{ GHz}$	–	7	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $f = 900\text{ MHz}$	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $f = 900\text{ MHz}$	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $f = 900\text{ MHz}$	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_{amb} = 25\text{ °C}$ ; $f = 2\text{ GHz}$	–	2.1	–	dB

## 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	–	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	up to $T_s = 70\text{ °C}$ ; note 1	–	500	mW
$T_{stg}$	storage temperature		–65	150	°C
$T_j$	junction temperature		–	175	°C

**THERMAL RESISTANCE**

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j-s}$	from junction to soldering point	see note 1	260 K/W

**Note**

- $T_s$  is the temperature at the soldering point of the collector tab.

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## CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0; V_{CB} = 8\text{ V}$	–	–	50	nA
$h_{FE}$	DC current gain	$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}$	60	120	250	
$C_e$	emitter capacitance	$I_C = i_c = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$	–	2	–	pF
$C_c$	collector capacitance	$I_E = i_e = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$	–	0.9	–	pF
$C_{re}$	feedback capacitance	$I_C = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$	–	0.6	–	pF
$f_T$	transition frequency	$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 1\text{ GHz}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain (note 1)	$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$	–	14	–	dB
		$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 2\text{ GHz}$	–	7	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$	12	13	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}; I_C = 10\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$	–	1.3	1.8	dB
		$\Gamma_s = \Gamma_{opt}; I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$	–	1.9	2.4	dB
		$\Gamma_s = \Gamma_{opt}; I_C = 10\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 2\text{ GHz}$	–	2.1	–	dB
$P_{L1}$	output power at 1 dB gain compression	$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; R_L = 50\text{ }\Omega; T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
$V_o$	output voltage (note 3)	$I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; Z_L = Z_S = 75\text{ }\Omega; T_{amb} = 25\text{ °C}$	–	550	–	mV

## Notes

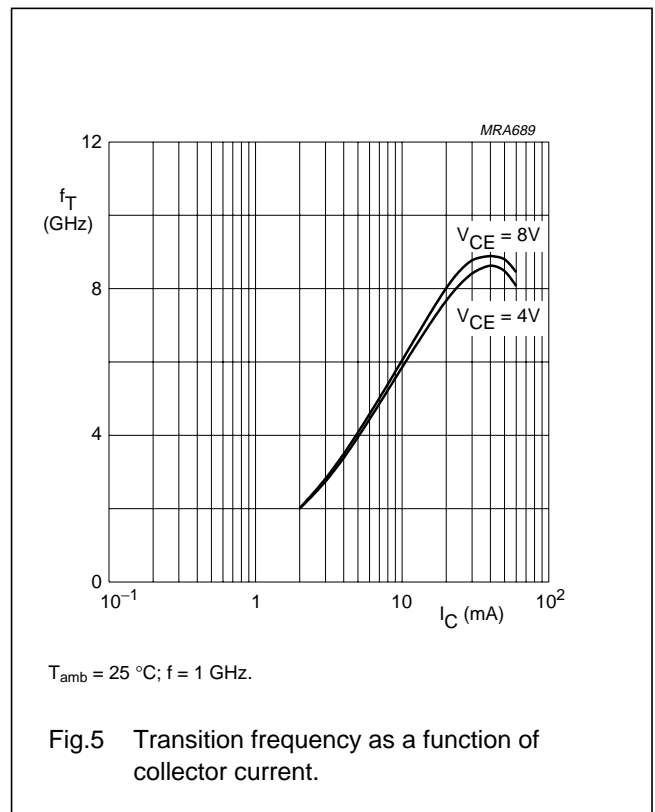
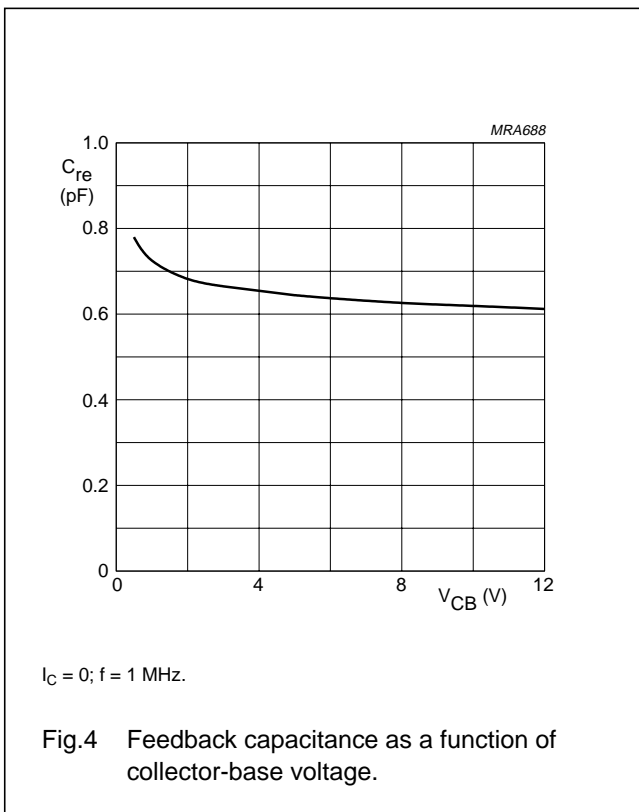
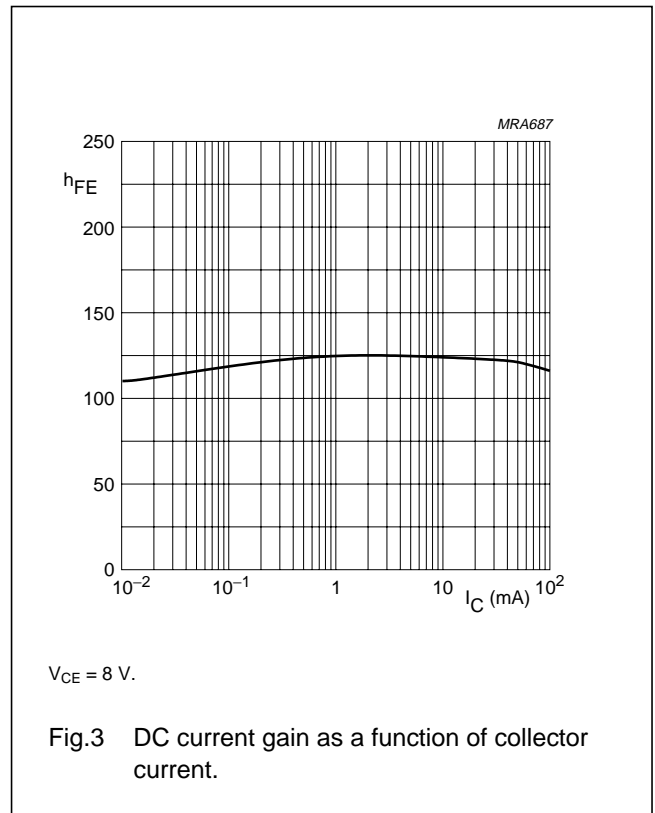
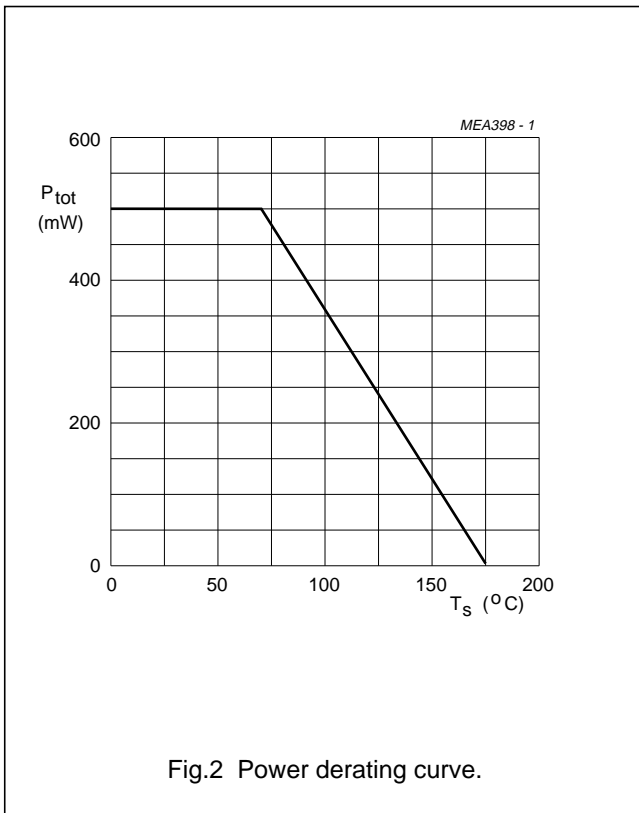
1.  $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and

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

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

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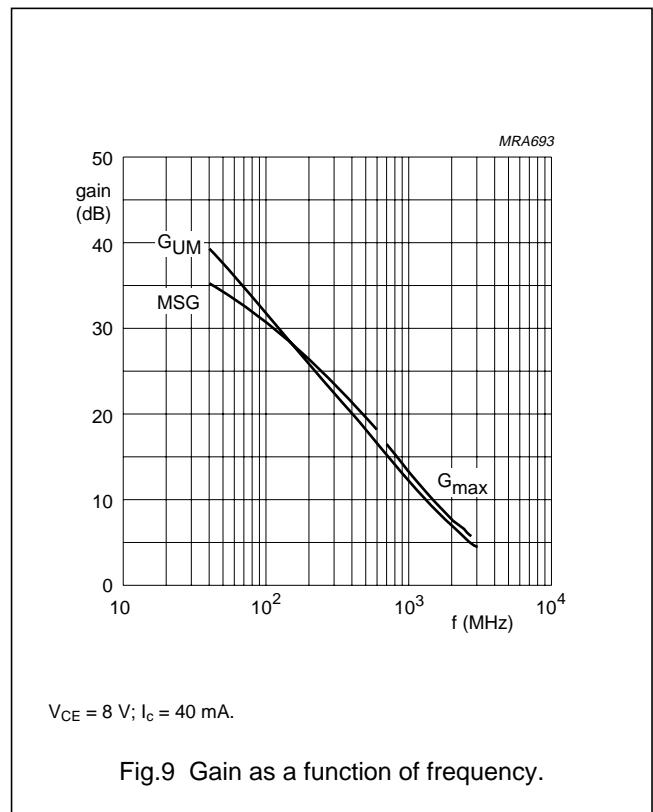
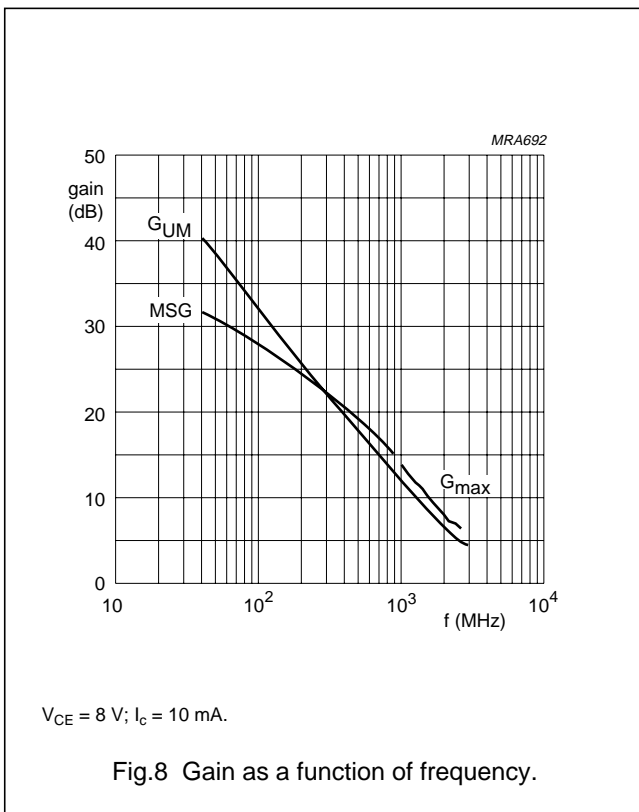
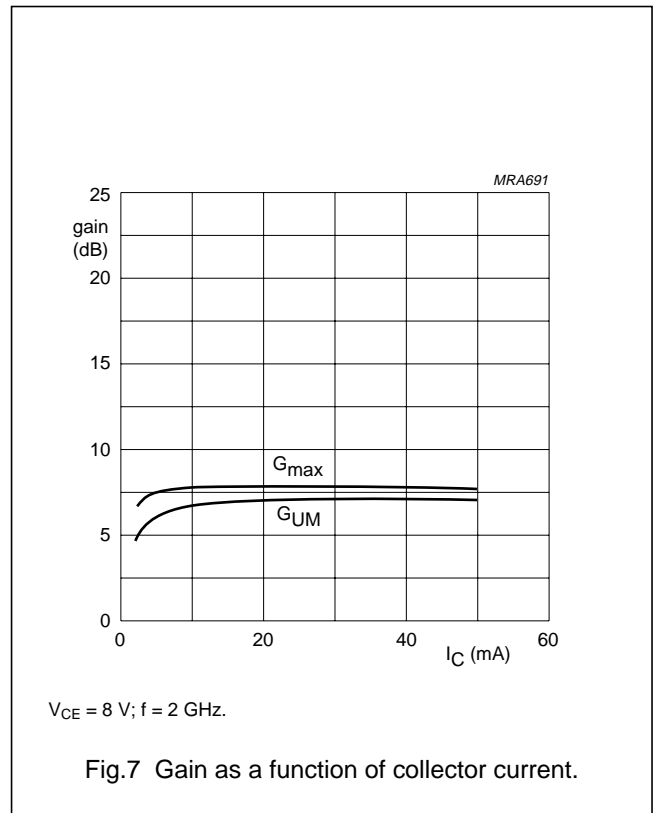
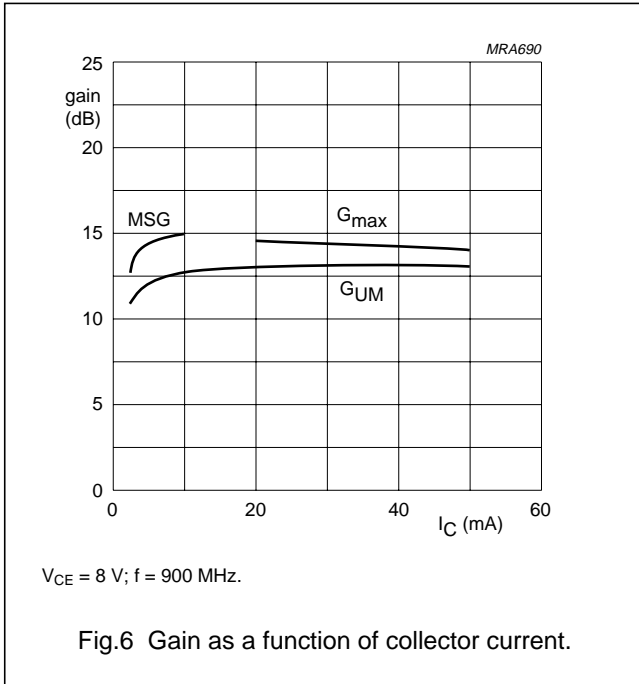
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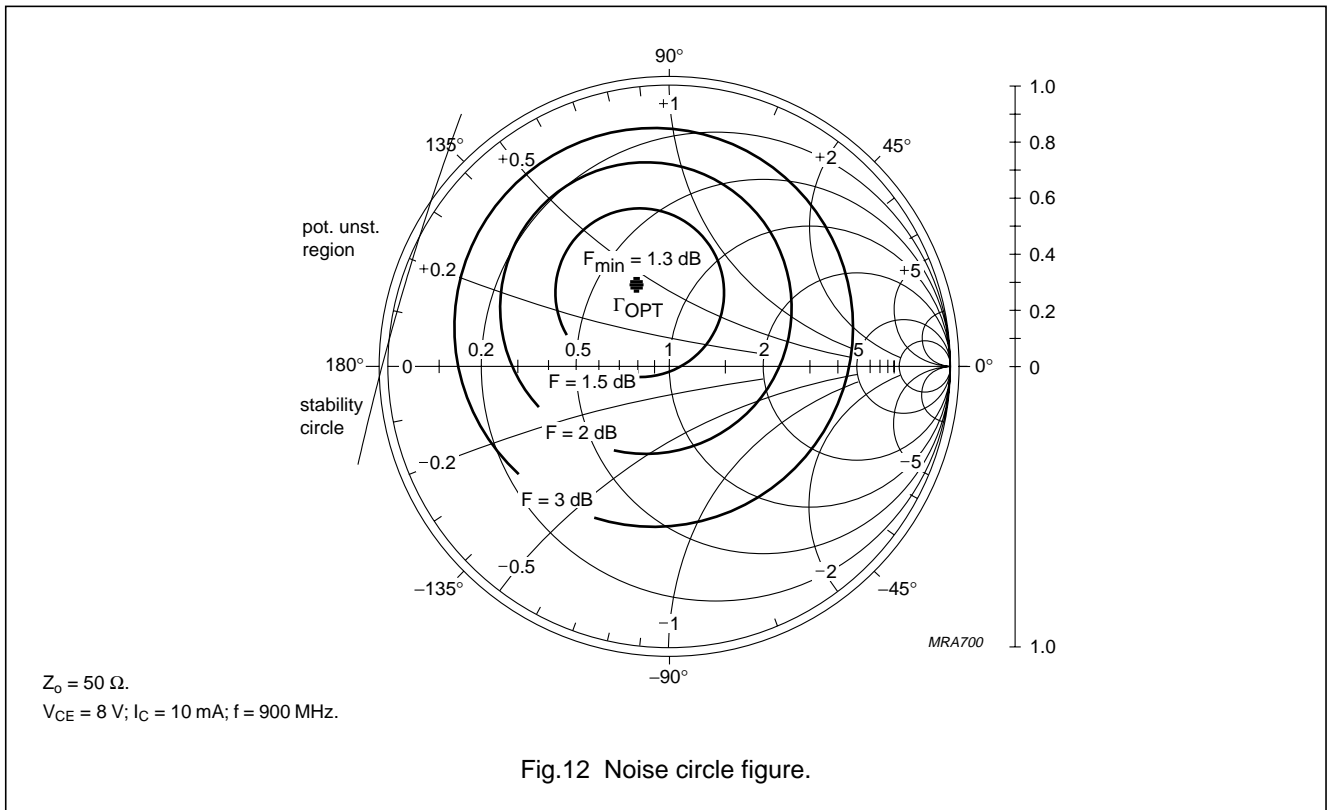
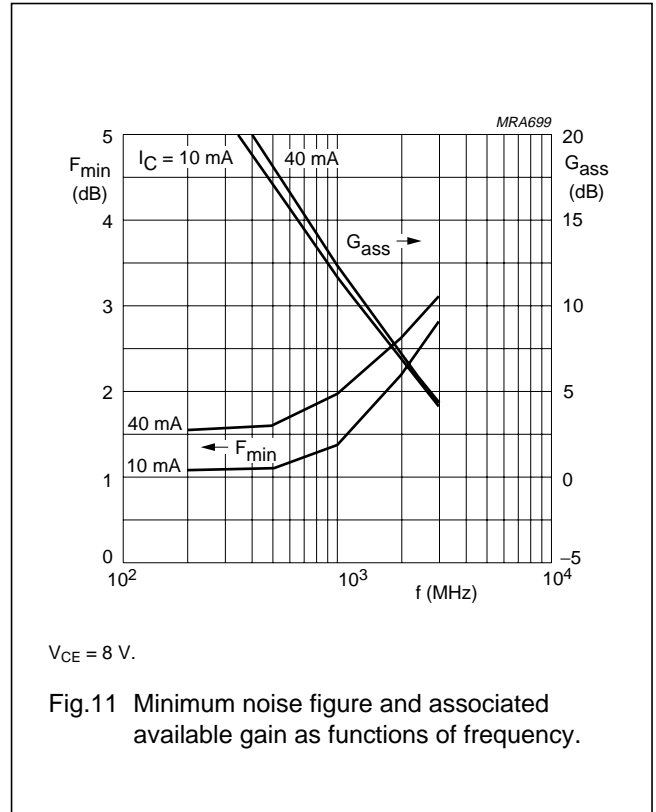
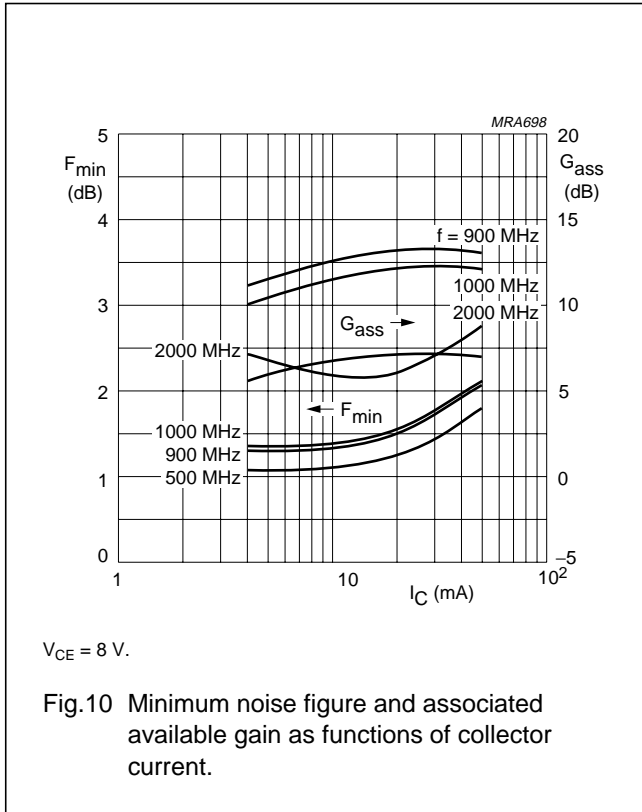
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In Figs 6 to 9,  $G_{UM}$  = maximum unilateral power gain; MSG = maximum stable gain;  $G_{max}$  = maximum available gain.



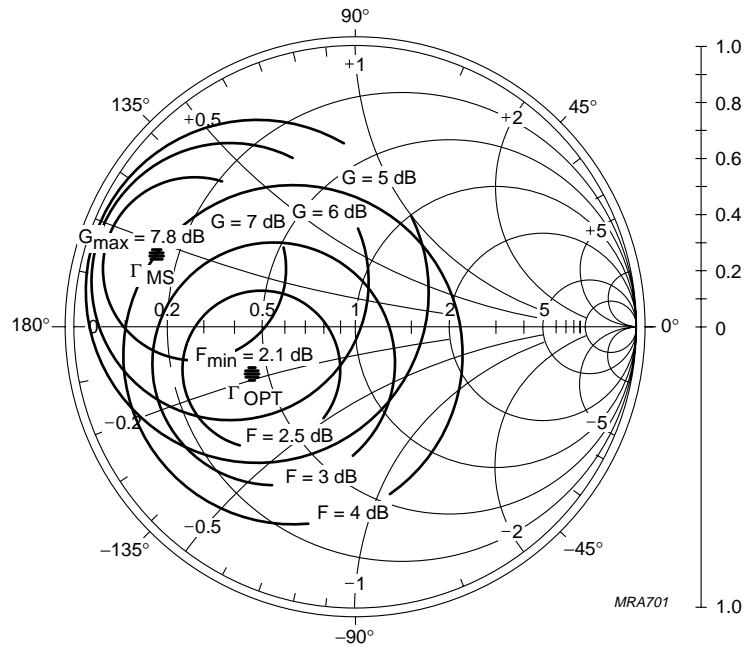
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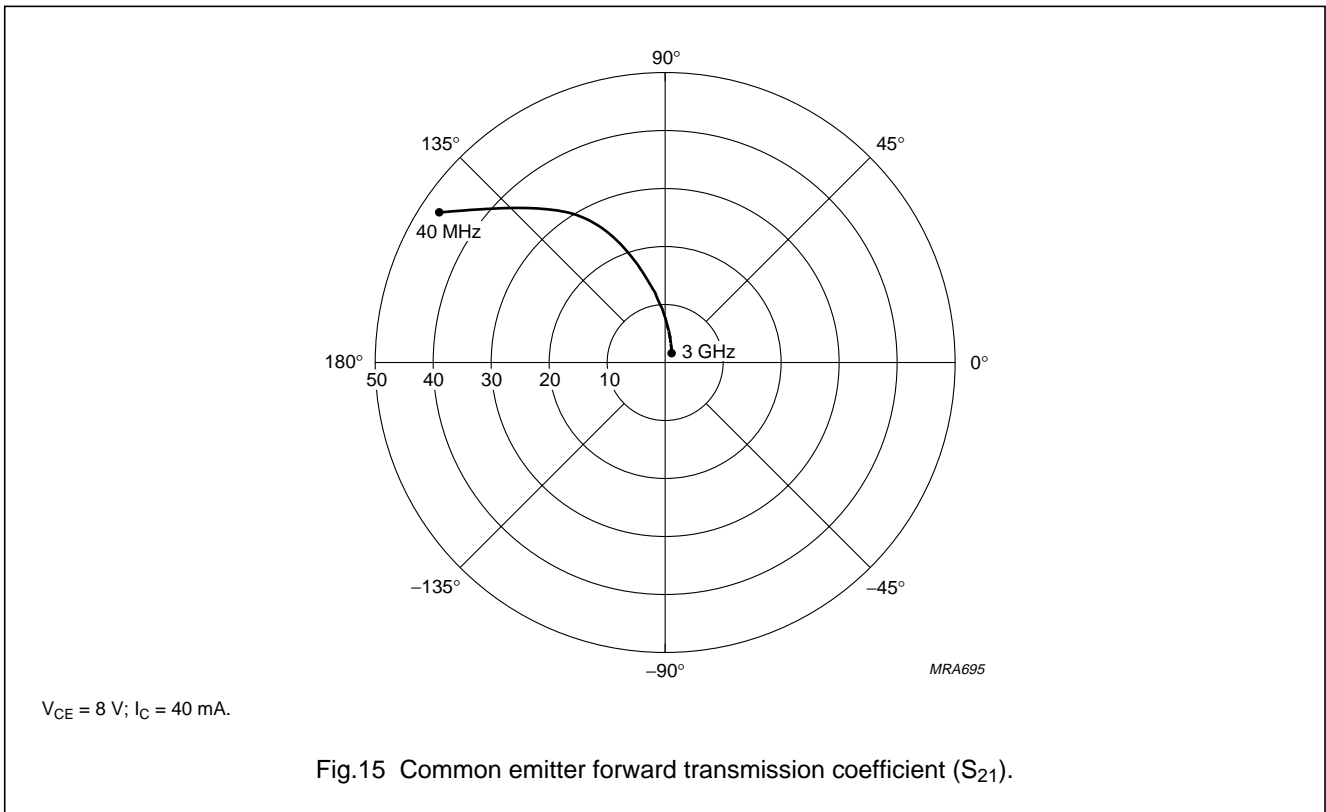
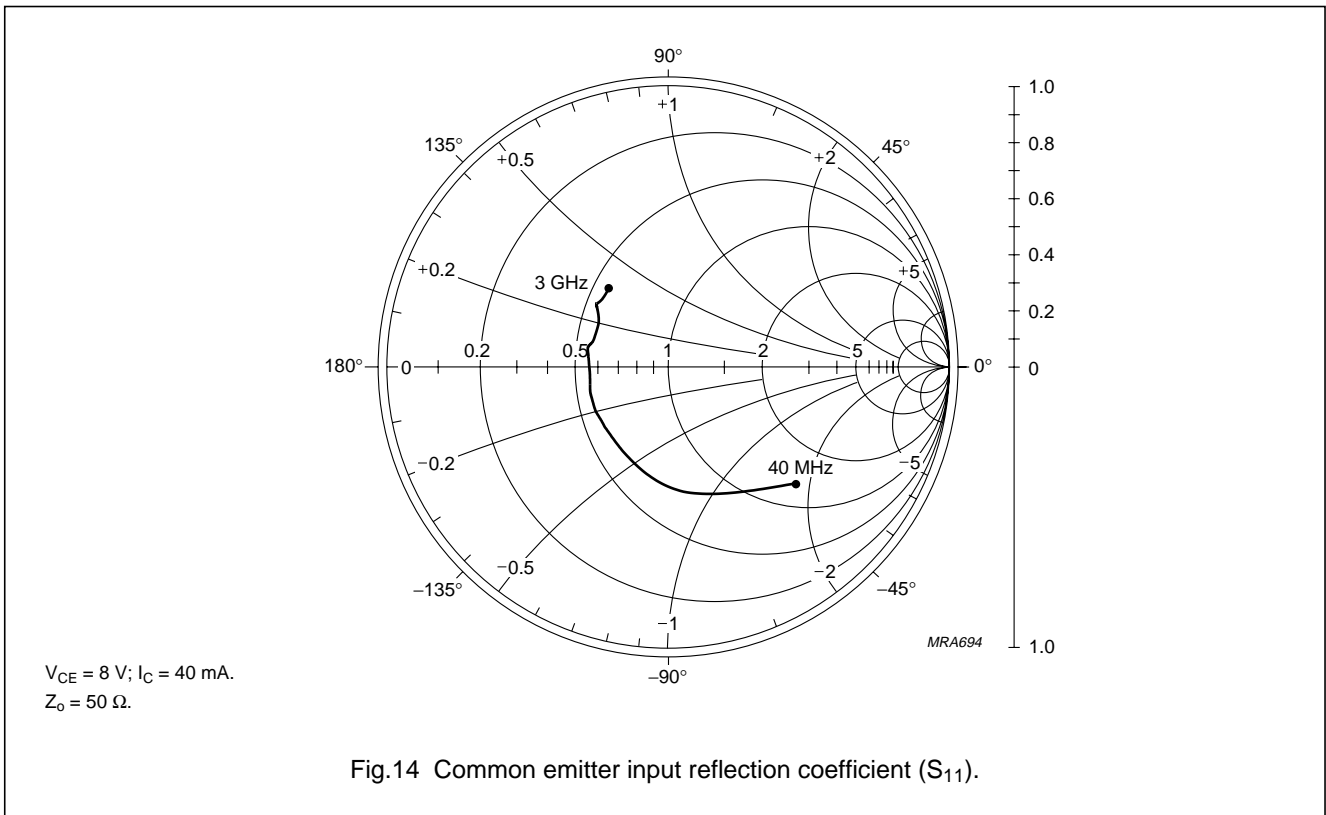


$Z_0 = 50 \Omega$ .  
 $V_{CE} = 8 V$ ;  $I_C = 10 \text{ mA}$ ;  $f = 2000 \text{ MHz}$ .

Fig.13 Noise circle figure.

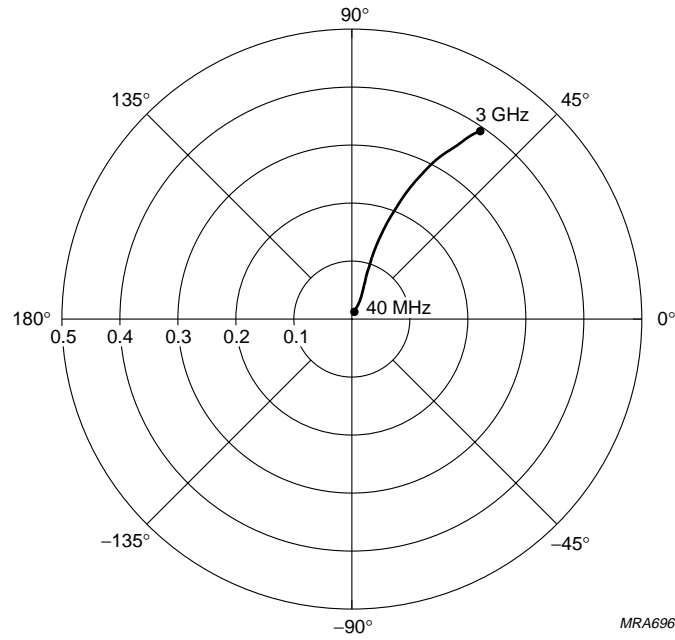
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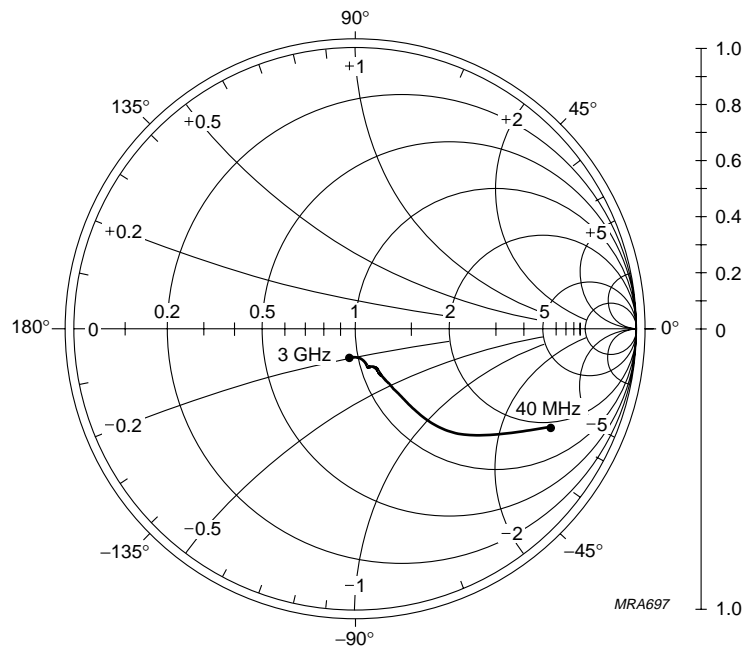
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$V_{CE} = 8\text{ V}; I_C = 40\text{ mA}$ .

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



$V_{CE} = 8\text{ V}; I_C = 40\text{ mA}$ .  
 $Z_0 = 50\ \Omega$ .

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

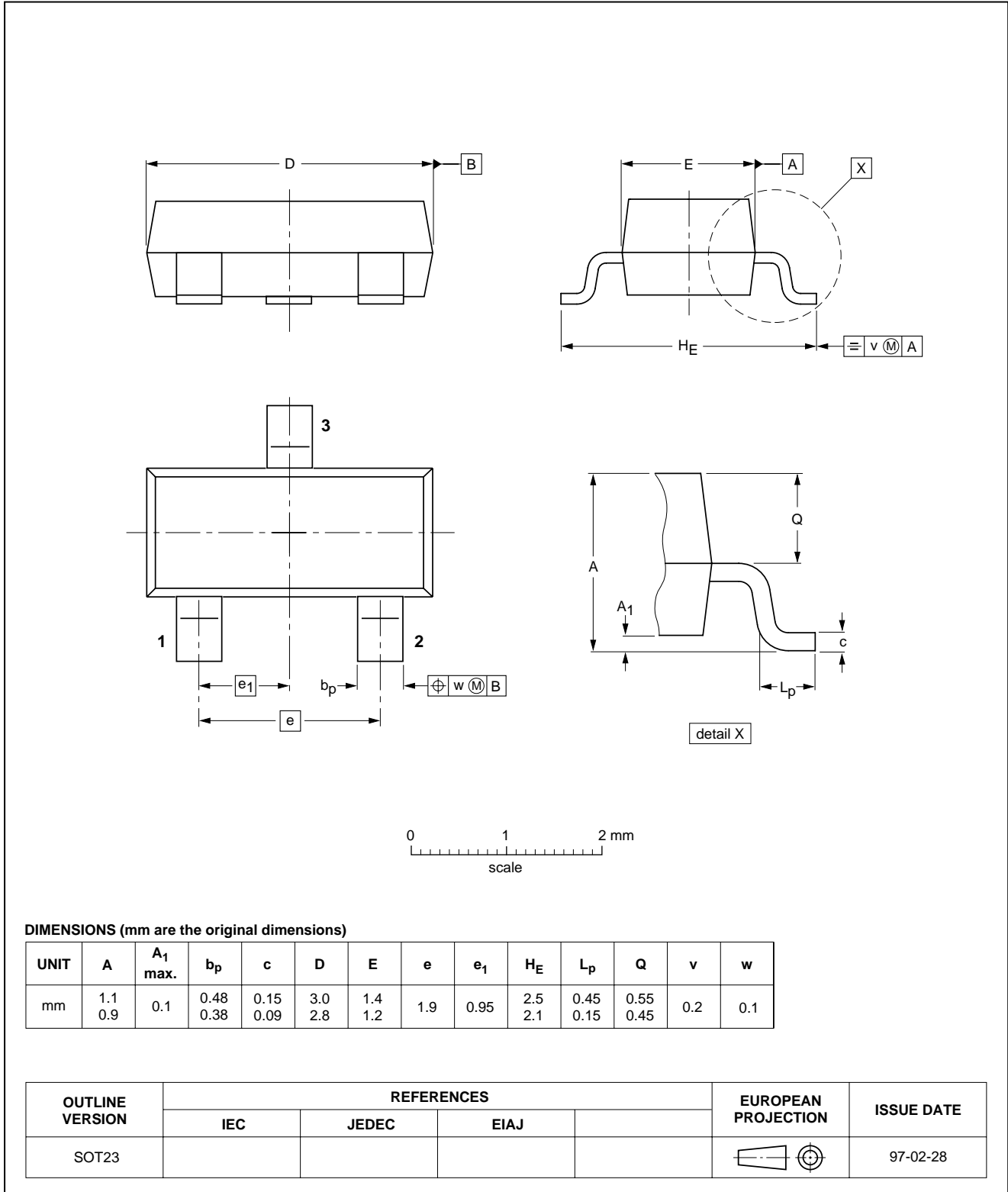
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PACKAGE OUTLINE

Plastic surface mounted package; 3 leads

SOT23



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**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.
<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>	
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**NOTES**

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