

# BFP196WN

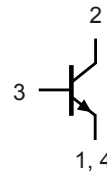
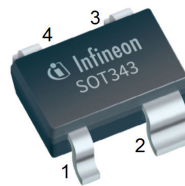
## Low noise silicon bipolar RF transistor

### Product description

- NPN silicon planar epitaxial transistor in 4-pin dual-emitter SOT343 package for low noise and low distortion wideband amplifiers. This RF transistor benefits from Infineon long-term experience in RF components and combines ease-of-use to stable volumes production, at benchmark quality and reliability.

### Features

- For high voltage applications  $V_{CE} < 12\text{ V}$
- Maximal power  $P_{tot} = 700\text{ mW}$
- Transition frequency  $f_T = 7.5\text{ GHz}$
- Noise figure  $NF_{min} = 1.3\text{ dB}$  at 900 MHz
- Easy to use Pb-free (RoHS compliant) and halogen-free industry standard SOT343 package with visible leads



### Application

- GNSS active antenna
- Amplifiers in antenna and telecommunications systems
- CATV
- Power amplifier for DECT and PCN systems

### Product validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

### Device information

**Attention:** ESD (Electrostatic discharge) sensitive device, observe handling precautions

Type / Ordering code	Package	Pin configuration				Marking	Related Links
BFP196WN / BFP196WNH6327XTSA1	SOT343	1=E	2=C	3=B	4=E	RLs	see <a href="#">SOT343 Package</a>

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Absolute maximum ratings

# 1 Absolute maximum ratings

**Table 1** Absolute maximum ratings at  $T_A = 25\text{ °C}$  (unless otherwise specified)

Parameter	Symbol	Values		Unit	Note or Test condition
		Min.	Max.		
Collector emitter voltage	$V_{CEO}$	–	12	V	Base open
Collector emitter voltage	$V_{CES}$	–	20	V	Emitter / base short circuited
Collector base voltage	$V_{CBO}$	–	20	V	Emitter open
Emitter base voltage	$V_{EBO}$	–	2	V	Collector open
DC collector current	$I_C$	–	150	mA	–
DC base current	$I_B$	–	15	mA	–
Total power	$P_{tot}$	–	700	mW	–
Junction temperature	$T_J$	–	150	°C	–
Storage temperature	$T_{Stg}$	-55	150	°C	–

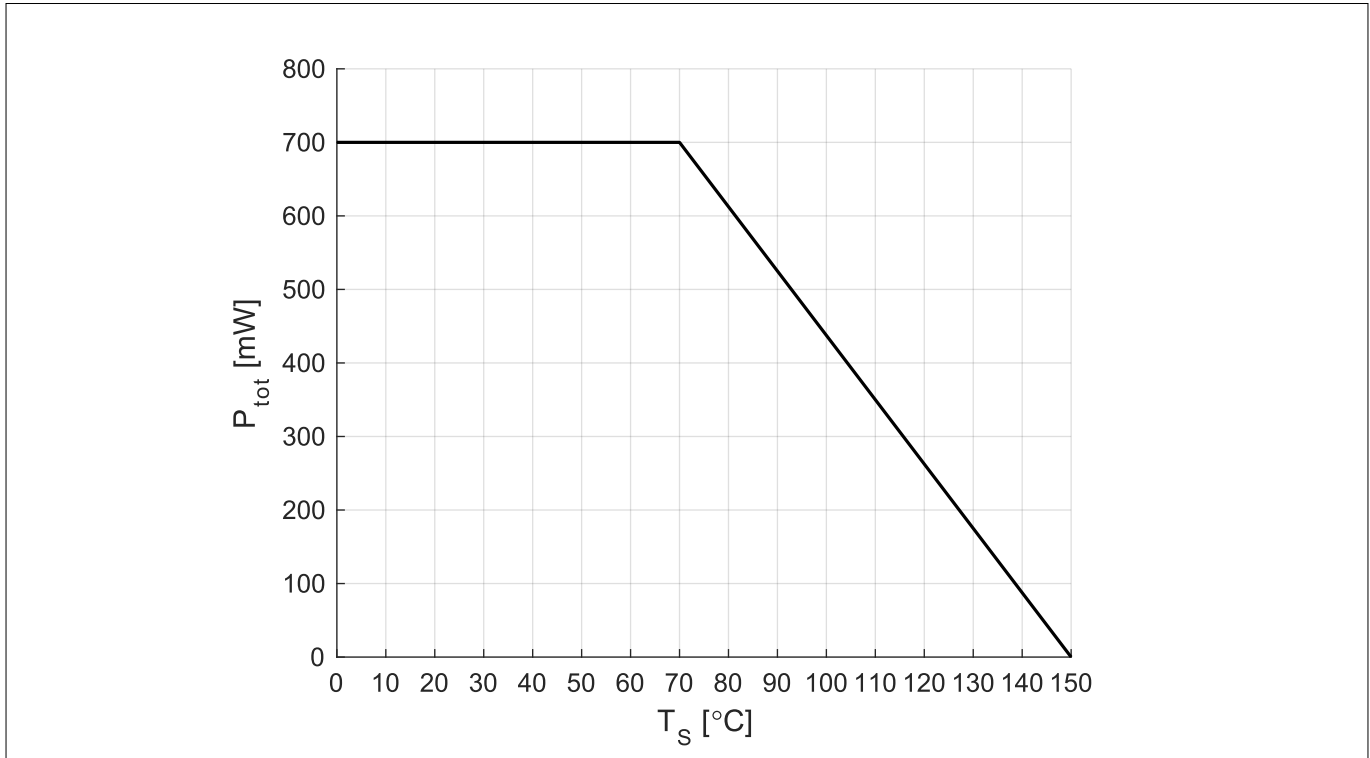
**Attention:** Stresses above the maximum values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings. Exceeding only one of these values may cause irreversible damage to the component.

**Thermal characteristics**

**2 Thermal characteristics**

**Table 2 Thermal resistance**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Junction - soldering point	$R_{thJS}$	–	115	–	K/W	1)



**Figure 1 Absolute maximum power dissipation  $P_{tot}$  vs.  $T_s$**

*Note:* In the horizontal part of the above curve the junction temperature  $T_J$  is lower than  $T_{J,max}$ . In the declining slope it is  $T_J = T_{J,max}$ .  $P_{tot}$  has to be reduced according to the curve in order not to exceed  $T_{J,max}$ . It is  $T_{J,max} = T_s + P_{tot} * R_{thJS}$ .

<sup>1</sup> For the definition of  $R_{thJS}$  please refer to the application note AN077

**Electrical performance in test fixture**

**3 Electrical performance in test fixture**

**3.1 DC parameter table**

**Table 3 DC characteristics at  $T_A = 25\text{ }^\circ\text{C}$**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Collector emitter breakdown voltage	$V_{CEO}$	12	–	–	V	$I_C = 1\text{ mA}$ , open base
Collector emitter leakage current	$I_{CES}$	–	–	100	$\mu\text{A}$	$V_{CE} = 20\text{ V}$ , $V_{BE} = 0\text{ V}$ Emitter / base short circuited
Collector base leakage current	$I_{CBO}$	–	–	100	nA	$V_{CB} = 10\text{ V}$ , $V_{BE} = 0$ Open emitter
Emitter base leakage current	$I_{EBO}$	–	–	1	$\mu\text{A}$	$V_{EB} = 1\text{ V}$ , $I_C = 0$ Open collector
DC current gain	$h_{FE}$	70	100	140		$V_{CE} = 8\text{ V}$ , $I_C = 50\text{ mA}$ Pulse measured

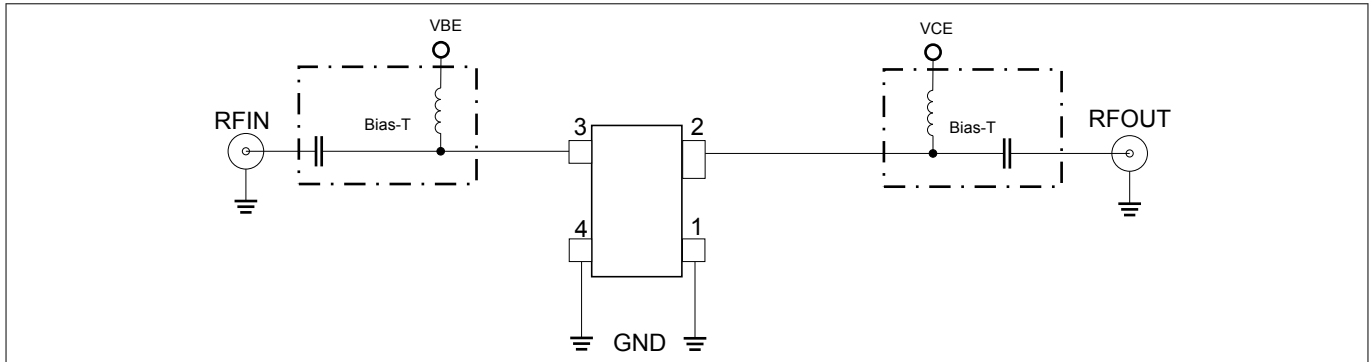
**3.2 AC parameter tables**

**Table 4 General AC characteristics at  $T_A = 25\text{ }^\circ\text{C}$**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Transition frequency	$f_T$	5	7.5	–	GHz	$V_{CE} = 8\text{ V}$ , $I_C = 90\text{ mA}$ , $f = 500\text{ MHz}$
Collector base capacitance	$C_{CB}$	–	0.9	–	pF	$V_{CB} = 10\text{ V}$ , $V_{BE} = 0\text{ V}$ , $f = 1\text{ MHz}$ Emitter grounded
Collector emitter capacitance	$C_{CE}$	–	0.35	–	pF	$V_{CE} = 10\text{ V}$ , $V_{BE} = 0\text{ V}$ , $f = 1\text{ MHz}$ Base grounded
Emitter base capacitance	$C_{EB}$	–	3.8	–	pF	$V_{EB} = 0.5\text{ V}$ , $V_{CB} = 0\text{ V}$ , $f = 1\text{ MHz}$ Collector grounded

**Electrical performance in test fixture**

Measurement setup for the AC characteristics shown in the following tables is a test fixture with Bias T's in a 50 Ω system,  $T_A = 25\text{ °C}$ .



**Figure 2** BFP196WN testing circuit

**Table 5** AC characteristics,  $V_{CE} = 8\text{ V}$ ,  $f = 0.45\text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
<b>Power gain</b>					dB	
Maximum power gain	$G_{ms}$	–	23.5	–		$I_C = 50\text{ mA}$ $Z_S = Z_{Sopt}, Z_L = Z_{Lopt}$
Transducer gain	$ S_{21} ^2$	–	19.0	–		$Z_S = Z_L = 50\text{ }\Omega$
<b>Minimum noise figure</b>	NFmin	–	0.95	–	dB	$I_C = 20\text{ mA}, Z_S = Z_{Sopt}$
<b>Linearity</b>					dBm	
1 dB compression point at output	OP1dB	–	19	–		$I_C = 50\text{ mA}$ $Z_S = Z_L = 50\text{ }\Omega$
3rd order intercept point at output	OIP3	–	32	–		

**Table 6** AC characteristics,  $V_{CE} = 8\text{ V}$ ,  $f = 0.9\text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
<b>Power gain</b>					dB	
Maximum power gain	$G_{ms}$	–	17.0	–		$I_C = 50\text{ mA}$ $Z_S = Z_{Sopt}, Z_L = Z_{Lopt}$
Transducer gain	$ S_{21} ^2$	–	13.0	–		$Z_S = Z_L = 50\text{ }\Omega$
<b>Minimum noise figure</b>	NFmin	–	1.1	–	dB	$I_C = 20\text{ mA}, Z_S = Z_{Sopt}$
<b>Linearity</b>					dBm	
1 dB compression point at output	OP1dB	–	19	–		$I_C = 50\text{ mA}$ $Z_S = Z_L = 50\text{ }\Omega$
3rd order intercept point at output	OIP3	–	32	–		

**Electrical performance in test fixture**

**Table 7 AC characteristics,  $V_{CE} = 8\text{ V}$ ,  $f = 1.5\text{ GHz}$**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
<b>Power gain</b>					dB	$I_C = 50\text{ mA}$ $Z_S = Z_{Sopt}, Z_L = Z_{Lopt}$ $Z_S = Z_L = 50\ \Omega$
Maximum power gain	$G_{ms}$	–	12.5	–		
Transducer gain	$ S_{21} ^2$	–	8.5	–		
<b>Minimum noise figure</b>	NFmin	–	1.7	–	dB	$I_C = 20\text{ mA}, Z_S = Z_{Sopt}$
<b>Linearity</b>					dBm	$I_C = 50\text{ mA}$ $Z_S = Z_L = 50\ \Omega$
1 dB compression point at output	OP1dB	–	19	–		
3rd order intercept point at output	OIP3	–	32	–		

**Table 8 AC characteristics,  $V_{CE} = 8\text{ V}$ ,  $f = 1.9\text{ GHz}$**

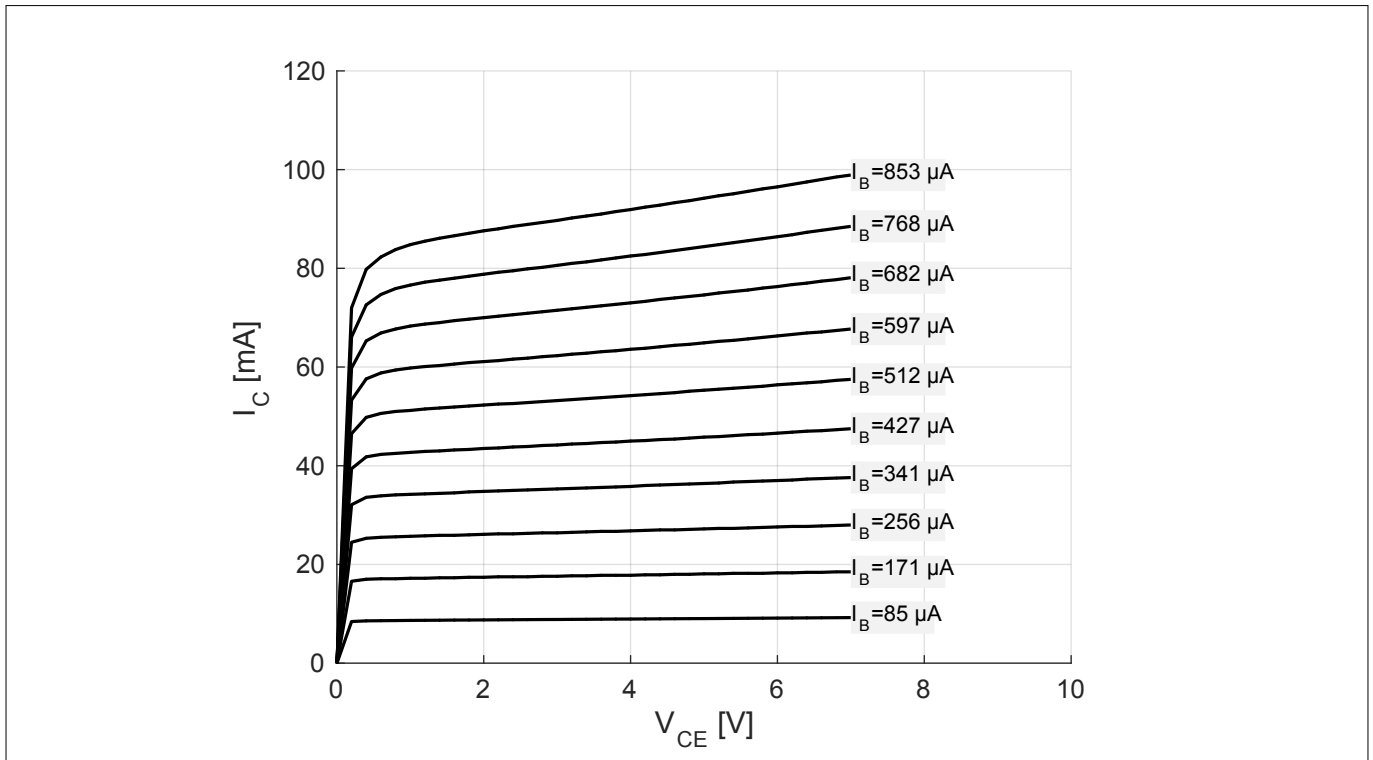
Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
<b>Power gain</b>					dB	$I_C = 50\text{ mA}$ $Z_S = Z_{Sopt}, Z_L = Z_{Lopt}$ $Z_S = Z_L = 50\ \Omega$
Maximum power gain	$G_{ms}$	–	11	–		
Transducer gain	$ S_{21} ^2$	–	6.5	–		
<b>Minimum noise figure</b>	NFmin	–	2.1	–	dB	$I_C = 20\text{ mA}, Z_S = Z_{Sopt}$
<b>Linearity</b>					dBm	$I_C = 50\text{ mA}$ $Z_S = Z_L = 50\ \Omega$
1 dB compression point at output	OP1dB	–	19	–		
3rd order intercept point at output	OIP3	–	32	–		

**Table 9 AC characteristics,  $V_{CE} = 5\text{ V}$ ,  $f = 2.4\text{ GHz}$**

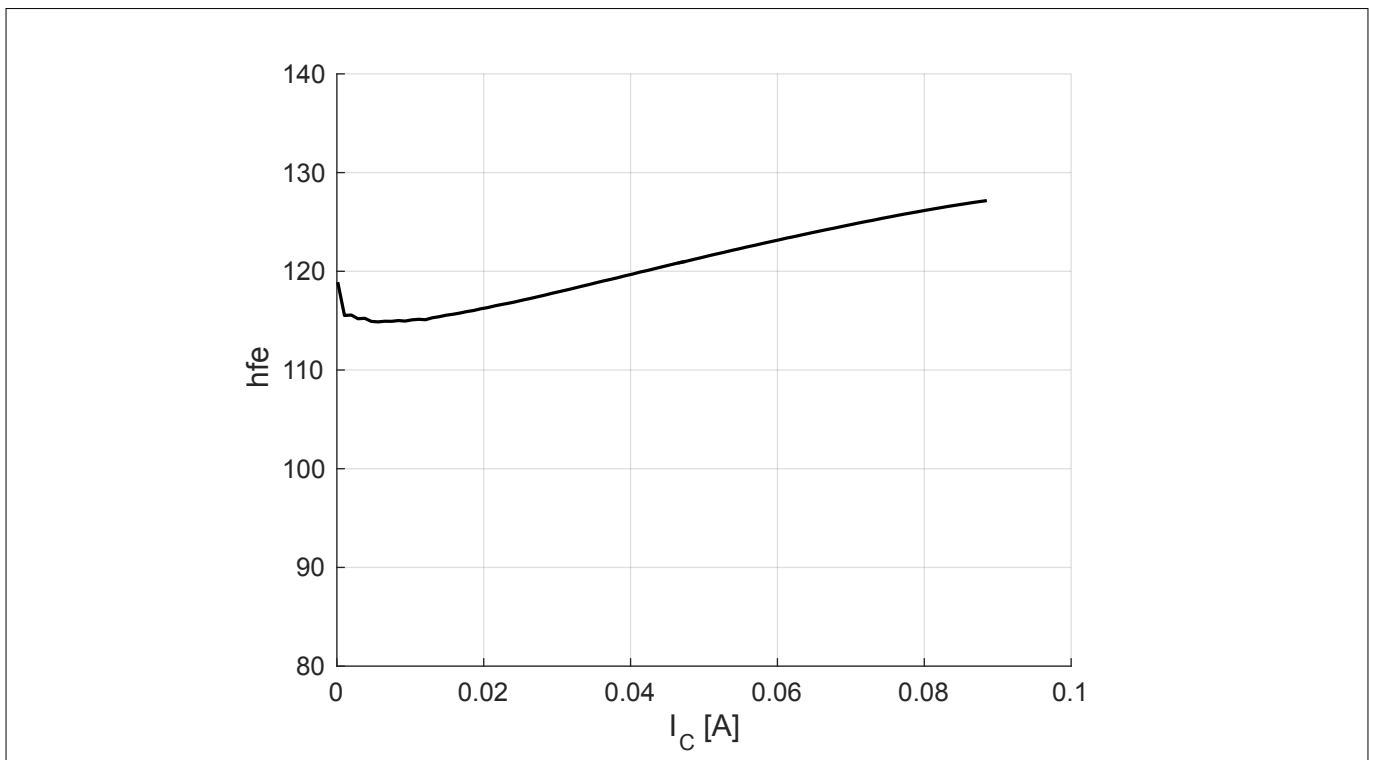
Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
<b>Power gain</b>					dB	$I_C = 50\text{ mA}$ $Z_S = Z_{Sopt}, Z_L = Z_{Lopt}$ $Z_S = Z_L = 50\ \Omega$
Maximum power gain	$G_{ms}$	–	9.7	–		
Transducer gain	$ S_{21} ^2$	–	4.8	–		
<b>Minimum noise figure</b>	NFmin	–	2.5	–	dB	$I_C = 20\text{ mA}, Z_S = Z_{Sopt}$
<b>Linearity</b>					dBm	$I_C = 50\text{ mA}$ $Z_S = Z_L = 50\ \Omega$
1 dB compression point at output	OP1dB	–	19	–		
3rd order intercept point at output	OIP3	–	32	–		

**Electrical performance in test fixture**

**3.3 Characteristic DC diagrams**



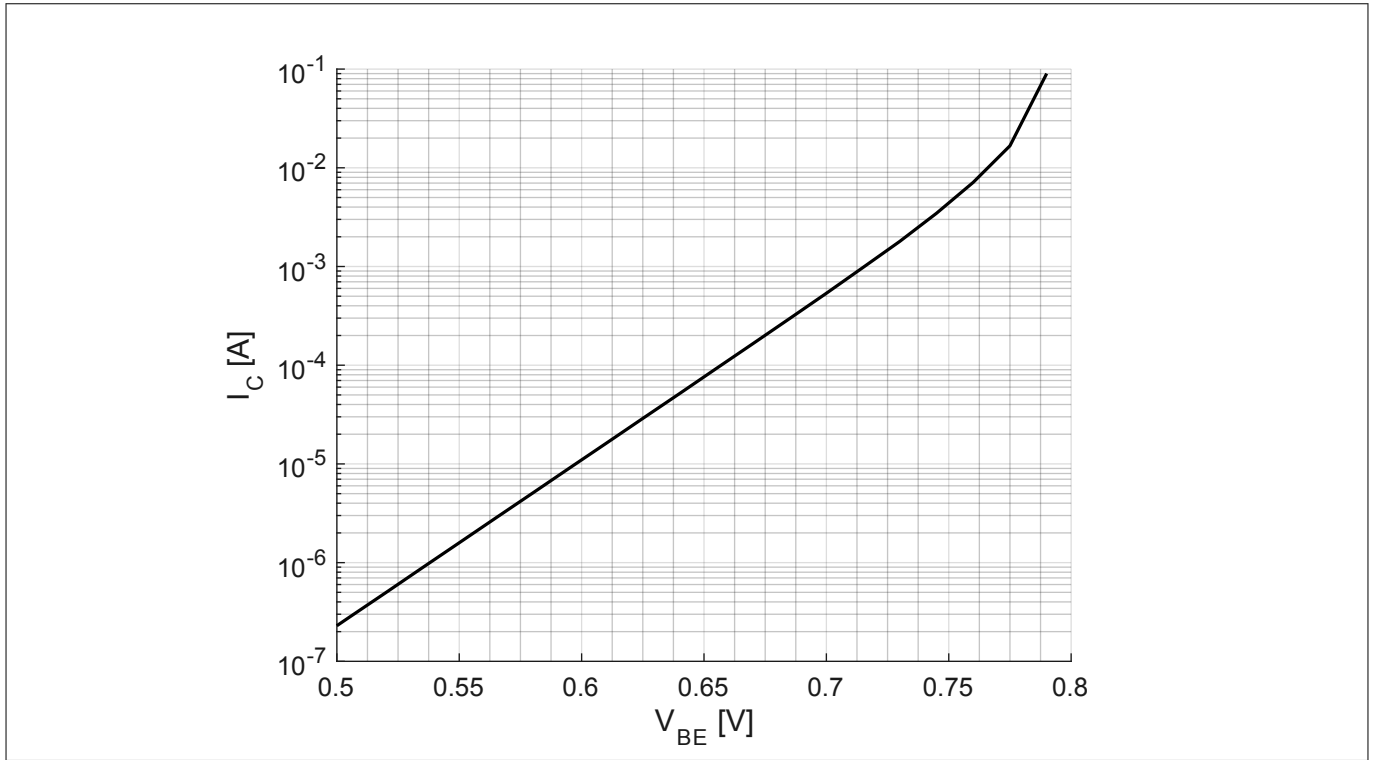
**Figure 3** Collector current  $I_C = f(V_{CE})$ ,  $I_B = \text{parameter}$



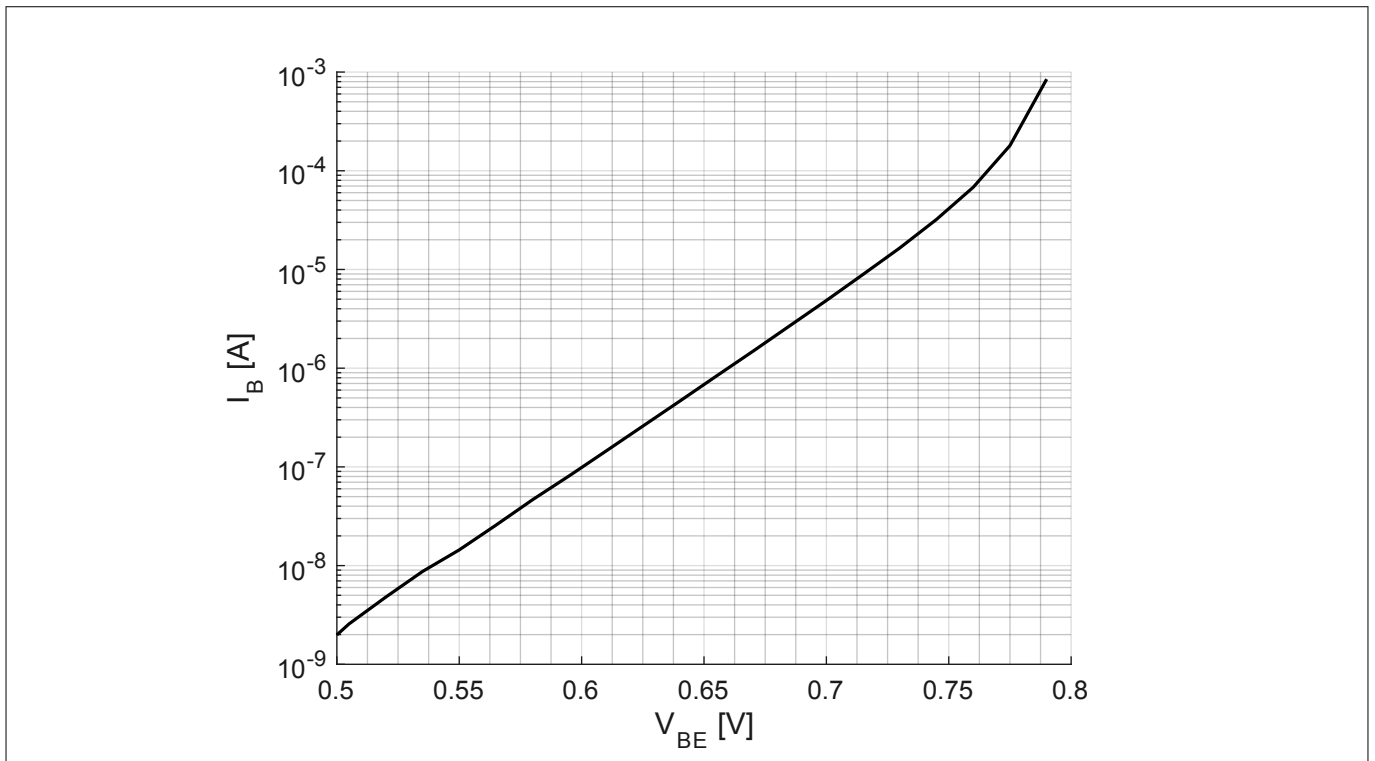
**Figure 4** Current gain  $h_{FE} = f(I_C)$ ,  $V_{CE} = 8$  V



**Electrical performance in test fixture**

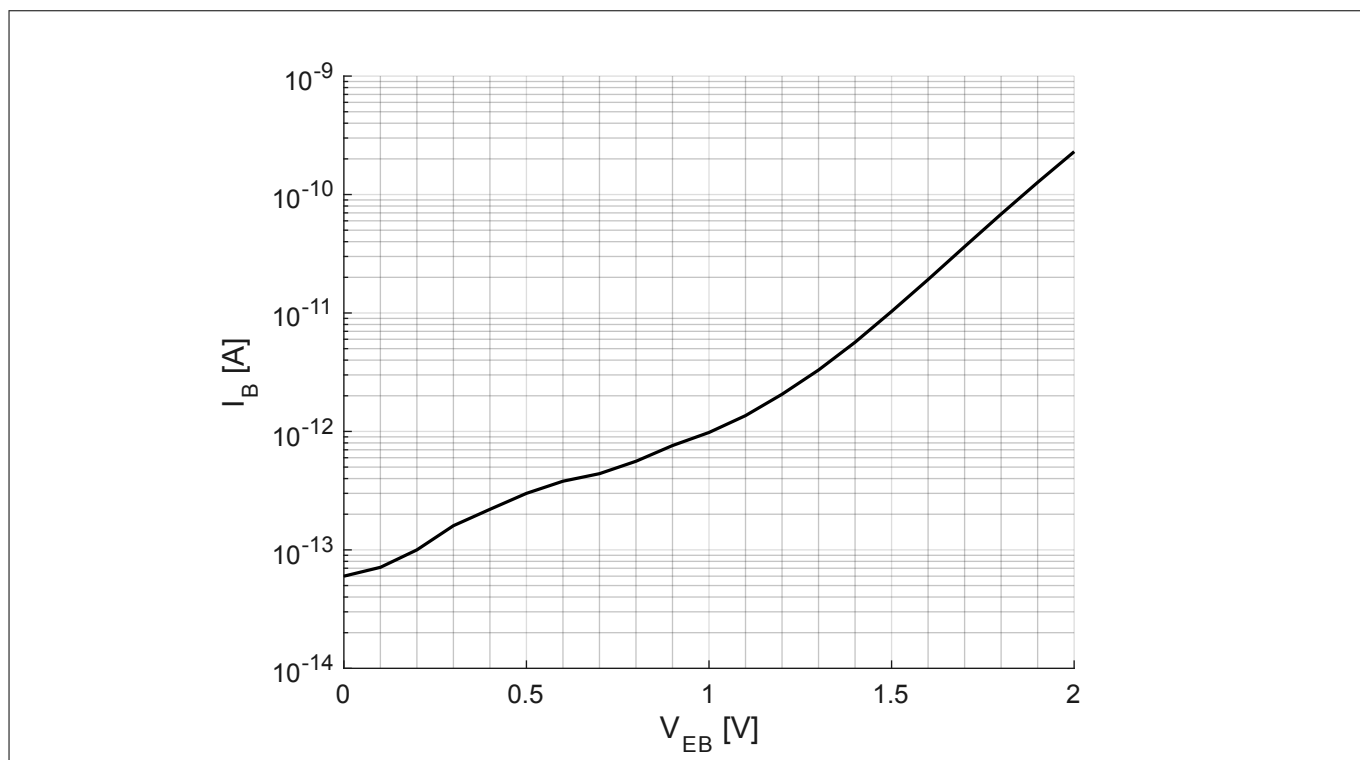


**Figure 5** Collector current  $I_C = f(V_{BE})$ ,  $V_{CE} = 8\text{ V}$



**Figure 6** Base current  $I_B = f(V_{BE})$ ,  $V_{CE} = 8\text{ V}$

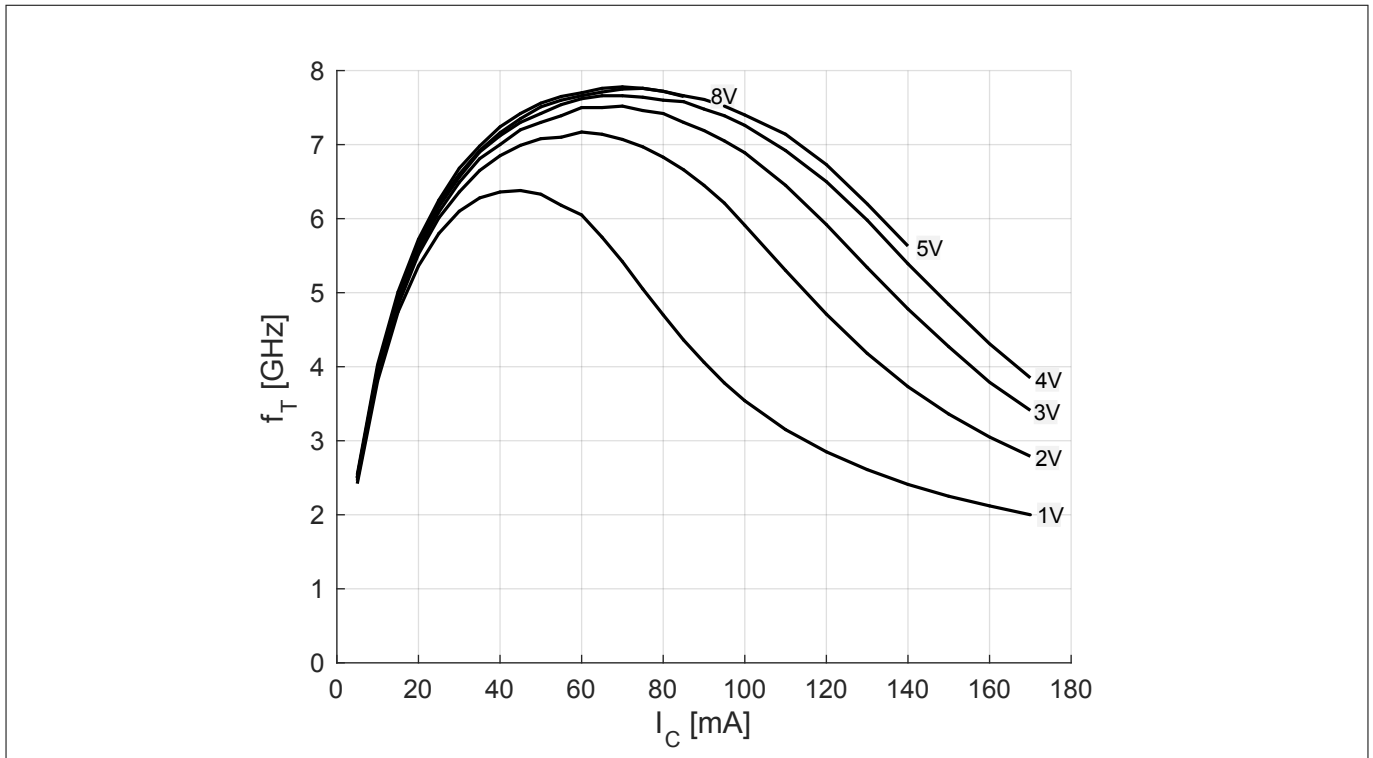
**Electrical performance in test fixture**



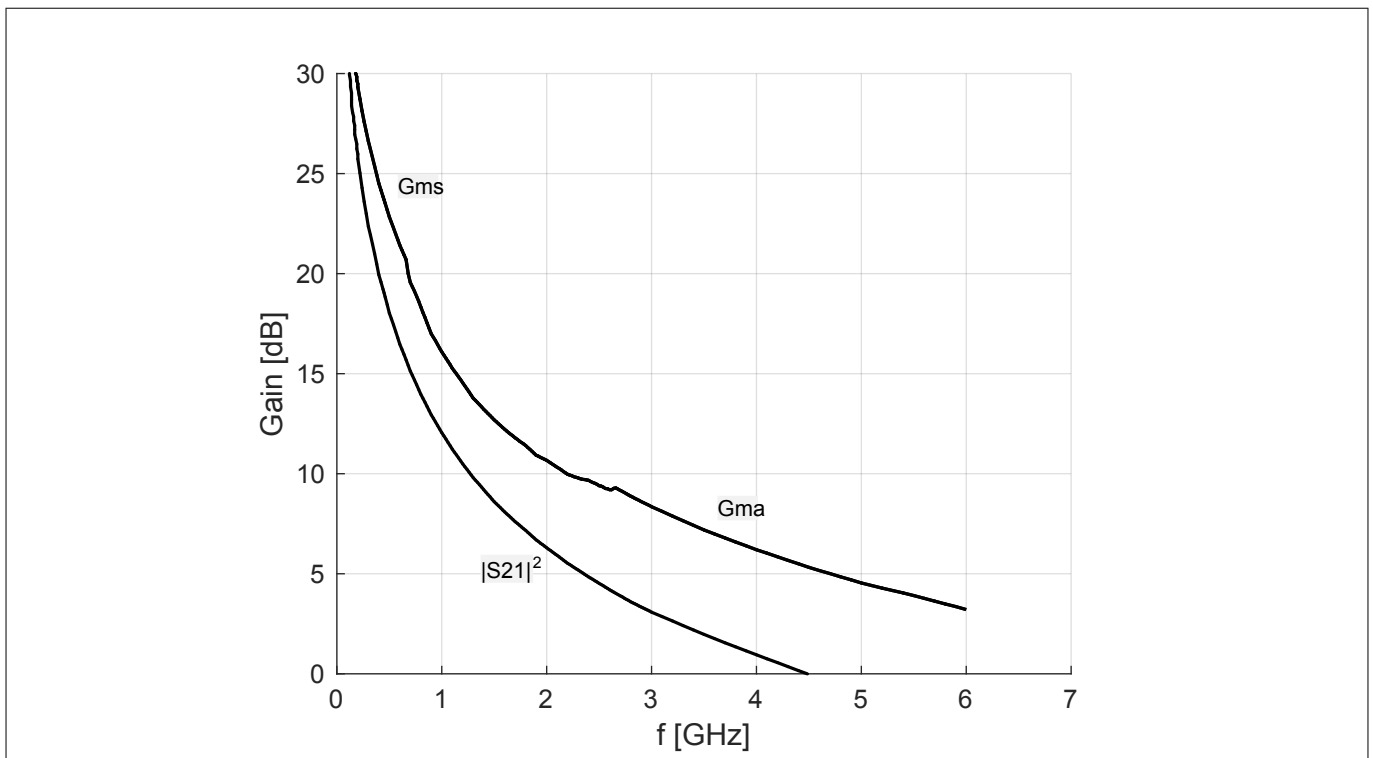
**Figure 7** Base/emitter leakage current  $I_B = f(V_{EB})$ ,  $V_{CE} = 8$  V

Note: Regard absolute maximum ratings for  $I_C$ ,  $V_{CE}$  and  $P_{tot}$  (see [Table 1](#))

### 3.4 Characteristic AC diagrams

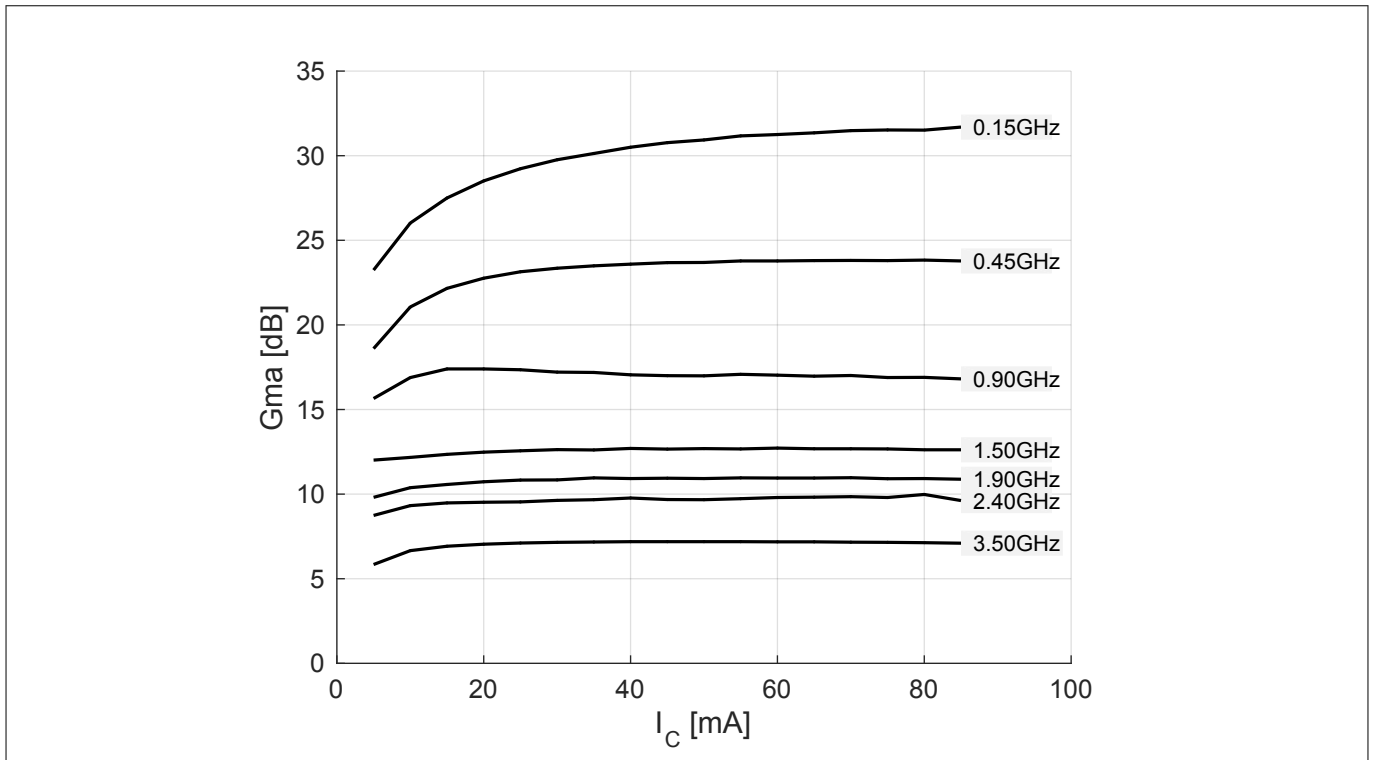


**Figure 8** Transition frequency  $f_T = f(I_C)$ ,  $V_{CE} = \text{parameter}$

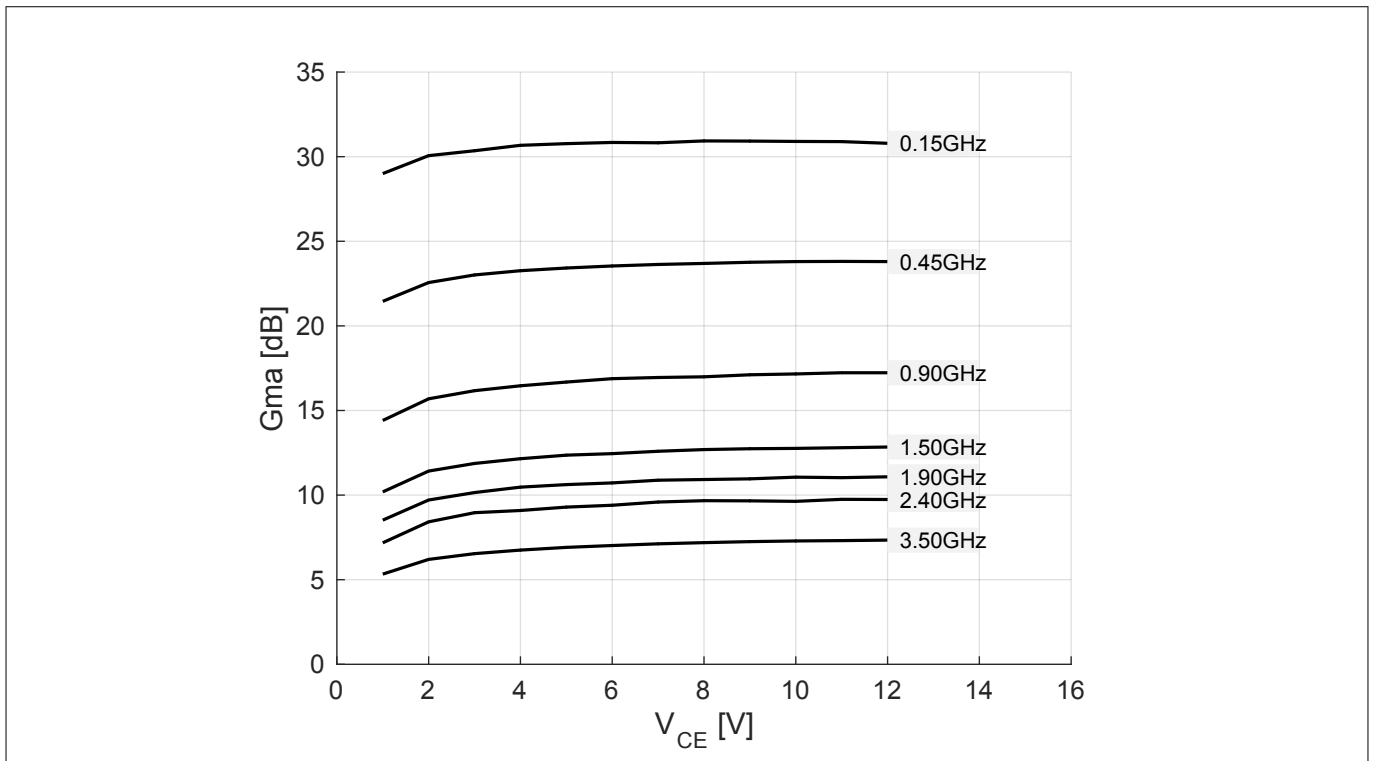


**Figure 9** Gain  $G_{ms}$ ,  $G_{ma}$ ,  $|S_{21}|^2 = f(f)$ ,  $I_C = 50 \text{ mA}$ ,  $V_{CE} = 8 \text{ V}$

**Electrical performance in test fixture**

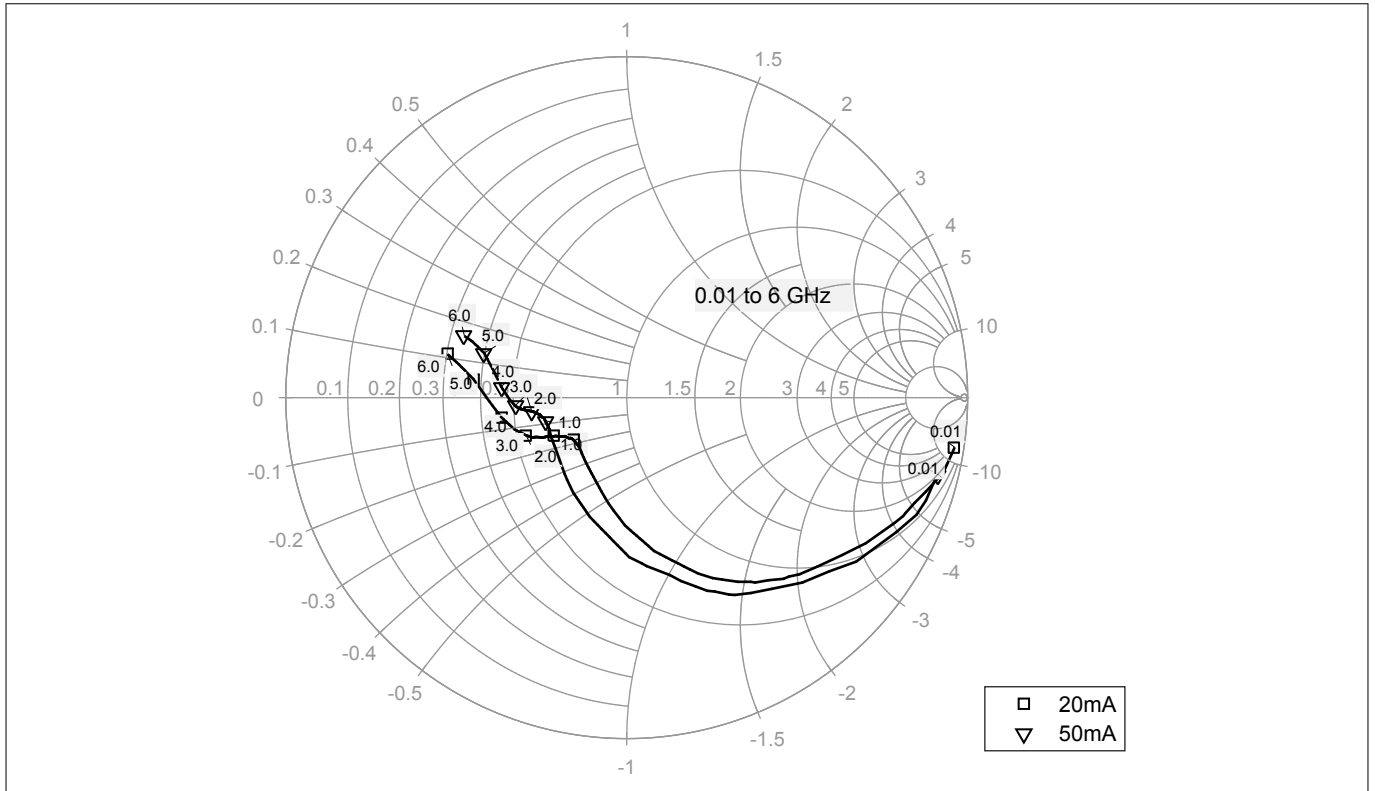


**Figure 10** Maximum power gain  $G_{max} = f(I_C)$ ,  $V_{CE} = 8\text{ V}$ ,  $f = \text{parameter}$

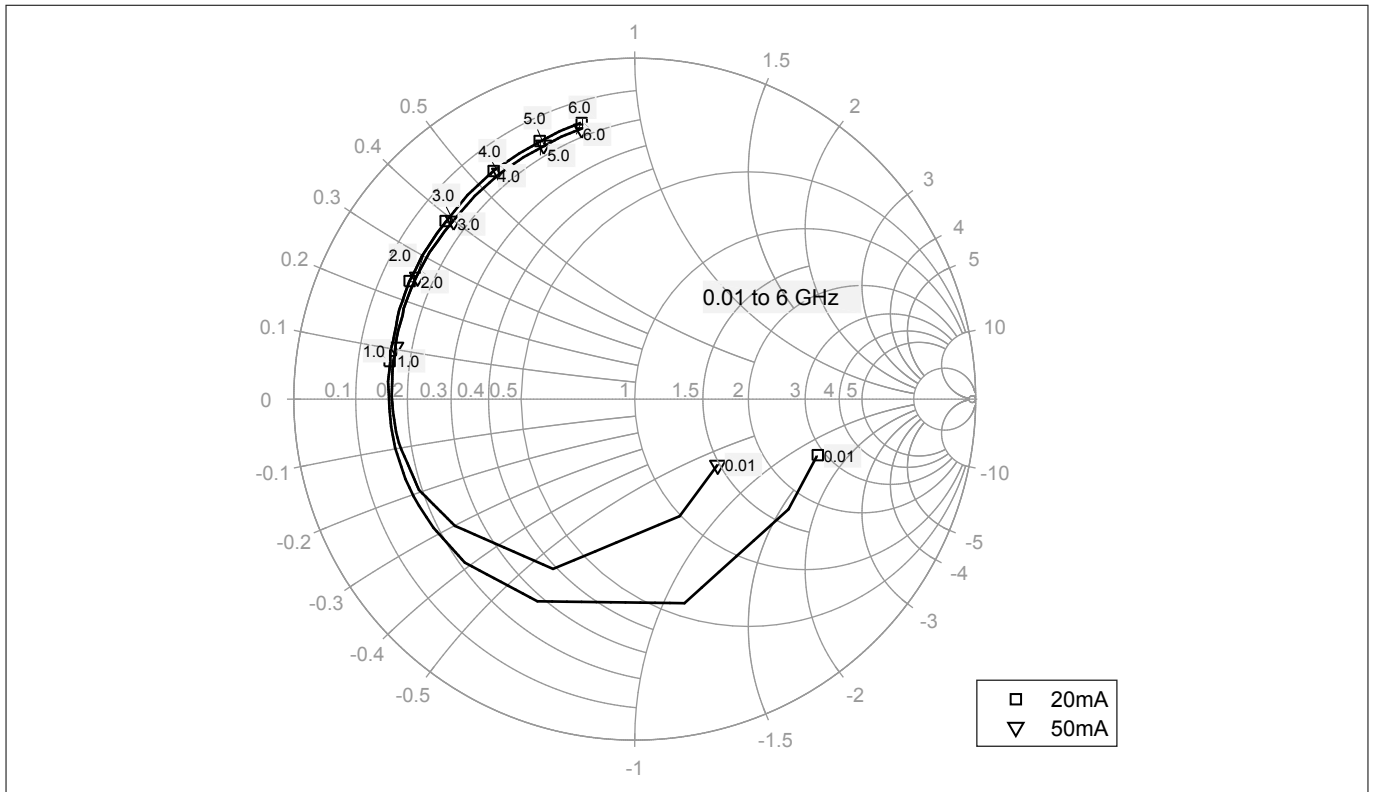


**Figure 11** Maximum power gain  $G_{max} = f(V_{CE})$ ,  $I_C = 50\text{ mA}$ ,  $f = \text{parameter}$

**Electrical performance in test fixture**

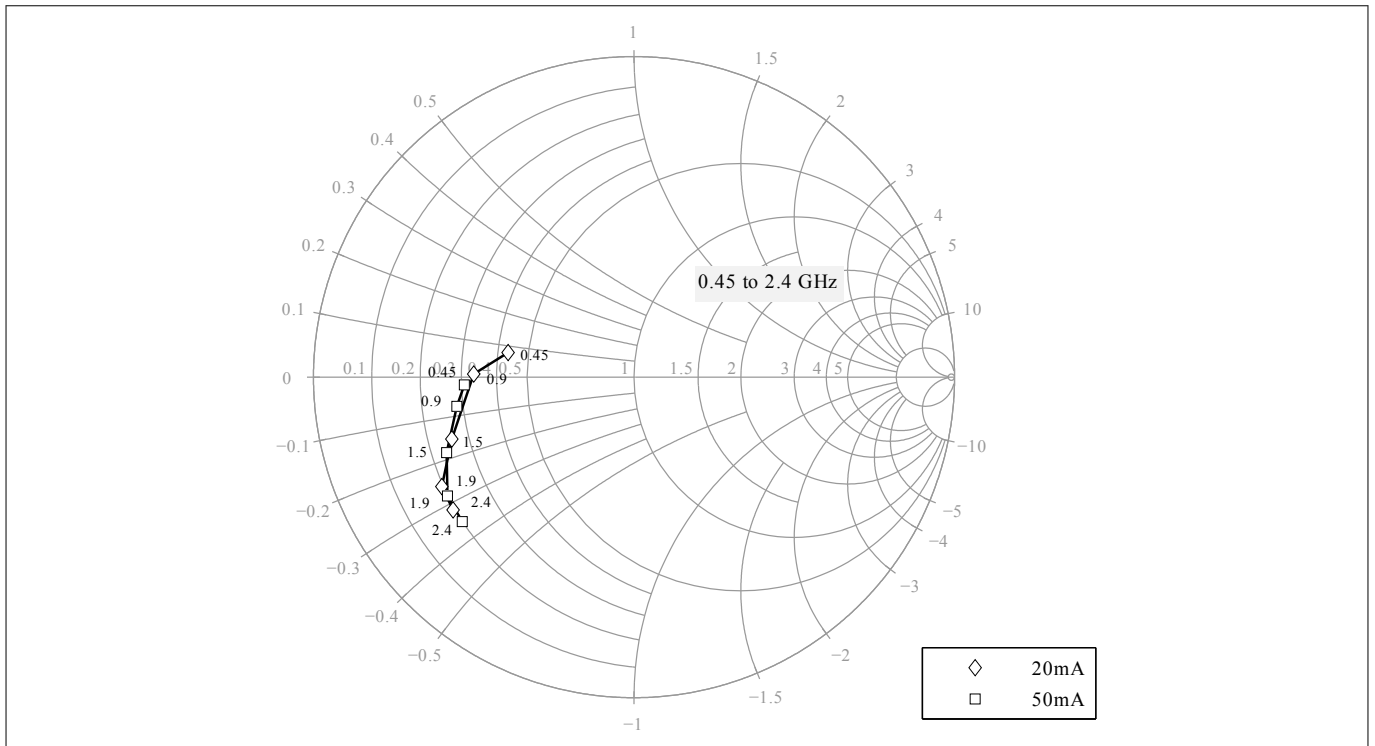


**Figure 12 Output reflection coefficient  $S_{22} = f(f)$  at  $V_{CE} = 8\text{ V}$ ,  $I_C = 20, 50\text{ mA}$**

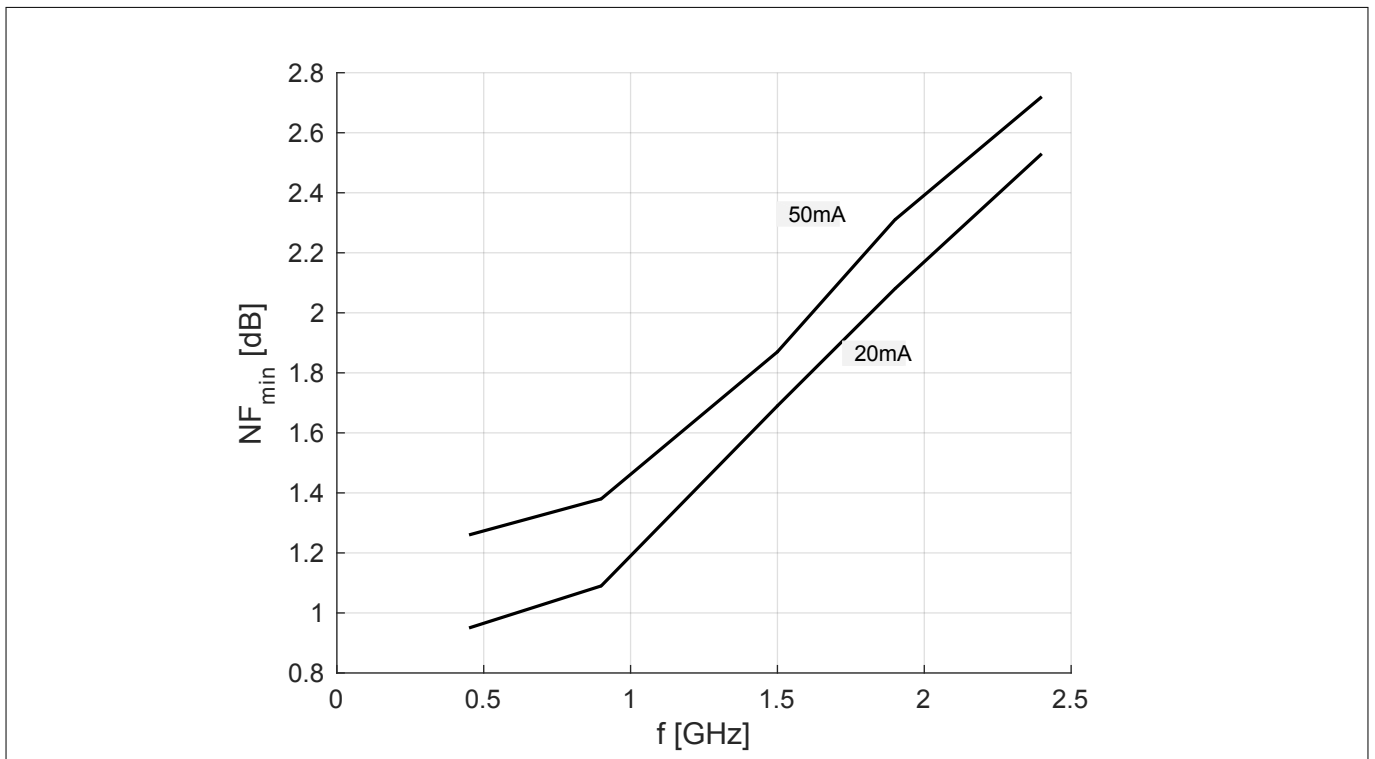


**Figure 13 Input reflection coefficient  $S_{11} = f(f)$  at  $V_{CE} = 8\text{ V}$ ,  $I_C = 20, 50\text{ mA}$**

**Electrical performance in test fixture**

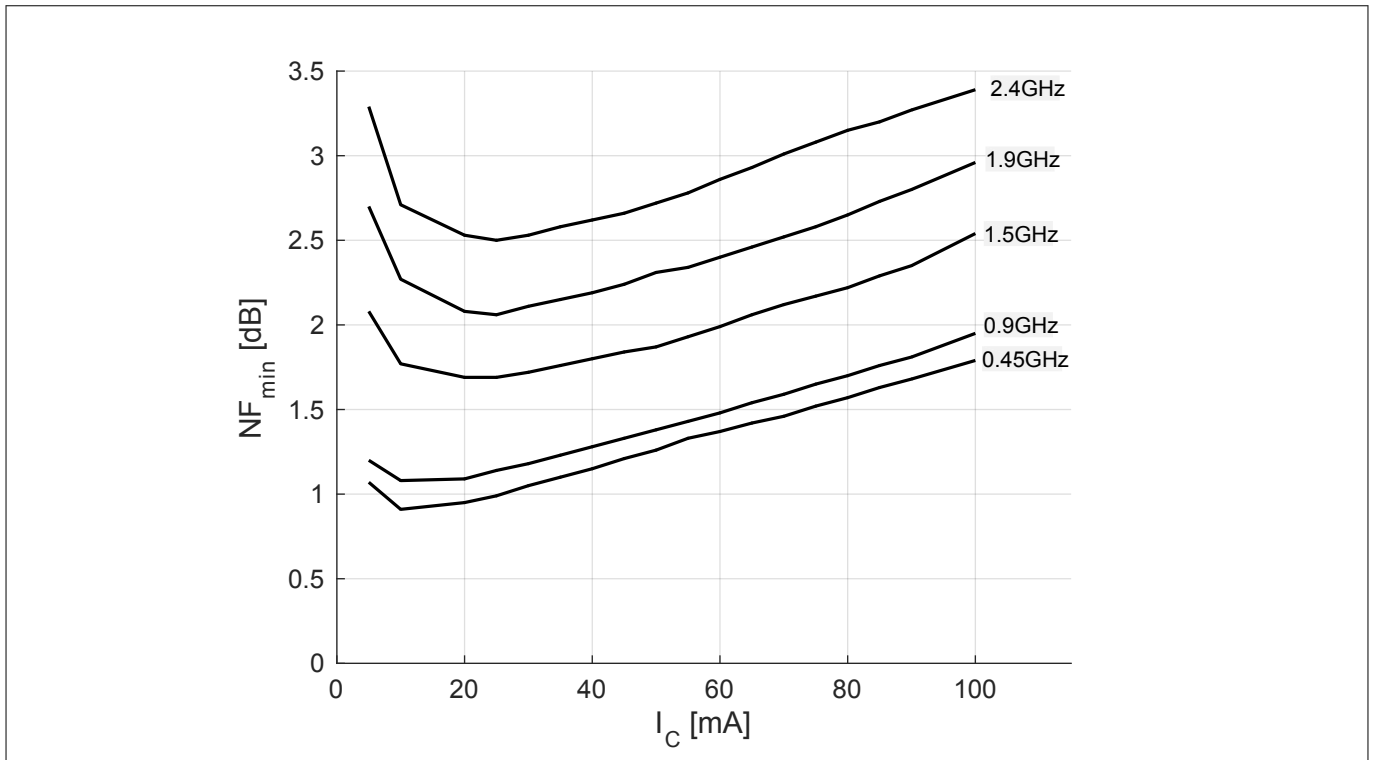


**Figure 14** Source impedance for minimum noise figure  $Z_{Sopt} = f(f)$ ,  $V_{CE} = 8\text{ V}$ ,  $I_C = 20, 50\text{ mA}$

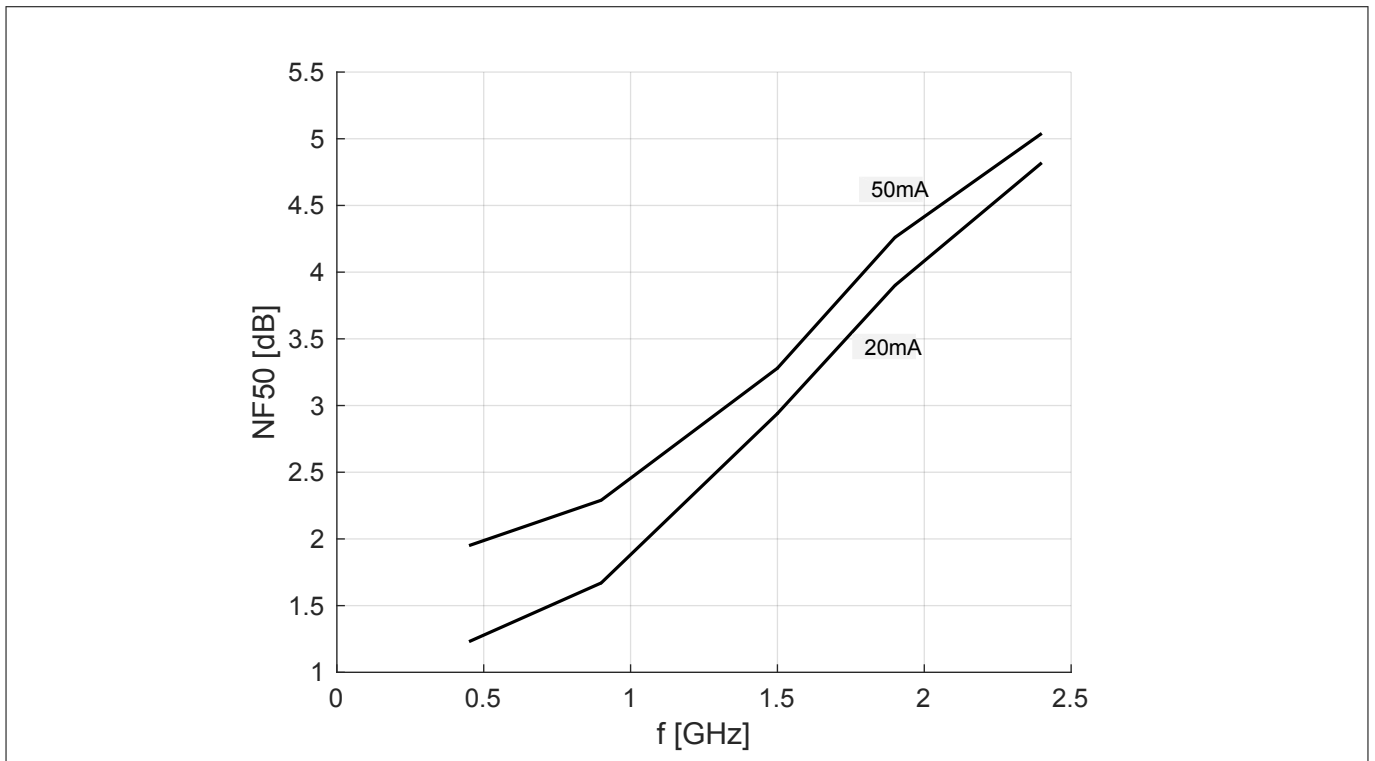


**Figure 15** Noise figure  $N_{Fmin} = f(f)$ ,  $V_{CE} = 8\text{ V}$ ,  $I_C = 20, 50\text{ mA}$ ,  $Z_S = Z_{Sopt}$

**Electrical performance in test fixture**

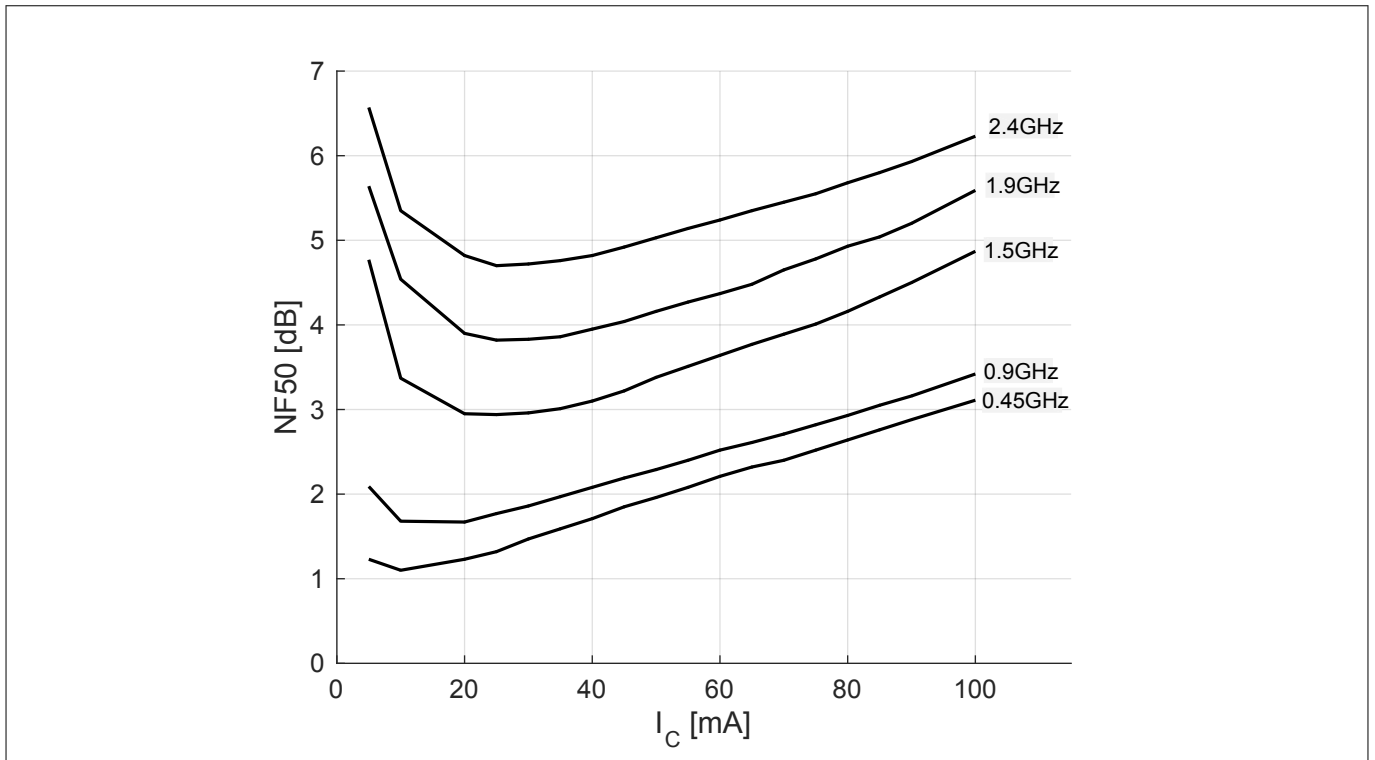


**Figure 16** Noise figure  $NF_{min} = f(I_C)$ ,  $V_{CE} = 8\text{ V}$ ,  $f = \text{parameter}$ ,  $Z_S = Z_{Sopt}$



**Figure 17** Noise figure  $NF_{50} = f(f)$ ,  $V_{CE} = 8\text{ V}$ ,  $I_C = 20, 50\text{ mA}$ ,  $Z_S = 50\ \Omega$

**Electrical performance in test fixture**

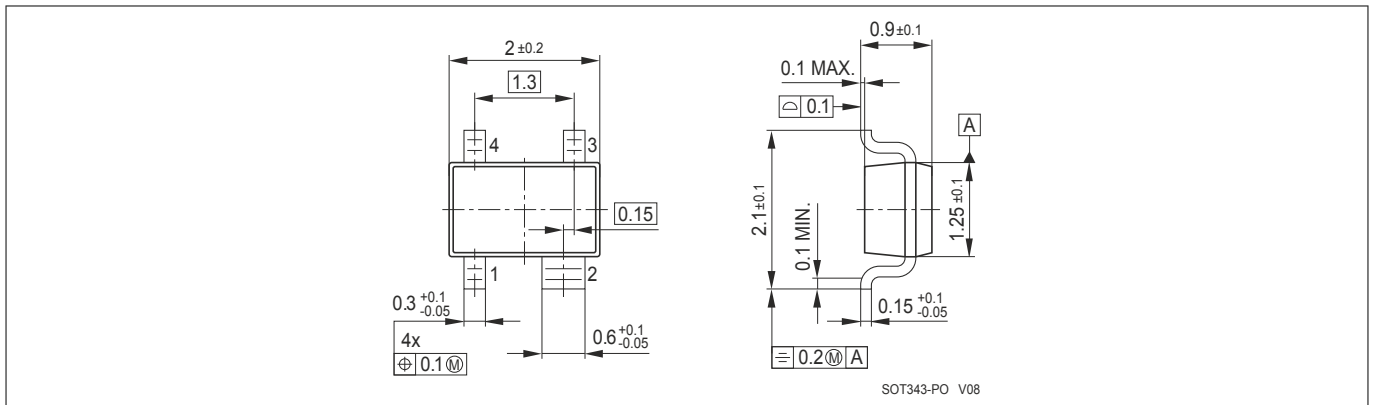


**Figure 18** Noise figure  $NF_{50} = f(I_C)$ ,  $V_{CE} = 8\text{ V}$ ,  $f = \text{parameter}$ ,  $Z_S = 50\ \Omega$

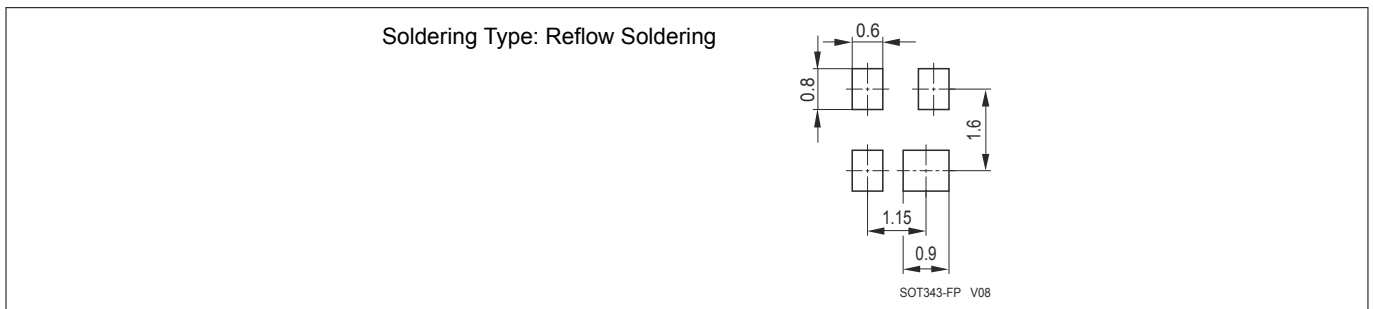
Note: The curves shown in this chapter **Characteristic AC diagrams** have been generated using typical devices but shall not be understood as a guarantee that all devices have identical characteristic curves.  $T_A = 25\text{ }^\circ\text{C}$ .



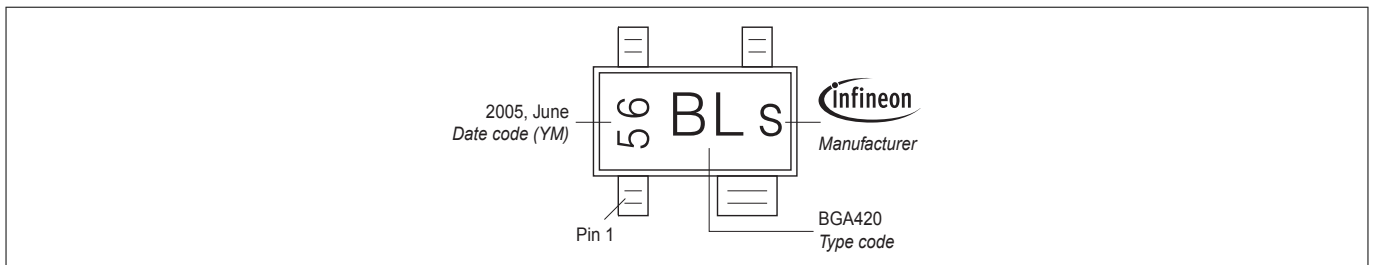
## 4 SOT343 Package



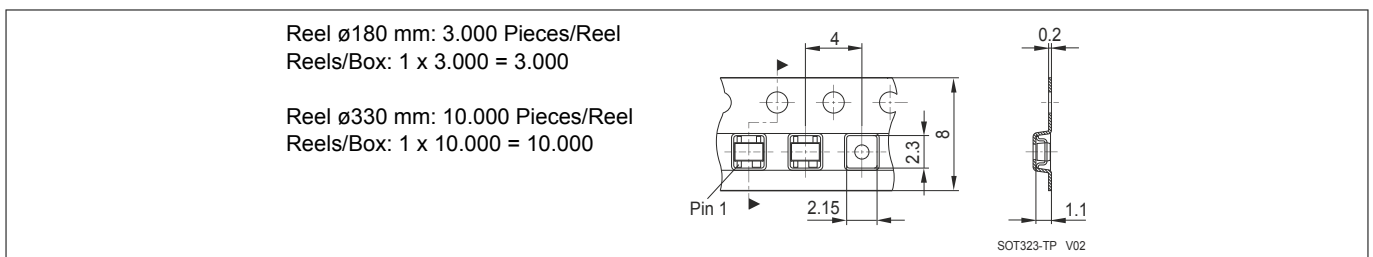
**Figure 19 SOT343 package outline (dimension in mm)**



**Figure 20 SOT343 footprint (dimension in mm)**



**Figure 21 SOT343 marking layout**



**Figure 22 SOT343 standard packing (dimension in mm)**

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**Revision history**

**Revision history**

Major changes since previous revision

Reference	Description
Revision History: 2016-12-21, Revision 0.9	
rev 0.9	Preliminary datasheet

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