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# DATA SHEET

**BFG541**

NPN 9 GHz wideband transistor

Product specification

September 1995



# NPN 9 GHz wideband transistor

# BFG541

### FEATURES

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

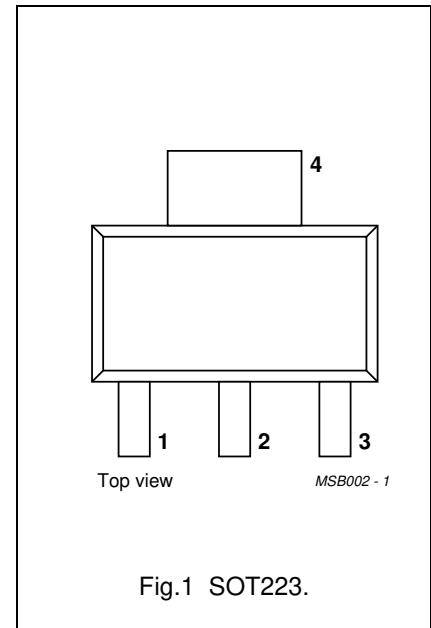
### PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector

### DESCRIPTION

NPN silicon planar epitaxial transistor, intended for 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 transistors are mounted in a plastic SOT223 envelope.



## NPN 9 GHz wideband transistor

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## 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	up to $T_s = 140\text{ °C}$ ; note 1	–	–	650	mW
$h_{FE}$	DC current gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_j = 25\text{ °C}$	60	120	250	
$C_{re}$	feedback capacitance	$I_C = 0$ ; $V_{CB} = 8\text{ V}$ ; $f = 1\text{ MHz}$	–	0.7	–	pF
$f_T$	transition frequency	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	9	–	GHz
$G_{UM}$	maximum unilateral power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	15	–	dB
		$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$	–	9	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	13	14	–	dB
F	noise figure	$\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.3	1.8	dB
$P_{L1}$	output power at 1 dB gain compression	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $R_L = 50\text{ }\Omega$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	21	–	dBm
ITO	third order intercept point	$I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $R_L = 50\text{ }\Omega$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	34	–	dBm

## 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 $T_s = 140\text{ °C}$ ; note 1	–	650	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	55 K/W

## Note

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

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## CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I <sub>CBO</sub>	collector cut-off current	I <sub>E</sub> = 0; V <sub>CB</sub> = 8 V	–	–	50	nA
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V	60	120	250	
C <sub>e</sub>	emitter capacitance	I <sub>C</sub> = I <sub>c</sub> = 0; V <sub>EB</sub> = 0.5 V; f = 1 MHz	–	2	–	pF
C <sub>c</sub>	collector capacitance	I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 8 V; f = 1 MHz	–	1	–	pF
C <sub>re</sub>	feedback capacitance	I <sub>C</sub> = 0; V <sub>CB</sub> = 8 V; f = 1 MHz	–	0.7	–	pF
f <sub>T</sub>	transition frequency	I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V; f = 1 GHz; T <sub>amb</sub> = 25 °C	–	9	–	GHz
G <sub>UM</sub>	maximum unilateral power gain (note 1)	I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	15	–	dB
		I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	–	9	–	dB
S <sub>21</sub>   <sup>2</sup>	insertion power gain	I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	13	14	–	dB
F	noise figure	Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 8 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	1.3	1.8	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	1.9	2.4	dB
		Γ <sub>s</sub> = Γ <sub>opt</sub> ; I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 8 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	–	2.1	–	dB
P <sub>L1</sub>	output power at 1 dB gain compression	I <sub>C</sub> = 40 mA; V <sub>CE</sub> = 8 V; R <sub>L</sub> = 50 Ω; f = 900 MHz; T <sub>amb</sub> = 25 °C	–	21	–	dBm
ITO	third order intercept point	note 2	–	34	–	dBm
V <sub>o</sub>	output voltage	note 3	–	500	–	mV
d <sub>2</sub>	second order intermodulation distortion	note 4	–	–50	–	dB

## Notes

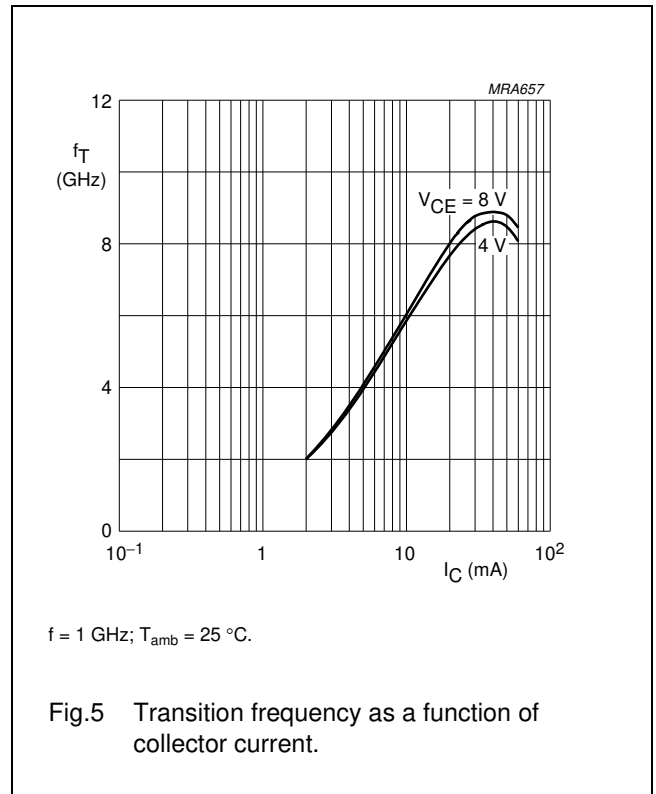
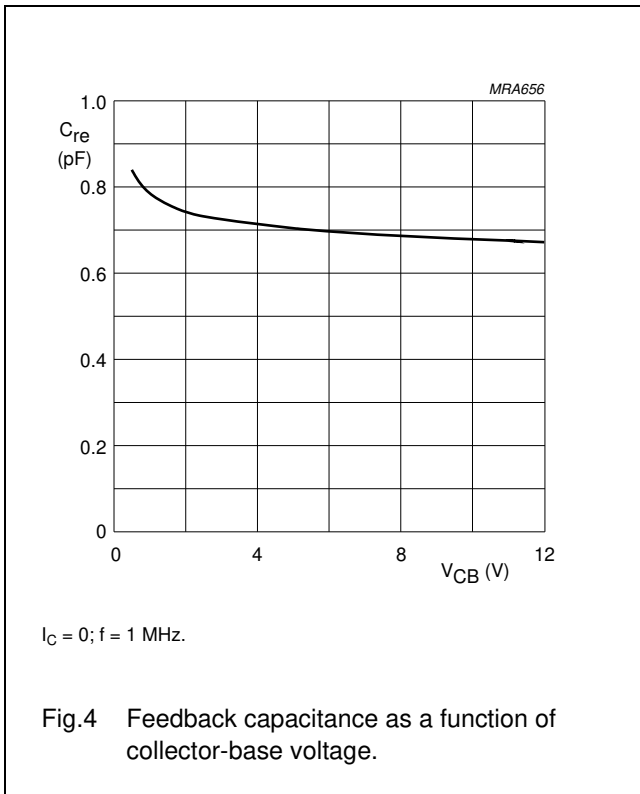
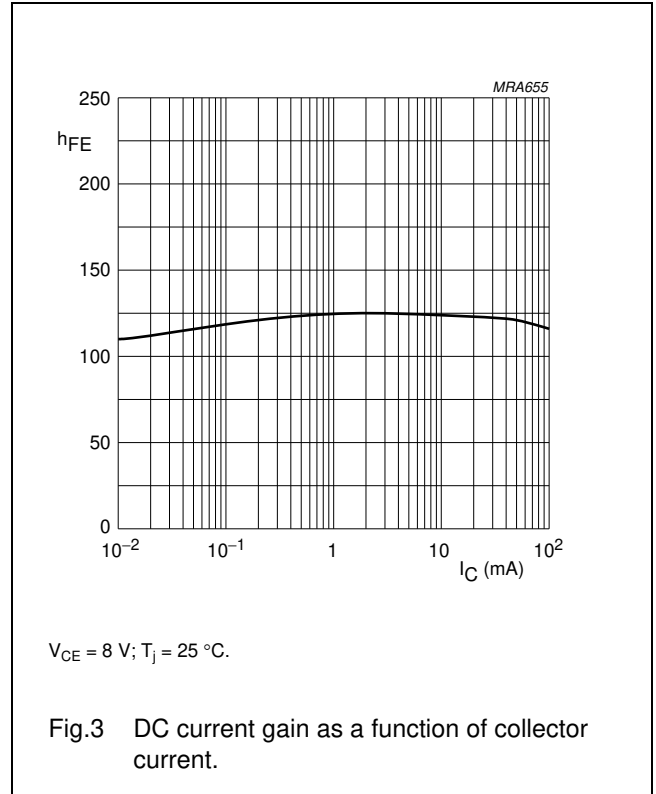
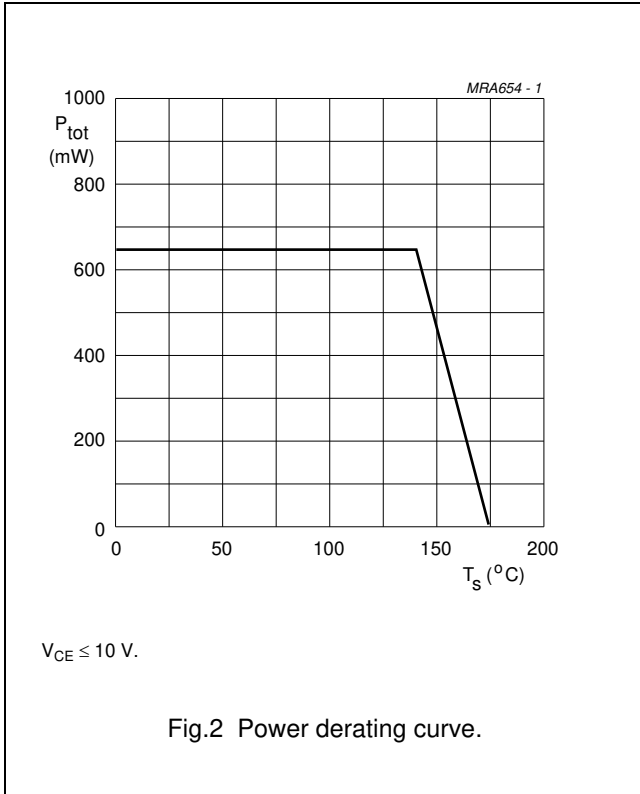
1. G<sub>UM</sub> is the maximum unilateral power gain, assuming S<sub>12</sub> is zero and

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

2. I<sub>C</sub> = 40 mA; V<sub>CE</sub> = 8 V; R<sub>L</sub> = 50 Ω; f = 900 MHz; T<sub>amb</sub> = 25 °C;  
f<sub>p</sub> = 900 MHz; f<sub>q</sub> = 902 MHz;  
measured at f<sub>(2p-q)</sub> = 898 MHz and at f<sub>(2p-q)</sub> = 904 MHz.
3. d<sub>im</sub> = –60 dB (DIN 45004B); I<sub>C</sub> = 40 mA; V<sub>CE</sub> = 8 V; Z<sub>L</sub> = Z<sub>s</sub> = 75 Ω; T<sub>amb</sub> = 25 °C;  
V<sub>p</sub> = V<sub>o</sub>; V<sub>q</sub> = V<sub>o</sub> –6 dB; V<sub>r</sub> = V<sub>o</sub> –6 dB;  
f<sub>p</sub> = 795.25 MHz; f<sub>q</sub> = 803.25 MHz; f<sub>r</sub> = 805.25 MHz;  
measured at f<sub>(p+q-r)</sub> = 793.25 MHz
4. I<sub>C</sub> = 40 mA; V<sub>CE</sub> = 8 V; V<sub>o</sub> = 325 mV; T<sub>amb</sub> = 25 °C;  
f<sub>p</sub> = 250 MHz; f<sub>q</sub> = 560 MHz;  
measured at f<sub>(p+q)</sub> = 810 MHz

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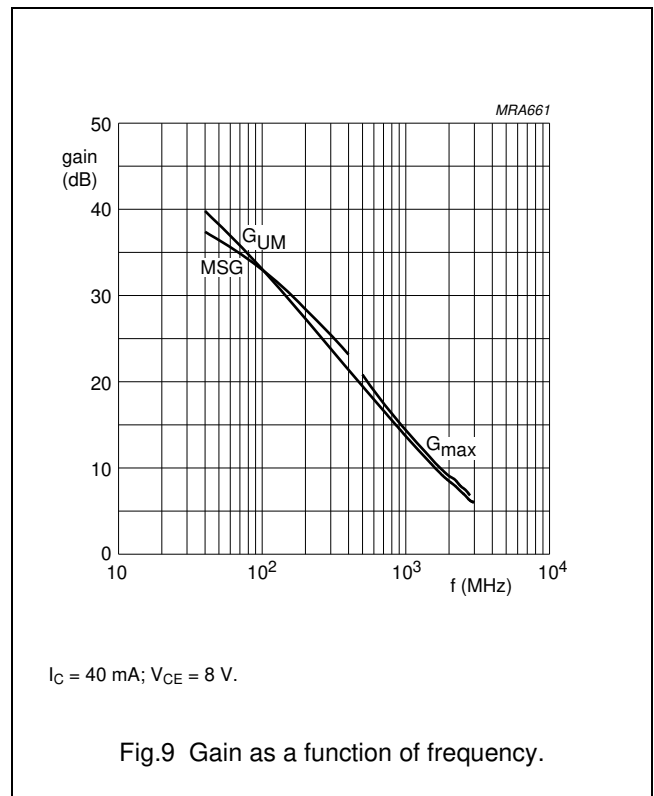
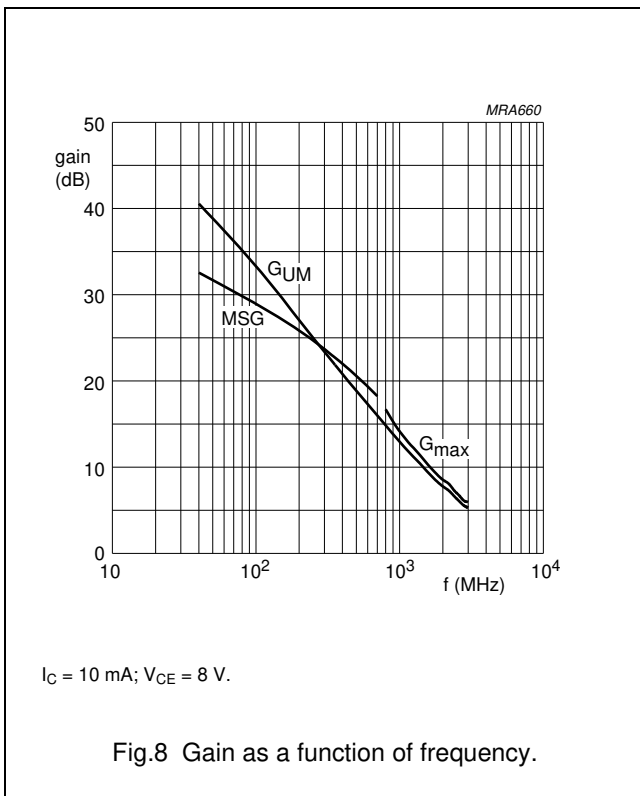
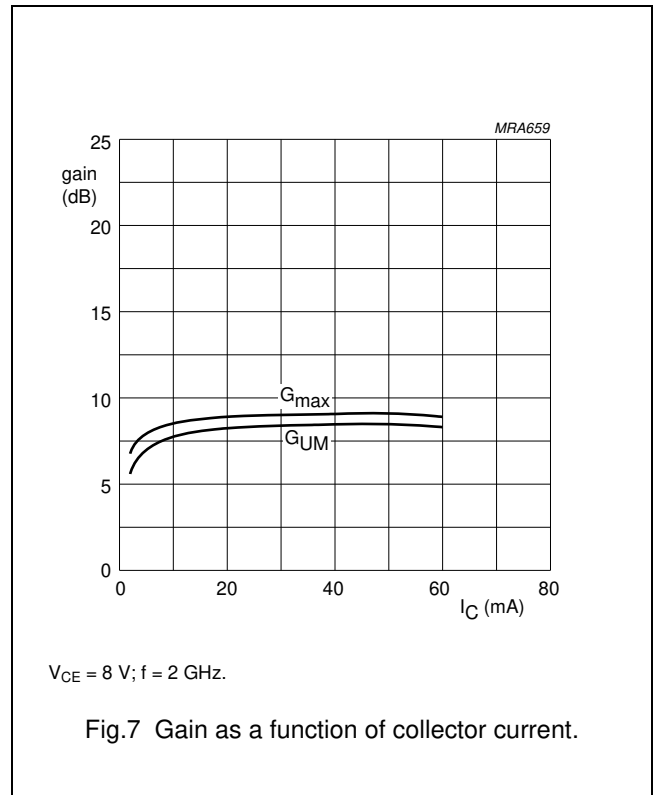
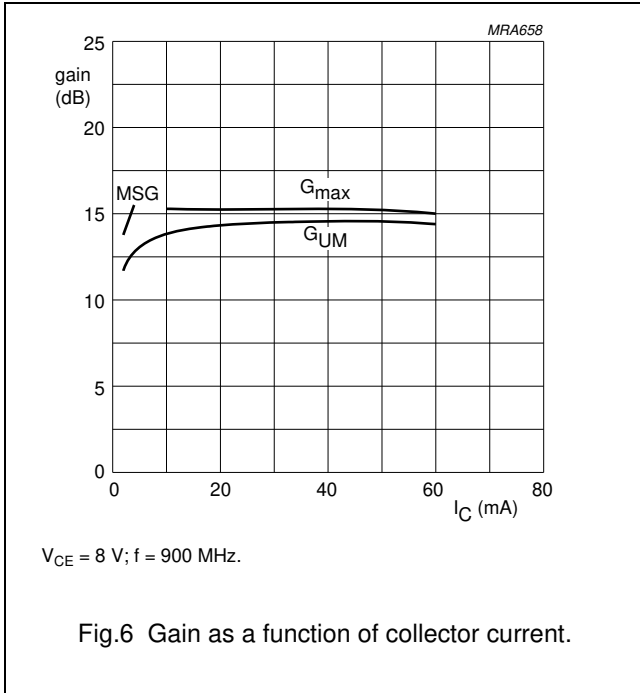
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In Figs 6 to 9,  $G_{UM}$  = maximum power gain;  $MSG$  = maximum stable gain;  $G_{max}$  = maximum available gain.



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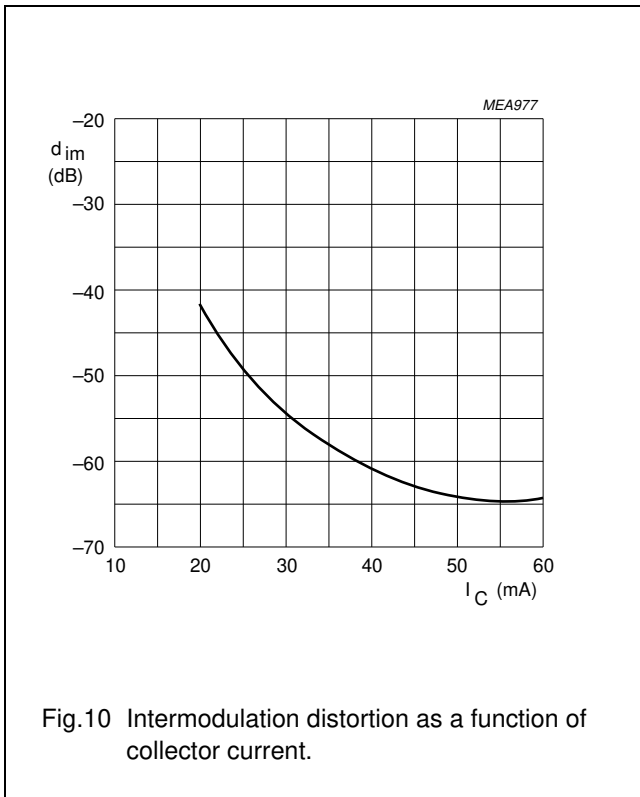


Fig.10 Intermodulation distortion as a function of collector current.

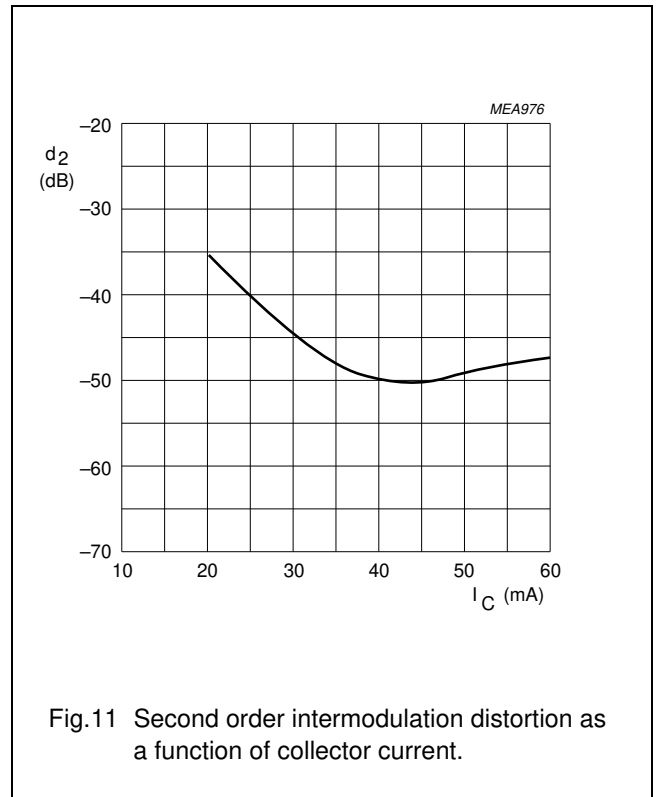
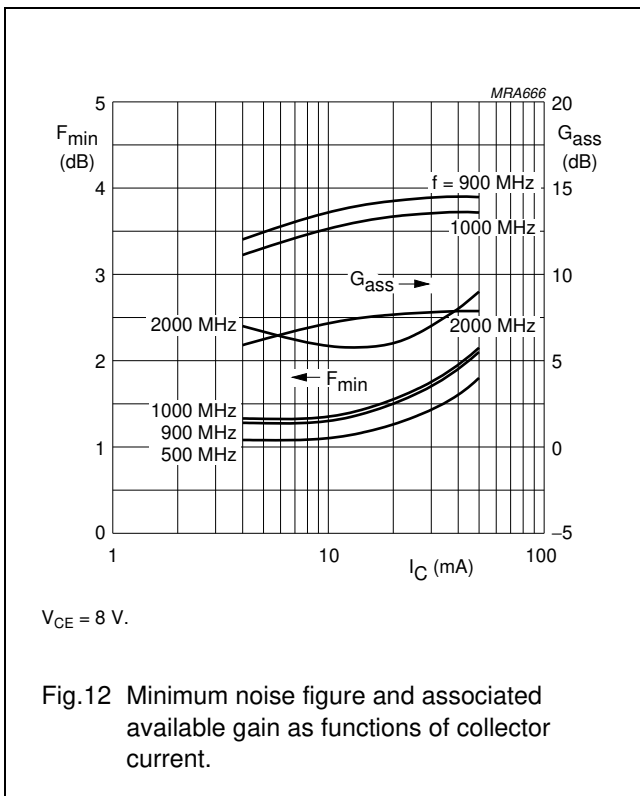
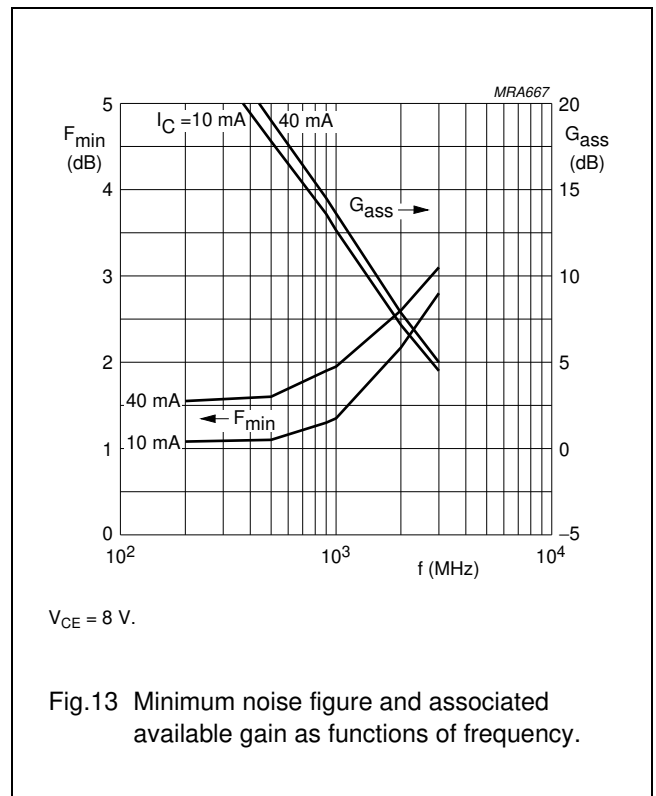


Fig.11 Second order intermodulation distortion as a function of collector current.



$V_{CE} = 8$  V.

Fig.12 Minimum noise figure and associated available gain as functions of collector current.



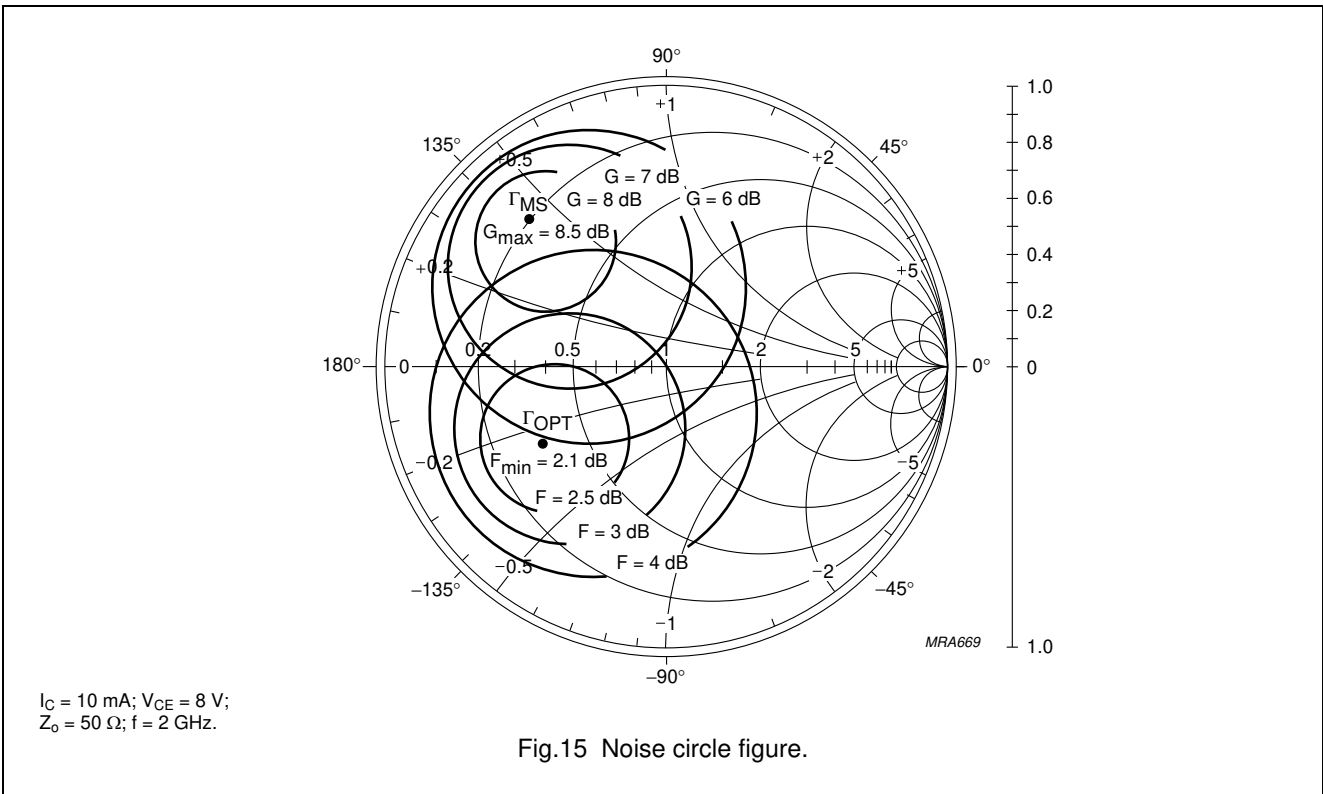
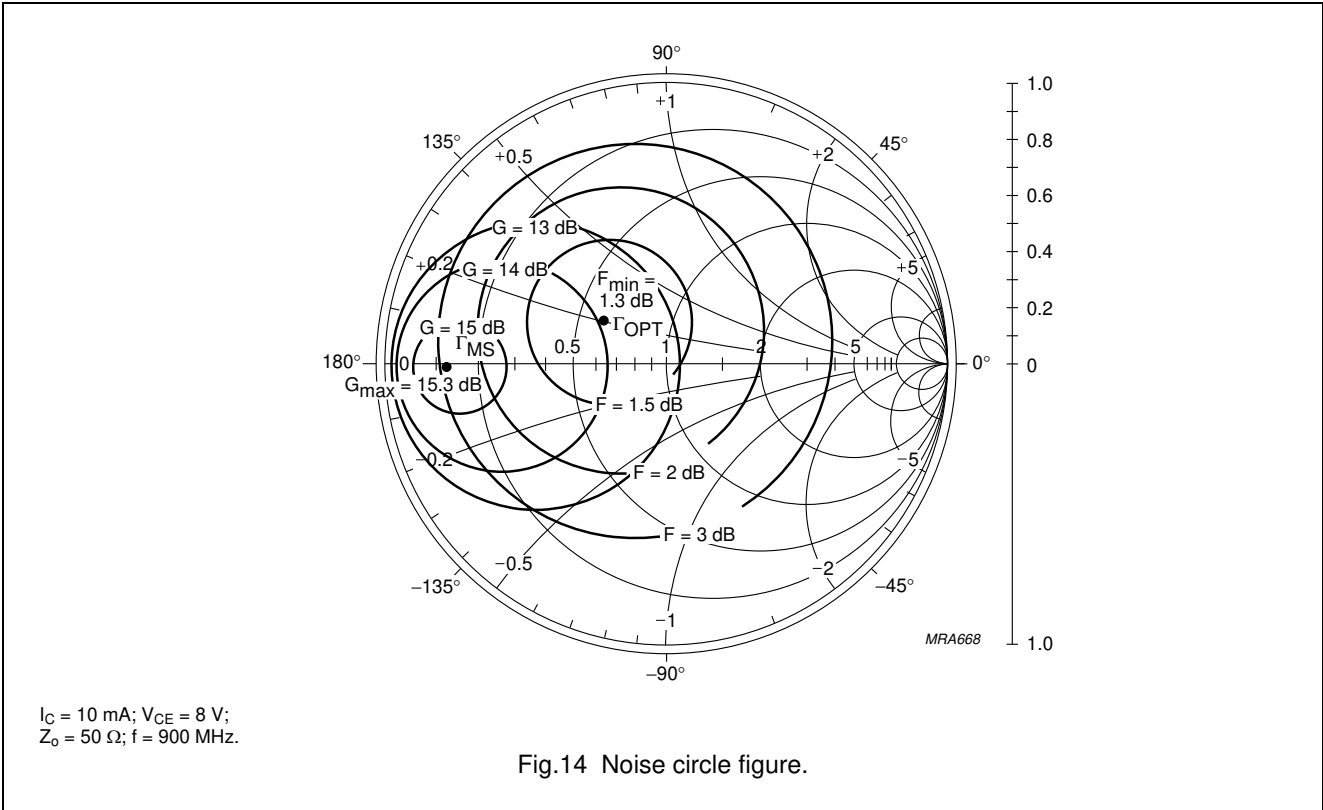
$V_{CE} = 8$  V.

Fig.13 Minimum noise figure and associated available gain as functions of frequency.



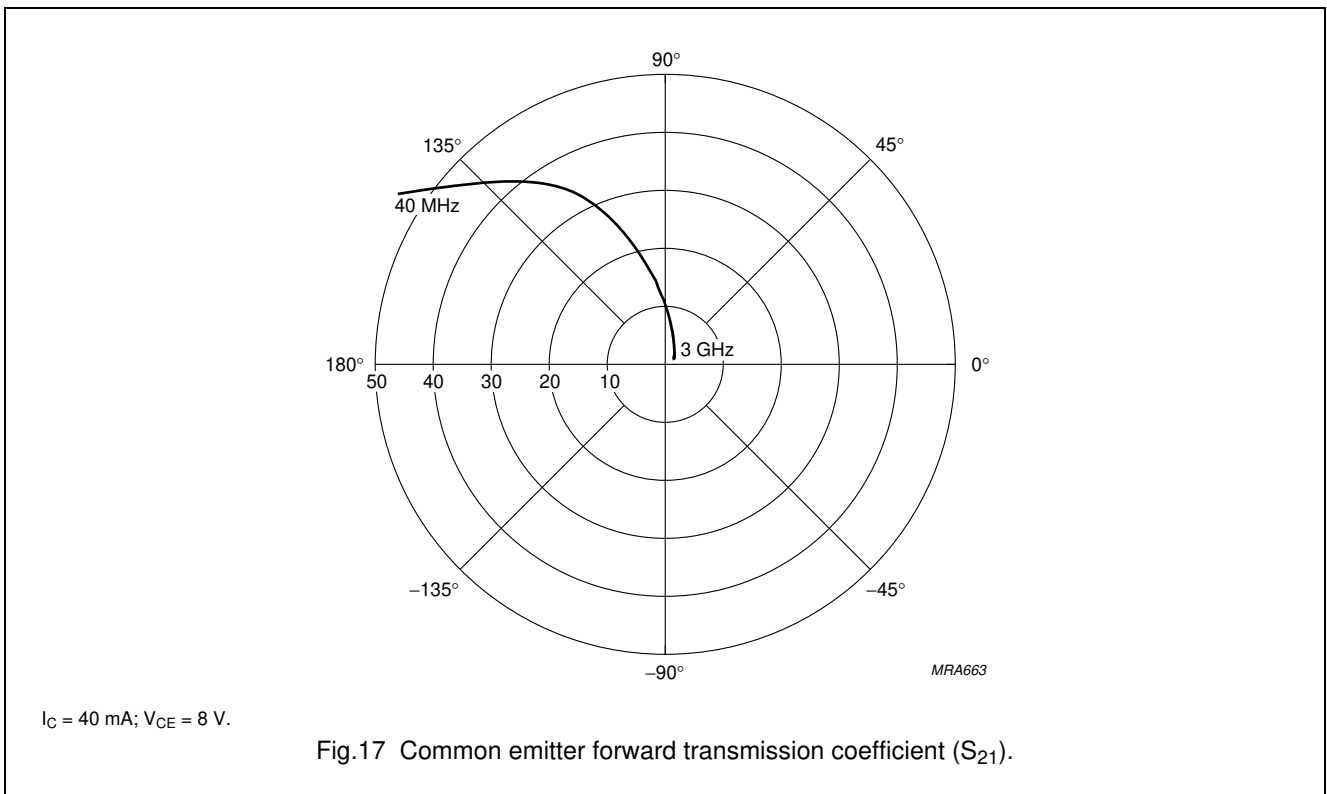
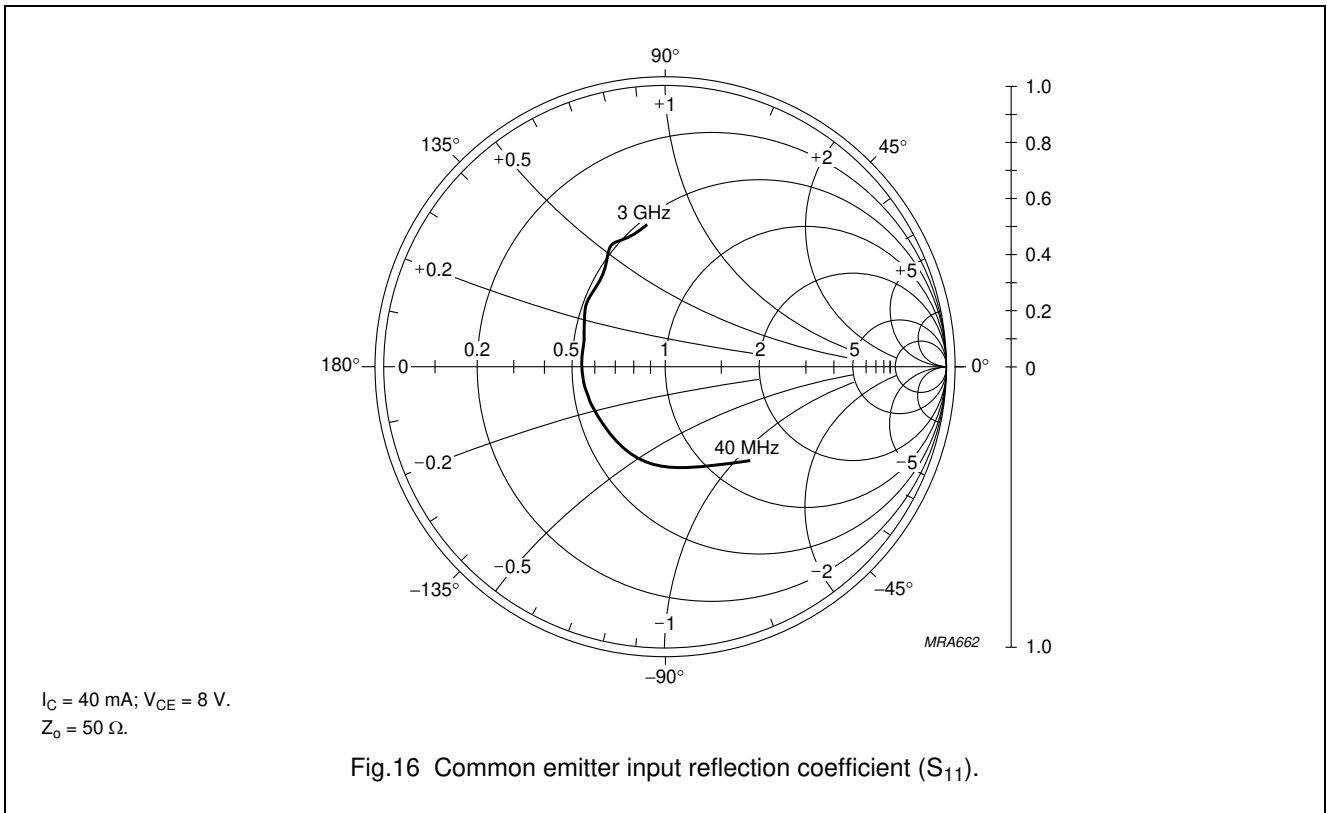
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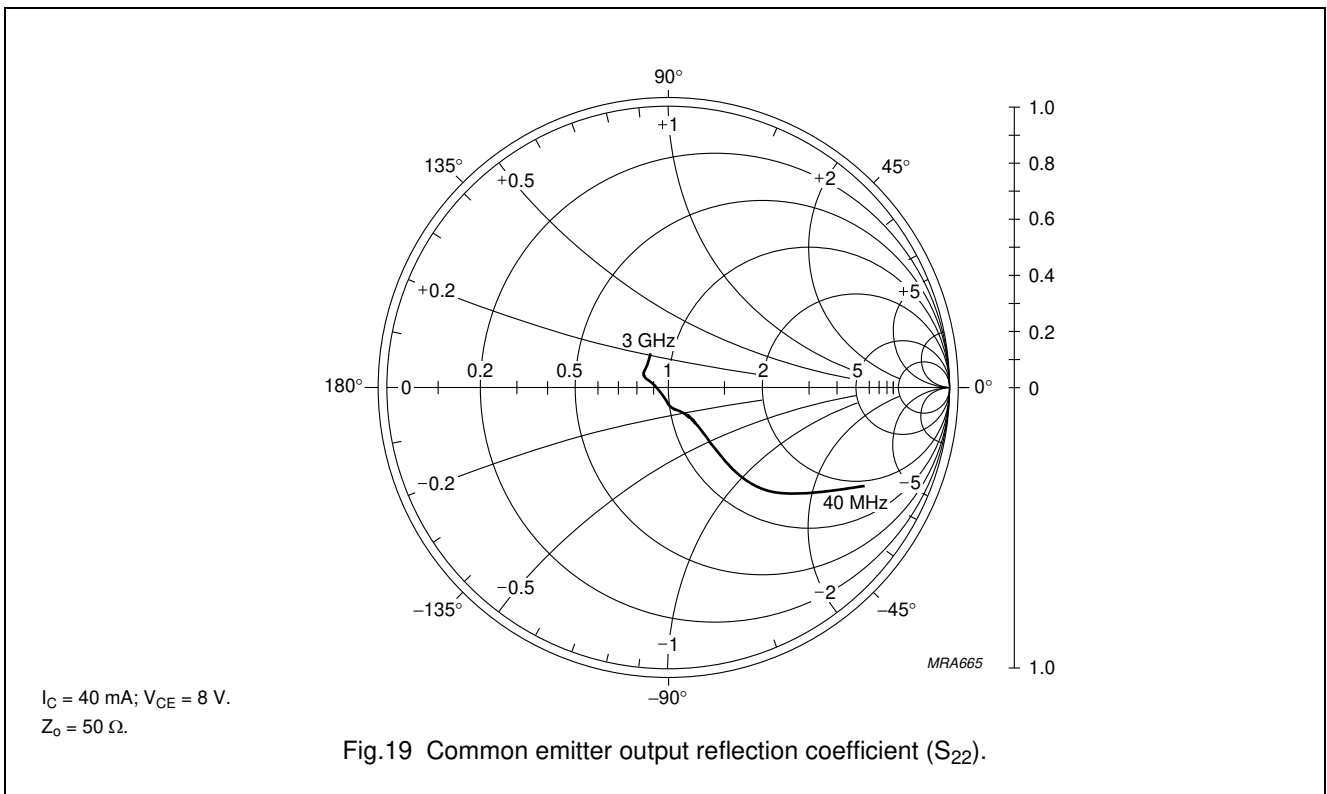
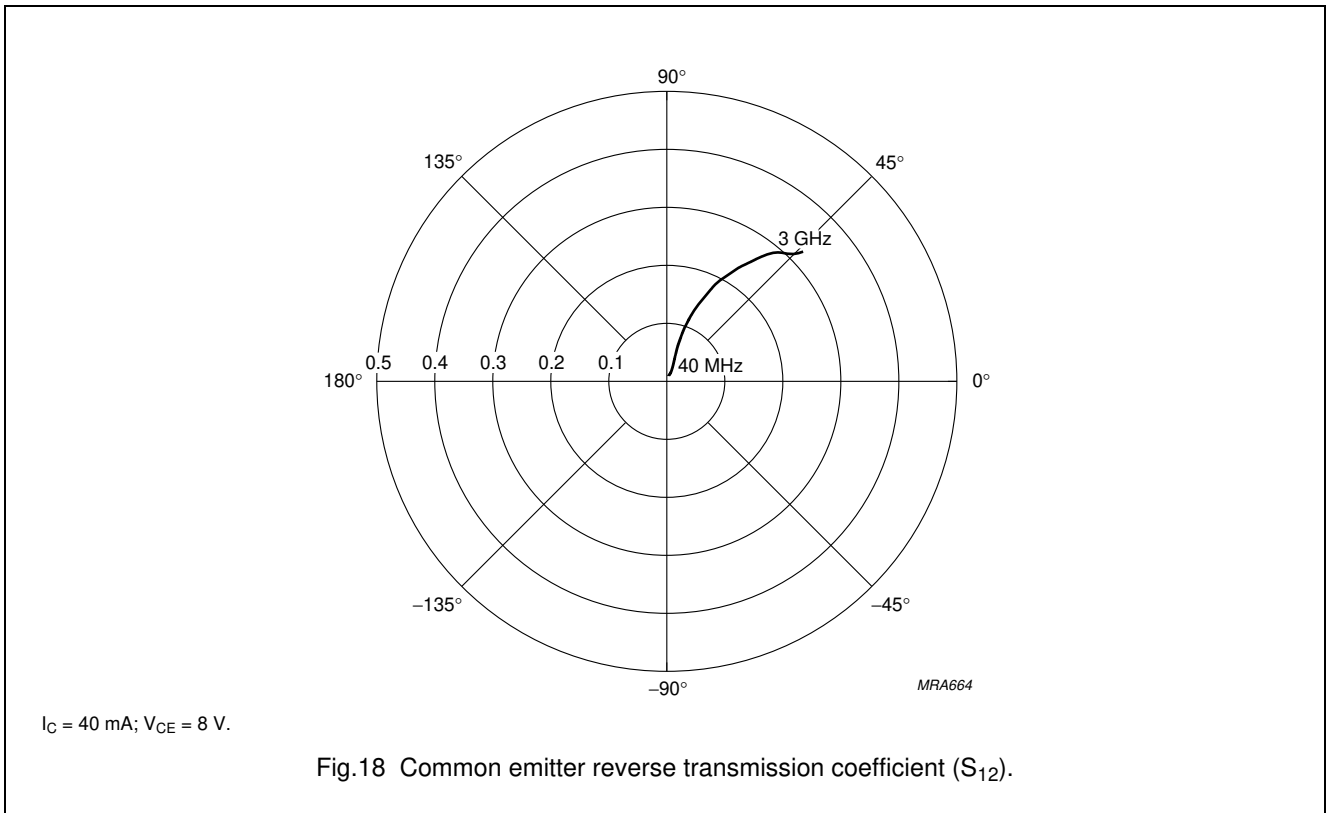
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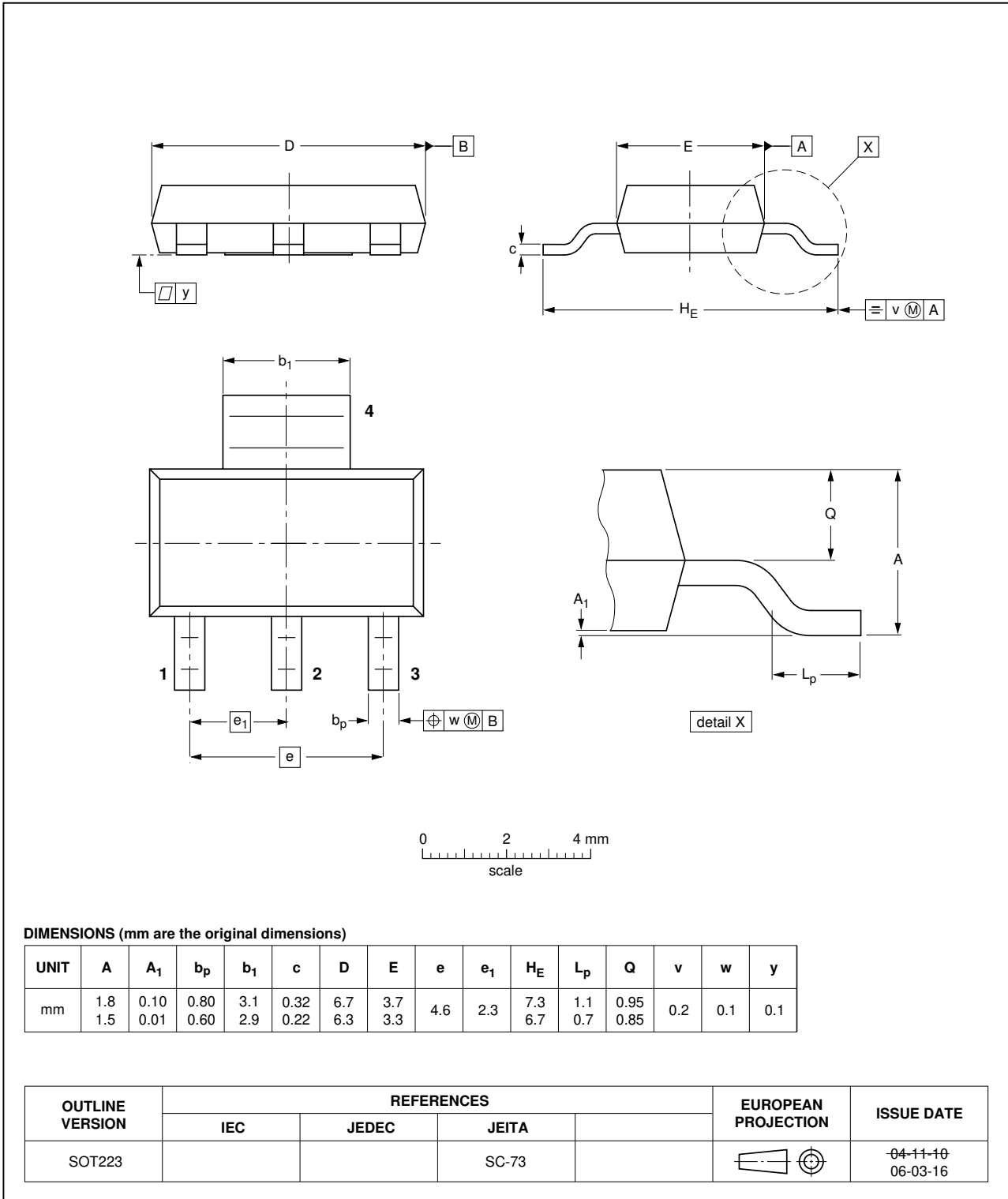
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PACKAGE OUTLINE

Plastic surface-mounted package with increased heatsink; 4 leads

SOT223



## NPN 9 GHz wideband transistor

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## DATA SHEET STATUS

DOCUMENT STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)</sup>	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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