BFP720FESD

SiGe:C NPN RF bipolar transistor

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Product description

The BFP720FESD is a wideband RF heterojunction bipolar transistor (HBT) with an integrated ESD protection.

Feature list

- Unique combination of high end RF performance and robustness: 21 dBm maximum RF input power, 2 kV HBM ESD hardness
- High transition frequency f_T = 45 GHz to enable low noise figure at high frequencies: NF_{min} = 0.8 dB at 5.5 GHz, 3 V, 5 mA
- High gain G_{ms} = 22 dB at 5.5 GHz, 3 V, 15 mA
- OIP_3 = 21 dBm at 5.5 GHz, 3 V, 15 mA

Product validation

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

Potential applications

- Wireless communications: WLAN, WiMax and UWB
- Satellite communication systems: GNSS navigation systems (GPS, GLONASS, BeiDou, Galileo), satellite radio (SDARs, DAB) and C-band LNB
- Multimedia applications such as portable TV, CATV and FM radio
- ISM applications like RKE, AMR and Zigbee, as well as for emerging wireless applications

Device information

Table 1   **Part information**

Product name / Ordering code	Package	Pin configuration				Marking	Pieces / Reel
BFP720FESD / BFP720FESDH6327XTSA1	TSFP-4-1	1 = B	2 = E	3 = C	4 = E	T3s	3000

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

Table of contents

1 Absolute maximum ratings

Table 2 Absolute maximum ratings at T_A = 25 °C (unless otherwise specified)

Parameter	Symbol	Values		Unit	Note or test condition
		Min.	Max.		
Collector emitter voltage	V_{CEO}	–	4.2	V	Open base
			3.7		T_A = -55 °C, open base
Collector base voltage [1]	V_{CBO}		4.9		Open emitter
			4.4		T_A = -55 °C, open emitter
Collector emitter voltage [2]	V_{CES}		4.2		E-B short circuited
			3.7		T_A = -55 °C, E-B short circuited
Base current	I_B	-10	3	mA	–
Collector current	I_C	–	30		
RF input power	P_{RFin}	–	21	dBm	
ESD stress pulse	V_{ESD}	-2	2	kV	HBM, all pins, acc. to JESD22-A114
Total power dissipation [3]	P_{tot}	–	100	mW	$T_S \leq 109$ °C
Junction temperature	T_J	–	150	°C	–
Storage temperature	T_{Stg}	-55			

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

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1   V_{CBO} is similar to V_{CEO} due to design.
2   V_{CES} is identical to V_{CEO} due to design.
3   T_S is the soldering point temperature. T_S is measured on the emitter lead at the soldering point of the PCB.

2 Thermal characteristics

Table 3 **Thermal resistance**

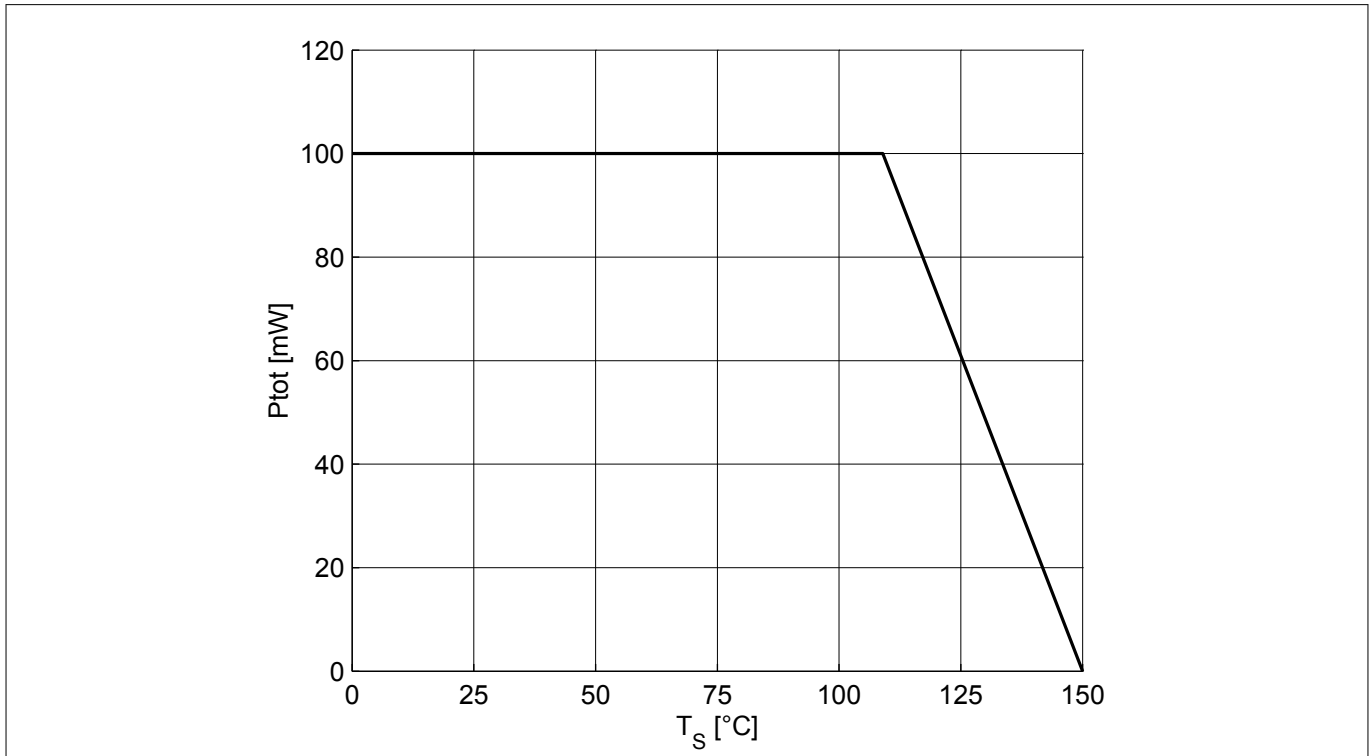| Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Junction - soldering point	R_{thJS}	–	405	–	K/W	–

Figure 1 **Total power dissipation $P_{tot} = f(T_S)$**

3 Electrical characteristics

3.1 DC characteristics

Table 4 DC characteristics at T_A = 25 °C

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Collector emitter breakdown voltage	$V_{(BR)CEO}$	4.2	4.7	–	V	I_C = 1 mA, I_B = 0, open base
Collector emitter leakage current	I_{CES}	–	–	400 [1]	nA	V_{CE} = 2 V, V_{BE} = 0, E-B short circuited
Collector base leakage current	I_{CBO}			400 [1]		V_{CB} = 2 V, I_E = 0, open emitter
Emitter base leakage current	I_{EBO}			10 [1]	µA	V_{EB} = 0.5 V, I_C = 0, open collector
DC current gain	h_{FE}	160	250	400		V_{CE} = 3 V, I_C = 15 mA, pulse measured

3.2 General AC characteristics

Table 5 General AC characteristics at T_A = 25 °C

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Transition frequency	f_T	–	45	–	GHz	V_{CE} = 3 V, I_C = 15 mA, f = 1 GHz
Collector base capacitance	C_{CB}		0.05		pF	V_{CB} = 3 V, V_{BE} = 0, f = 1 MHz, emitter grounded
Collector emitter capacitance	C_{CE}		0.35			V_{CE} = 3 V, V_{BE} = 0, f = 1 MHz, base grounded
Emitter base capacitance	C_{EB}		0.4			V_{EB} = 0.4 V, V_{CB} = 0, f = 1 MHz, collector grounded

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1 Maximum values not limited by the device but by the short cycle time of the 100% test.

3.3 Frequency dependent AC characteristics

Measurement setup is a test fixture with Bias-T's in a 50 Ω system, T_A = 25 °C.

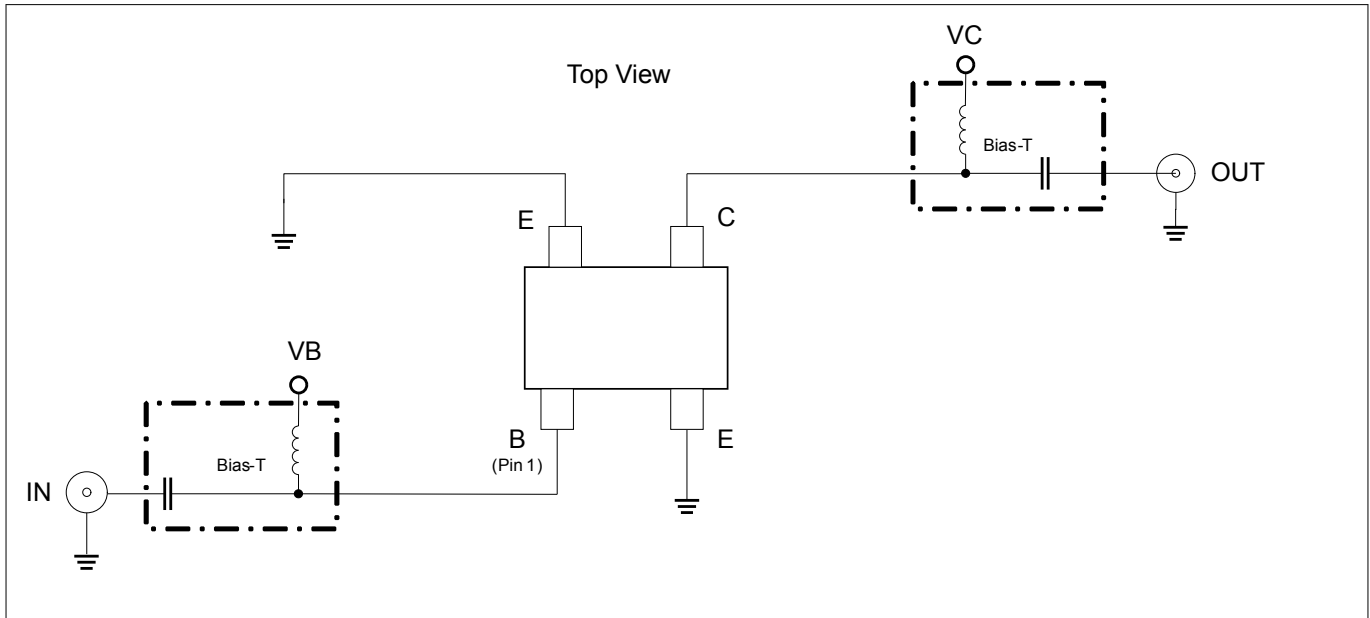**Figure 2**　　**Testing circuit**

Table 6　　**AC characteristics, V_{CE} = 3 V, f = 150 MHz**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $|S_{21}|^2$	– 	38.5 30.5	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.5 29	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	21.5 6	– 	dBm	$Z_S = Z_L$ = 50 Ω I_C = 15 mA

Electrical characteristics

Table 7   AC characteristics, V_{CE} = 3 V, f = 450 MHz

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $|S_{21}|^2$	– 	33.5 30	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.5 27.5	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	21.5 6	– 	dBm	Z_S = Z_L = 50 Ω I_C = 15 mA

Table 8   AC characteristics, V_{CE} = 3 V, f = 900 MHz

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $|S_{21}|^2$	– 	30.5 28.5	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.55 25.5	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	22 6.5	– 	dBm	Z_S = Z_L = 50 Ω I_C = 15 mA

Table 9   AC characteristics, V_{CE} = 3 V, f = 1.5 GHz

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $|S_{21}|^2$	– 	28 26	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.55 23.5	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	22 7	– 	dBm	Z_S = Z_L = 50 Ω I_C = 15 mA

Electrical characteristics

Table 10   **AC characteristics, V_{CE} = 3 V, f = 1.9 GHz**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $\lvert S_{21}\rvert^2$	– 	27 25	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.55 22.5	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	22 7	– 	dBm	$Z_S = Z_L = 50\ \Omega$ I_C = 15 mA

Table 11   **AC characteristics, V_{CE} = 3 V, f = 2.4 GHz**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $\lvert S_{21}\rvert^2$	– 	26 23.5	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.6 21	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	22 7	– 	dBm	$Z_S = Z_L = 50\ \Omega$ I_C = 15 mA

Table 12   **AC characteristics, V_{CE} = 3 V, f = 3.5 GHz**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $\lvert S_{21}\rvert^2$	– 	24.5 20.5	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.65 19	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	21.5 7	– 	dBm	$Z_S = Z_L = 50\ \Omega$ I_C = 15 mA

Electrical characteristics

Table 13   AC characteristics, V_{CE} = 3 V, f = 5.5 GHz

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ms} $\|S_{21}\|^2$	– 	22 17	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	0.8 16	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	21 7	– 	dBm	$Z_S = Z_L$ = 50 Ω I_C = 15 mA

Table 14   AC characteristics, V_{CE} = 3 V, f = 10 GHz

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	G_{ma} $\|S_{21}\|^2$	– 	15 11	– 	dB	I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}	– 	1.3 10	– 	dB	I_C = 5 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}	– 	20 6	– 	dBm	$Z_S = Z_L$ = 50 Ω I_C = 15 mA

Note: $G_{ms} = |S_{21} / S_{12}|$ *for k < 1;* $G_{ma} = |S_{21} / S_{12}| (k\text{-}(k^2\text{-}1)^{1/2})$ *for k > 1. In order to get the* NF_{min} *values stated in this chapter the test fixture losses have been subtracted from all measured results.* OIP_3 *value depends on termination of all intermodulation frequency components. Termination used for this measurement is 50 Ω from 0.2 MHz to 12 GHz.*

3.4 Characteristic DC diagrams
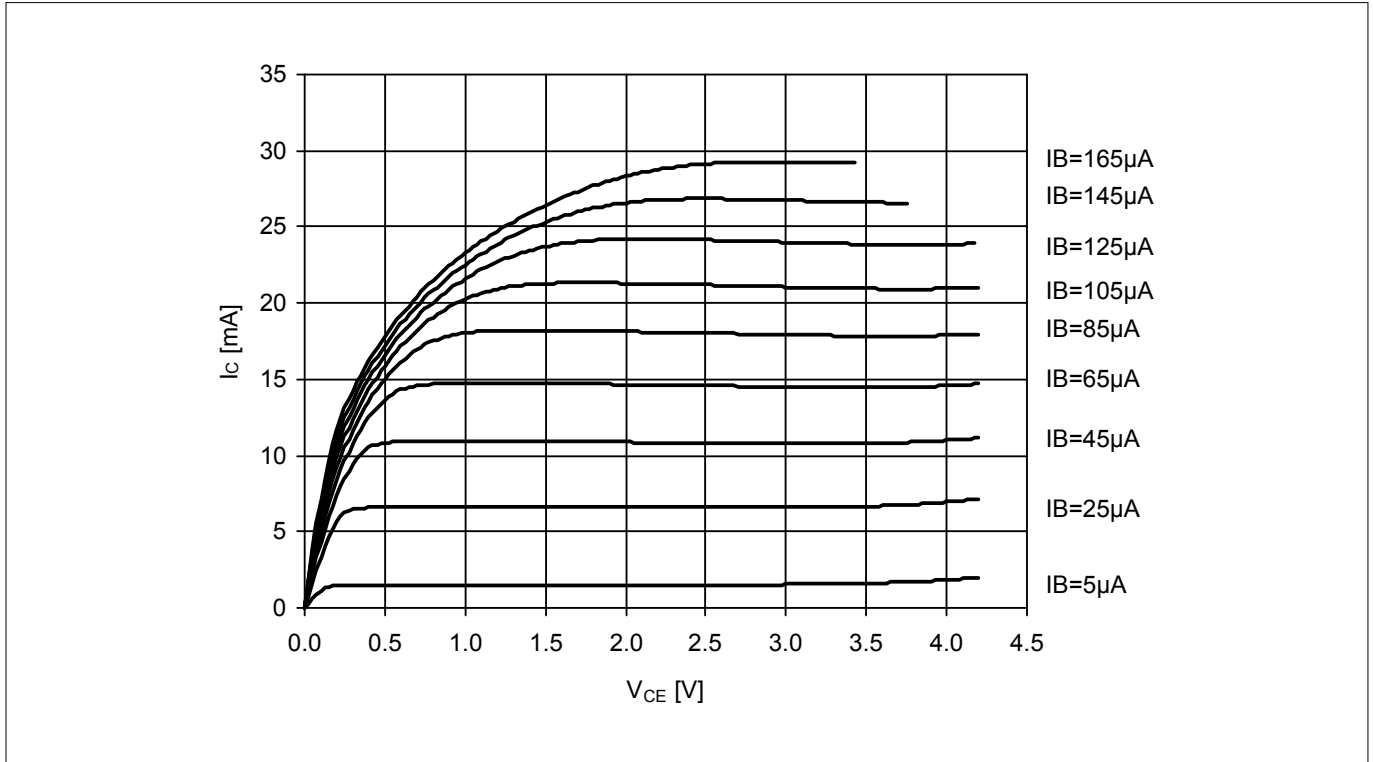
Figure 3 Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, I_B = parameter
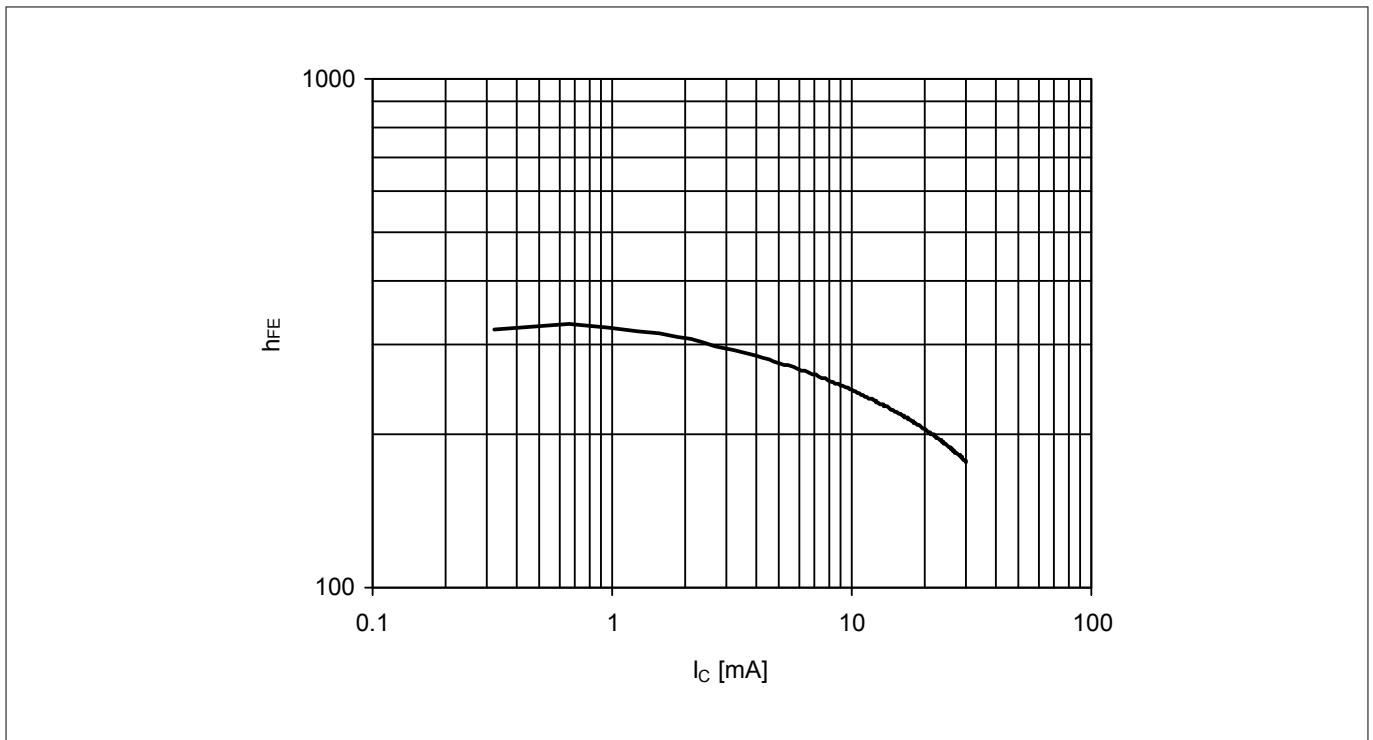
Figure 4 DC current gain $h_{FE} = f(I_C)$, $V_{CE} = 3$ V

Electrical characteristics
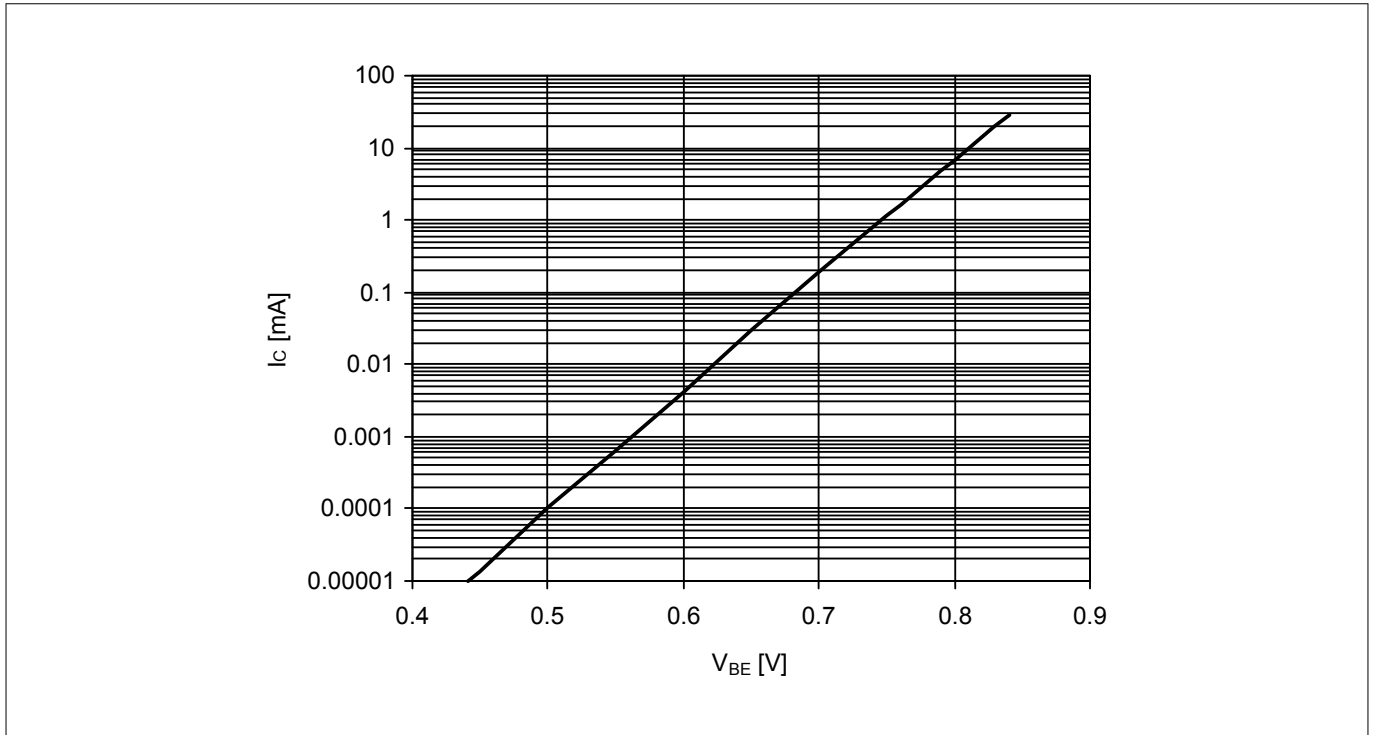
Figure 5   Collector current vs. base emitter voltage $I_C = f(V_{BE})$, $V_{CE} = 2$ V
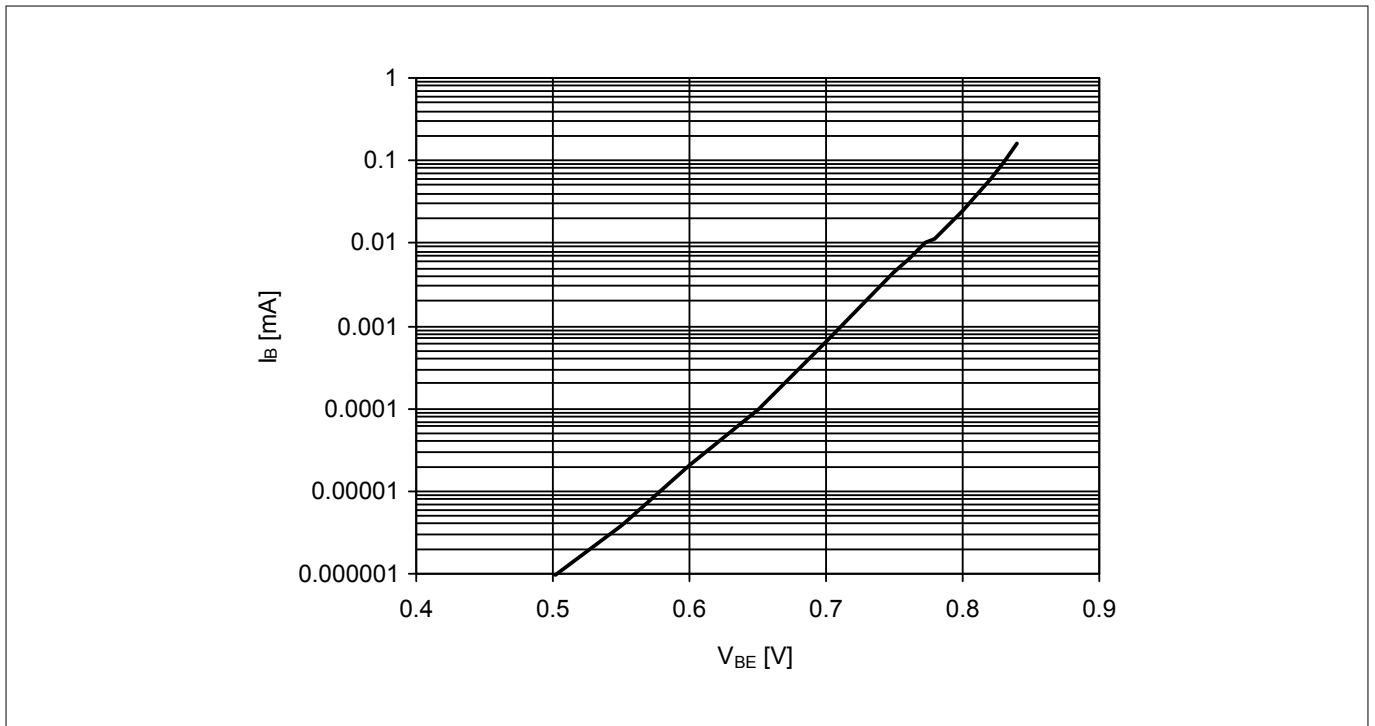
Figure 6   Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 2$ V
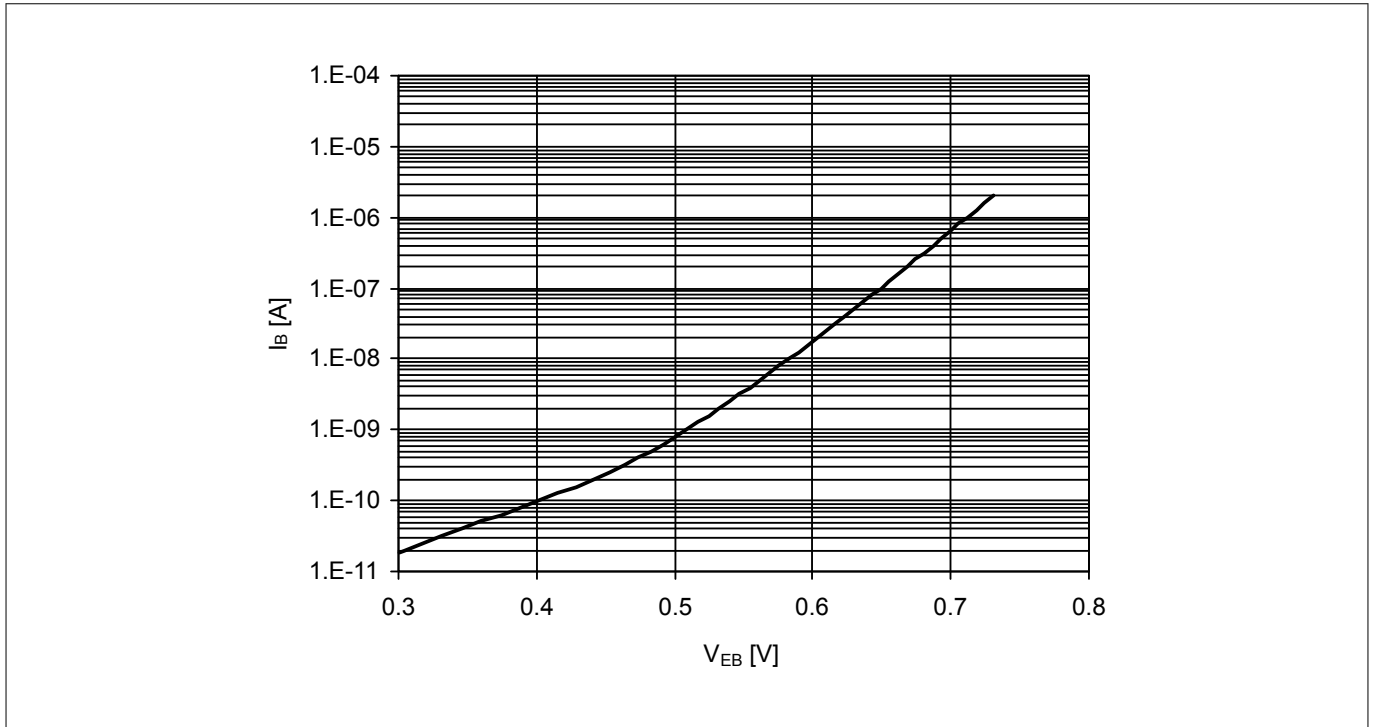
Electrical characteristics

Figure 7   Base current vs. base emitter reverse voltage $I_B = f(V_{EB})$, $V_{CE} = 2$ V

3.5 Characteristic AC diagrams
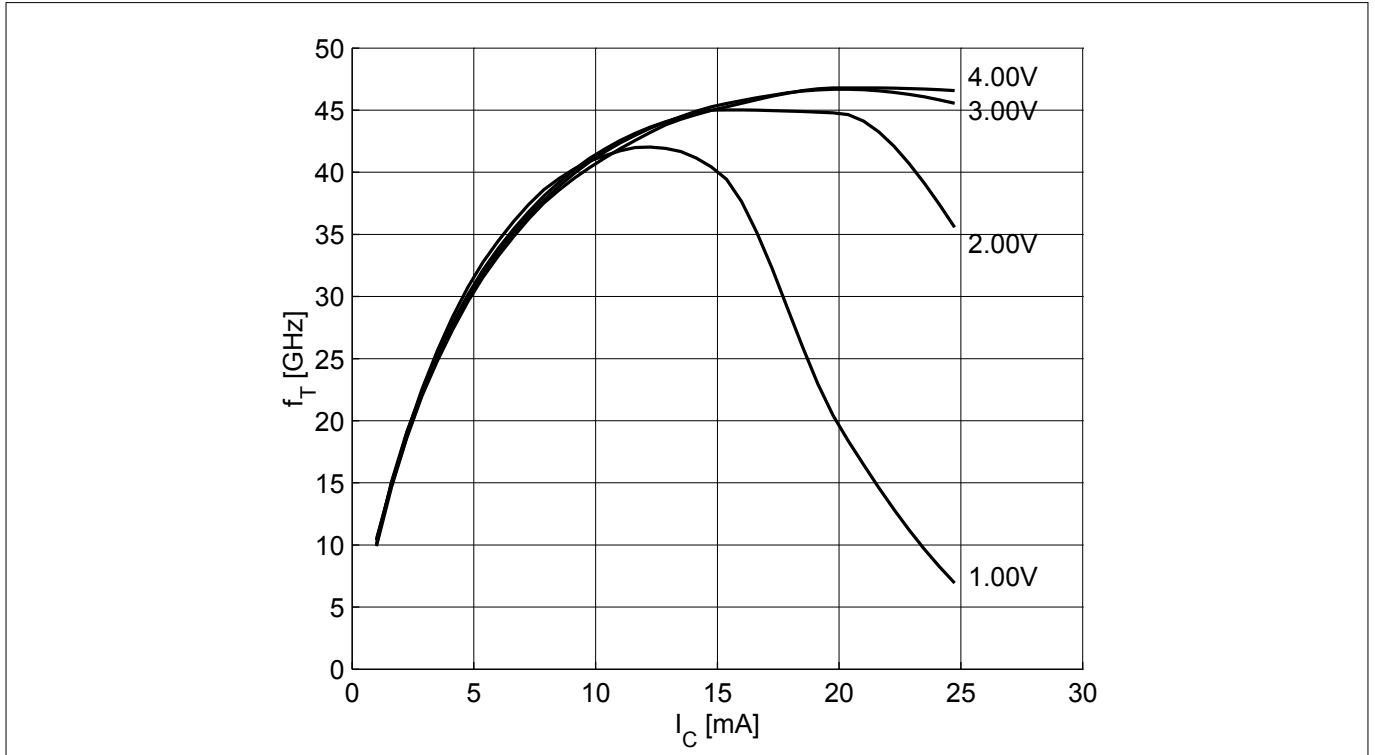
Figure 8   Transition frequency $f_T = f(I_C)$, $f = 1$ GHz, V_{CE} = parameter
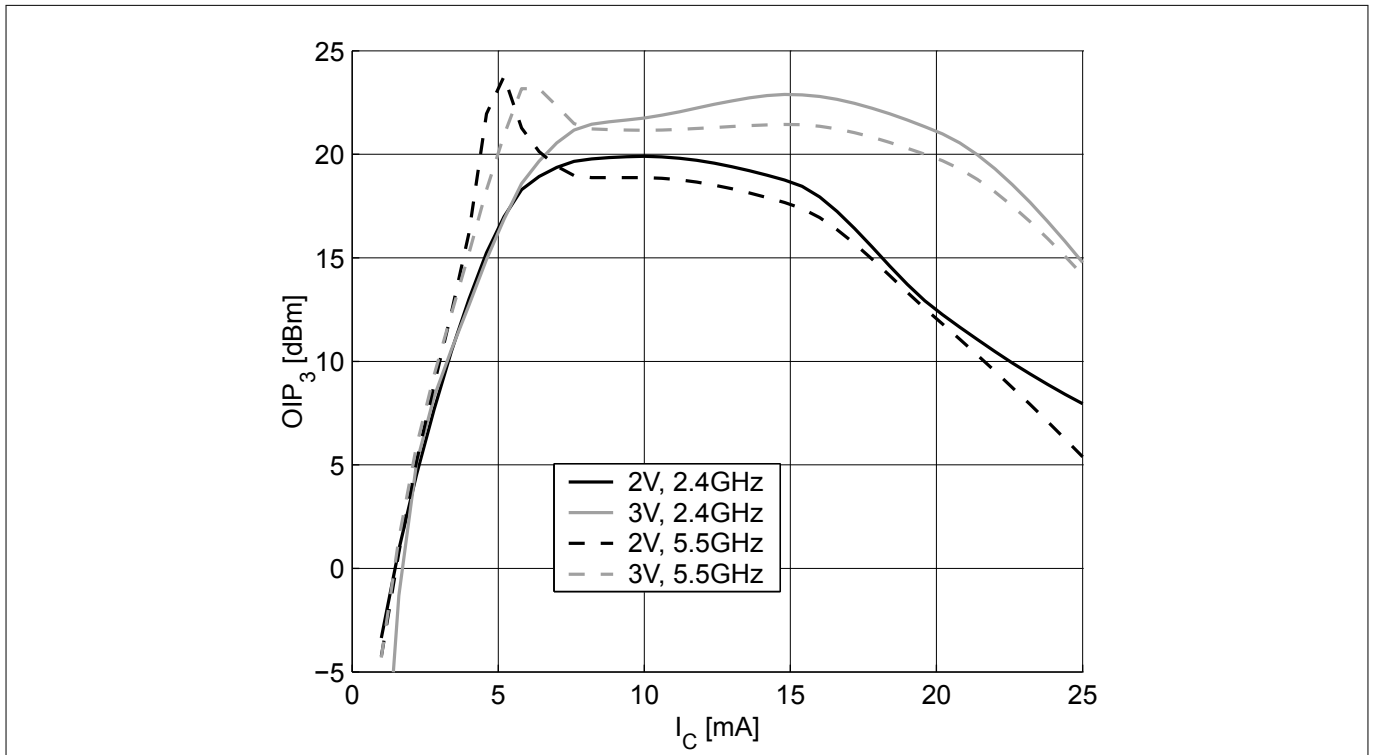
Figure 9   3rd order intercept point $OIP_3 = f(I_C)$, $Z_S = Z_L = 50\ \Omega$, V_{CE}, f = parameters

Electrical characteristics
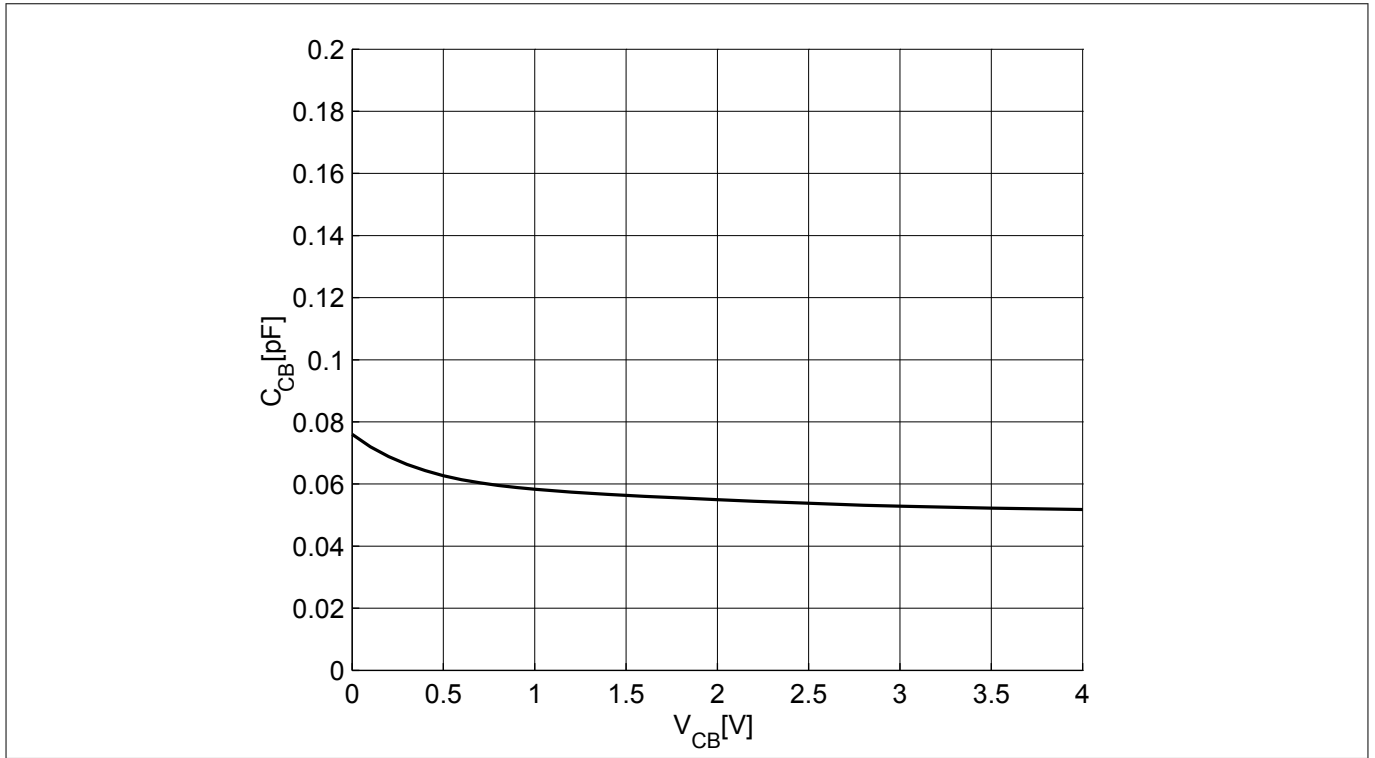
Figure 10   Collector base capacitance C_{CB} = f(V_{CB}), f = 1 MHz
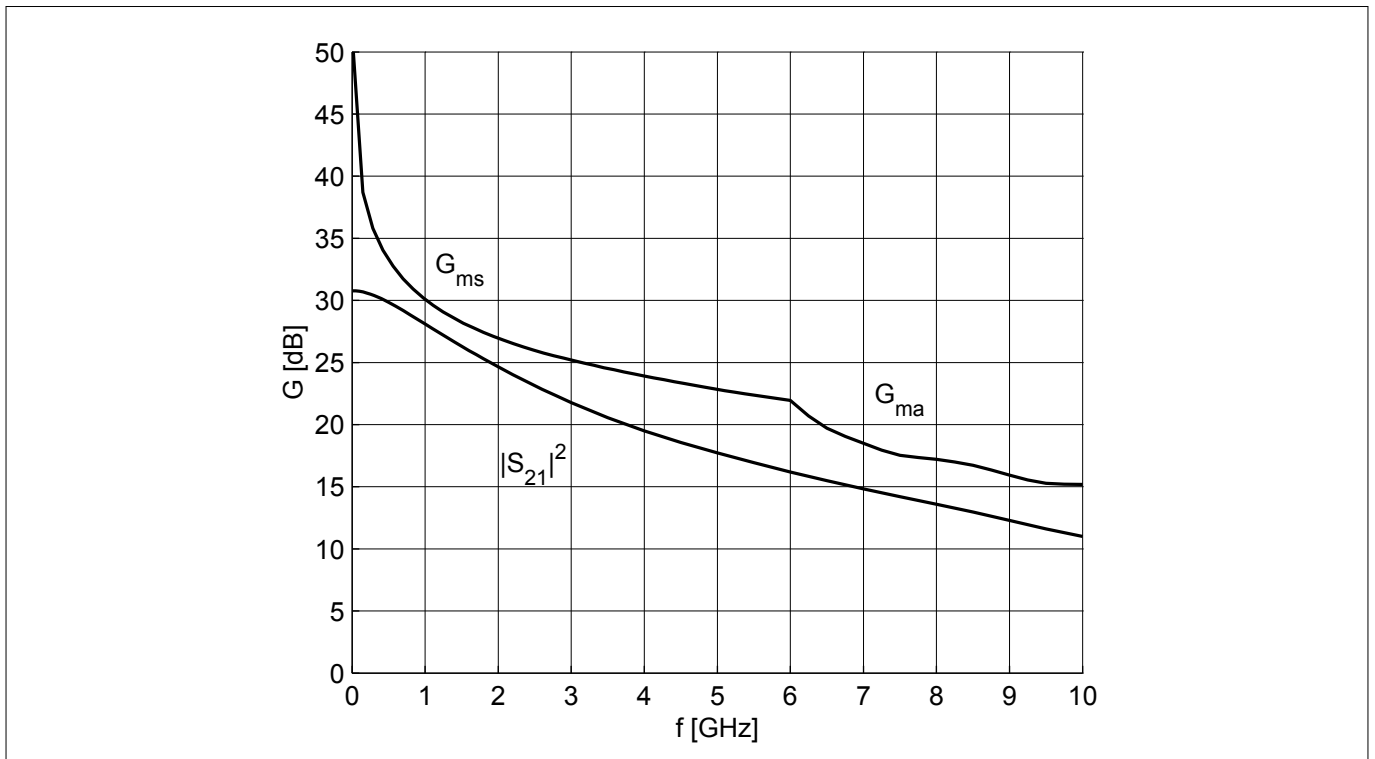
Figure 11   Gain G_{ma}, G_{ms}, |S$_{21}$|^2 = f(f), V_{CE} = 3 V, I_C = 15 mA

Electrical characteristics
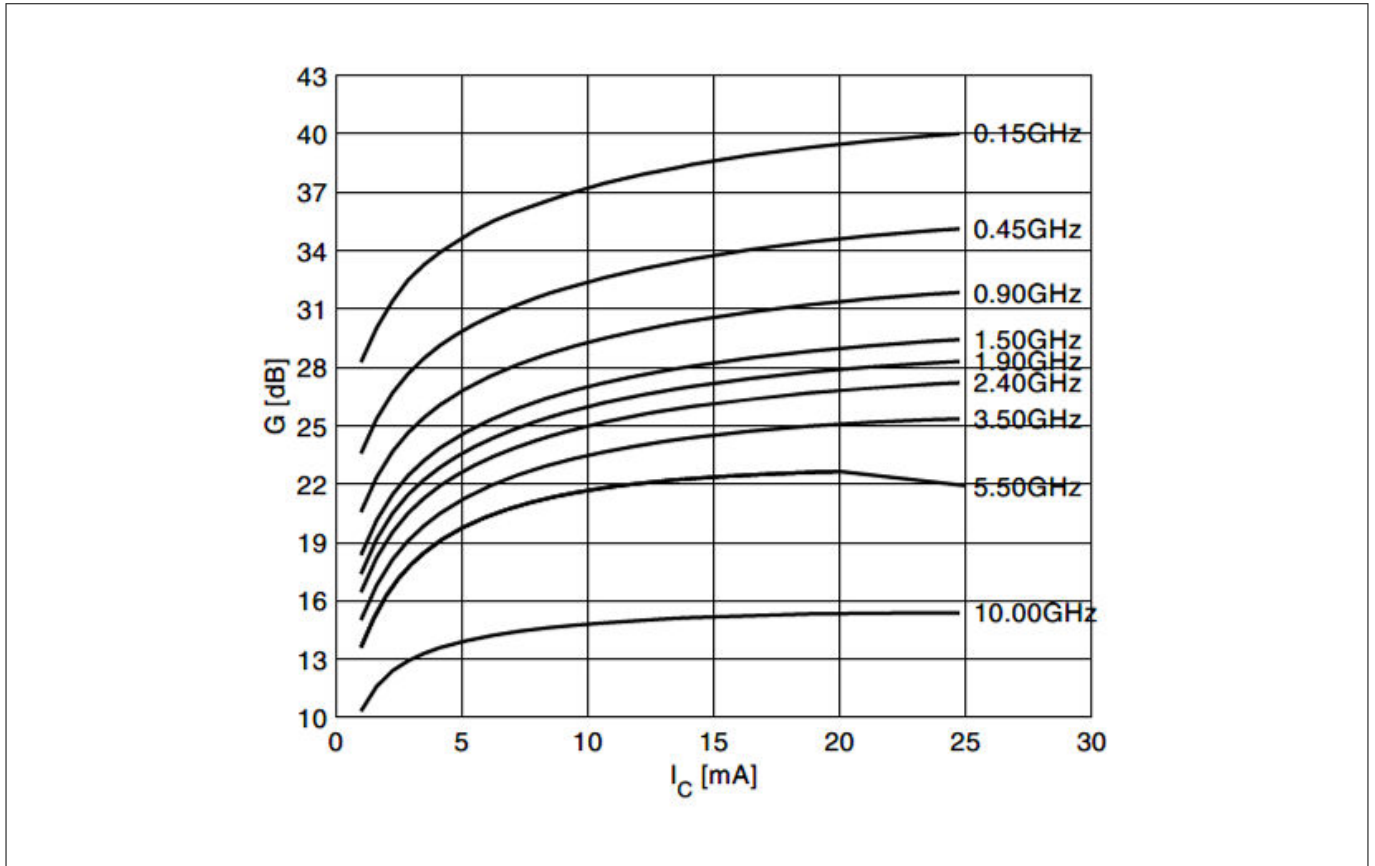
Figure 12   **Maximum power gain $G_{max} = f(I_C)$, $V_{CE} = 3$ V, f = parameter in GHz**
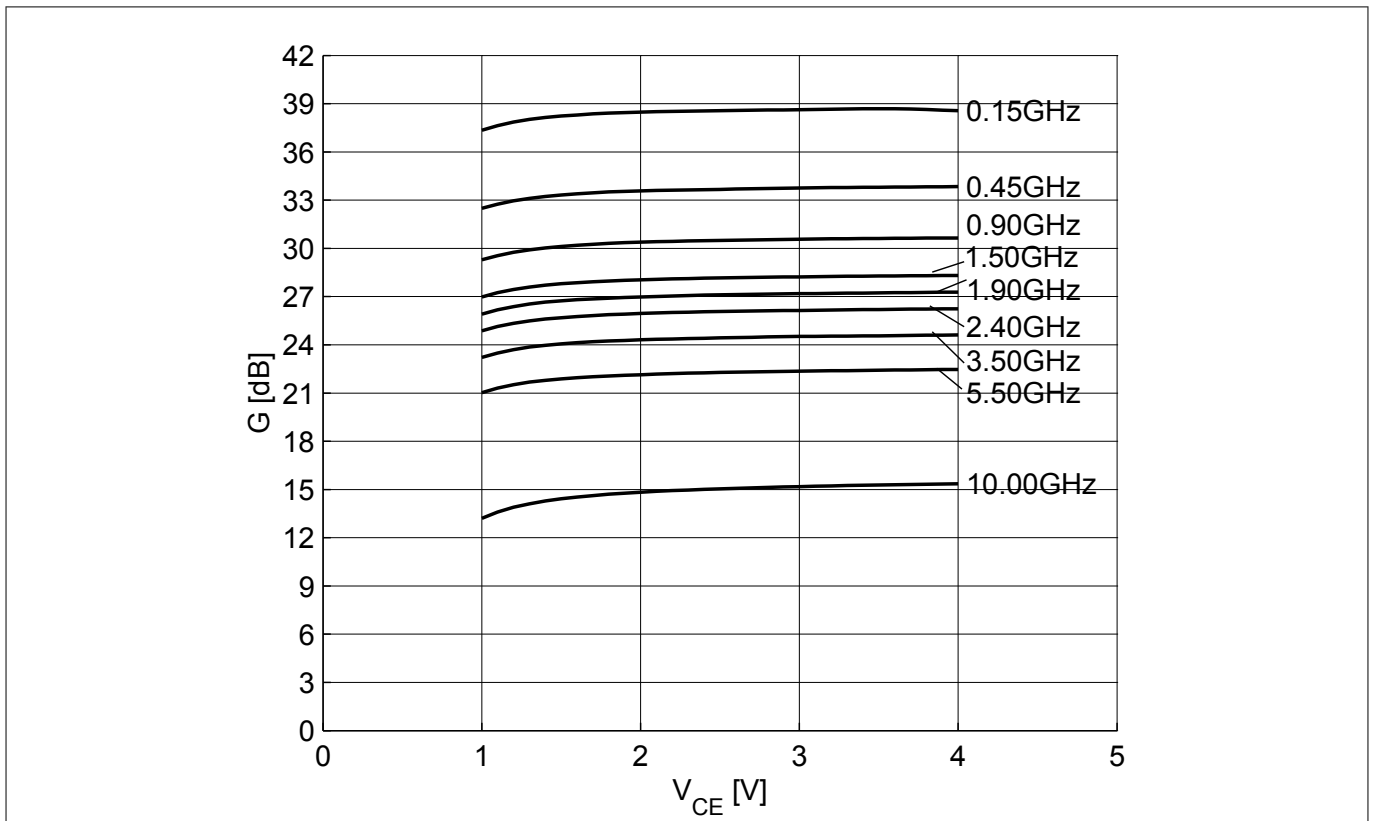
Figure 13   **Maximum power gain $G_{max} = f(V_{CE})$, $I_C = 15$ mA, f = parameter in GHz**

Electrical characteristics
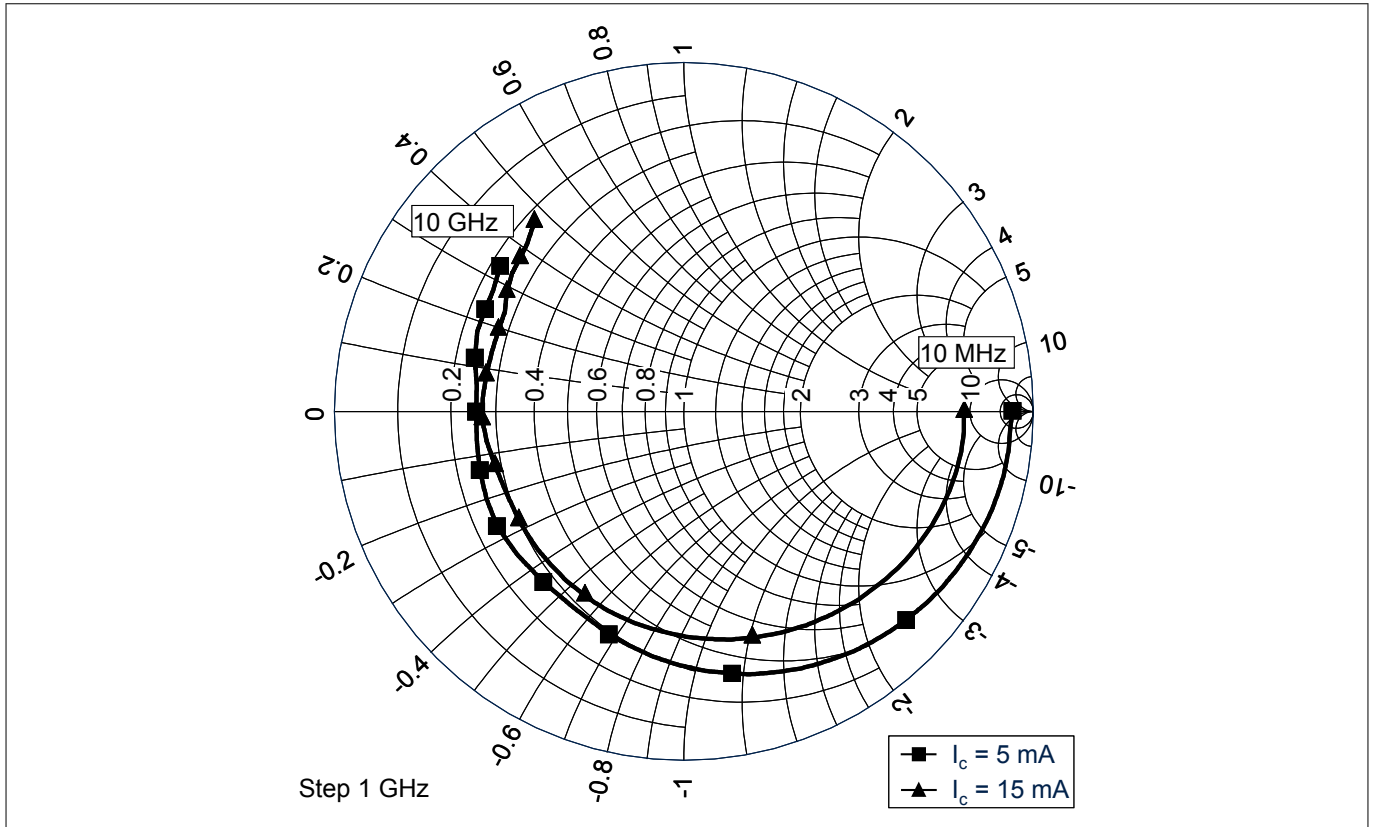
Figure 14   **Input reflection coefficient S_{11} = f(f), V_{CE} = 3 V, I_C = 5 / 15 mA**
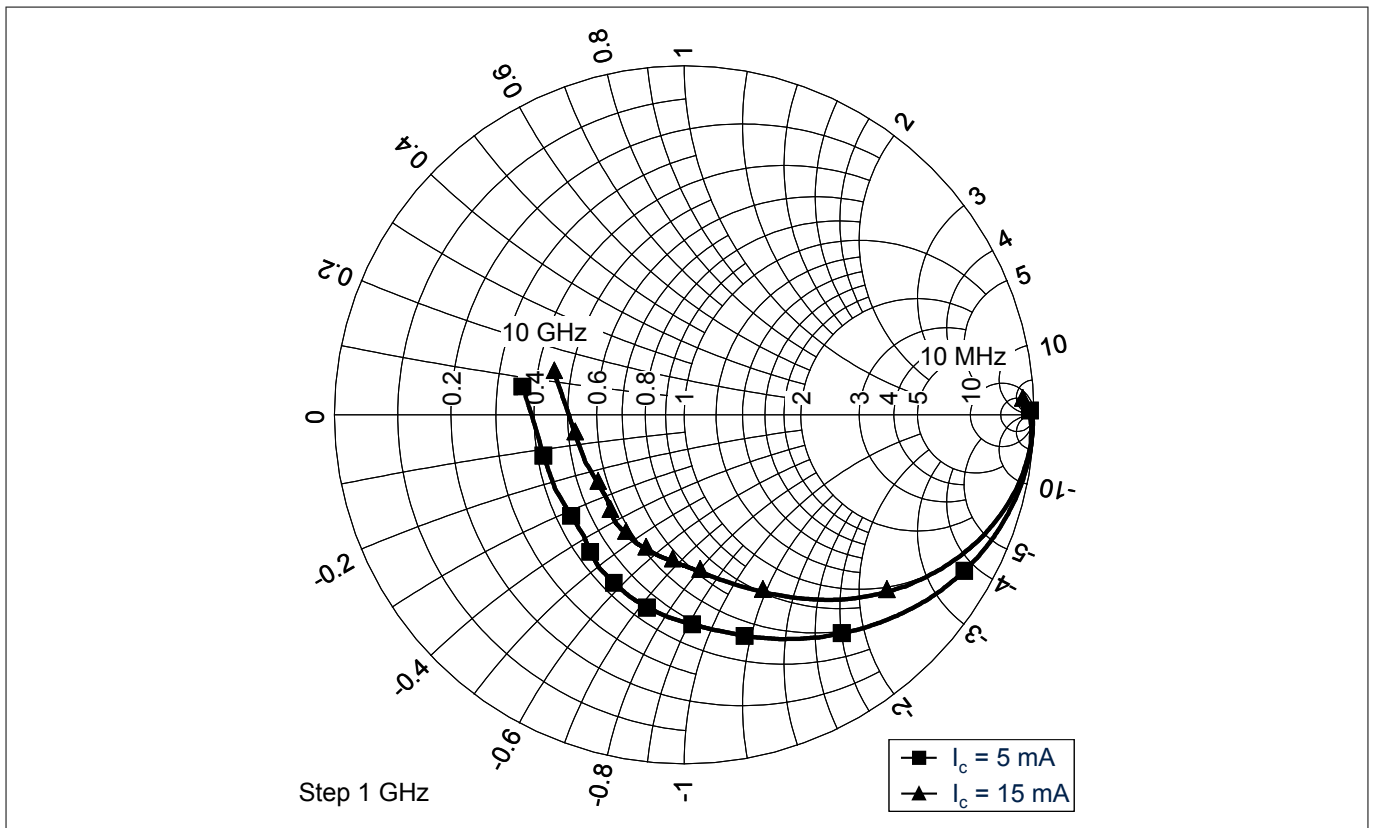
Figure 15   **Output reflection coefficient S_{22} = f(f), V_{CE} = 3 V, I_C = 5 / 15 mA**

Electrical characteristics
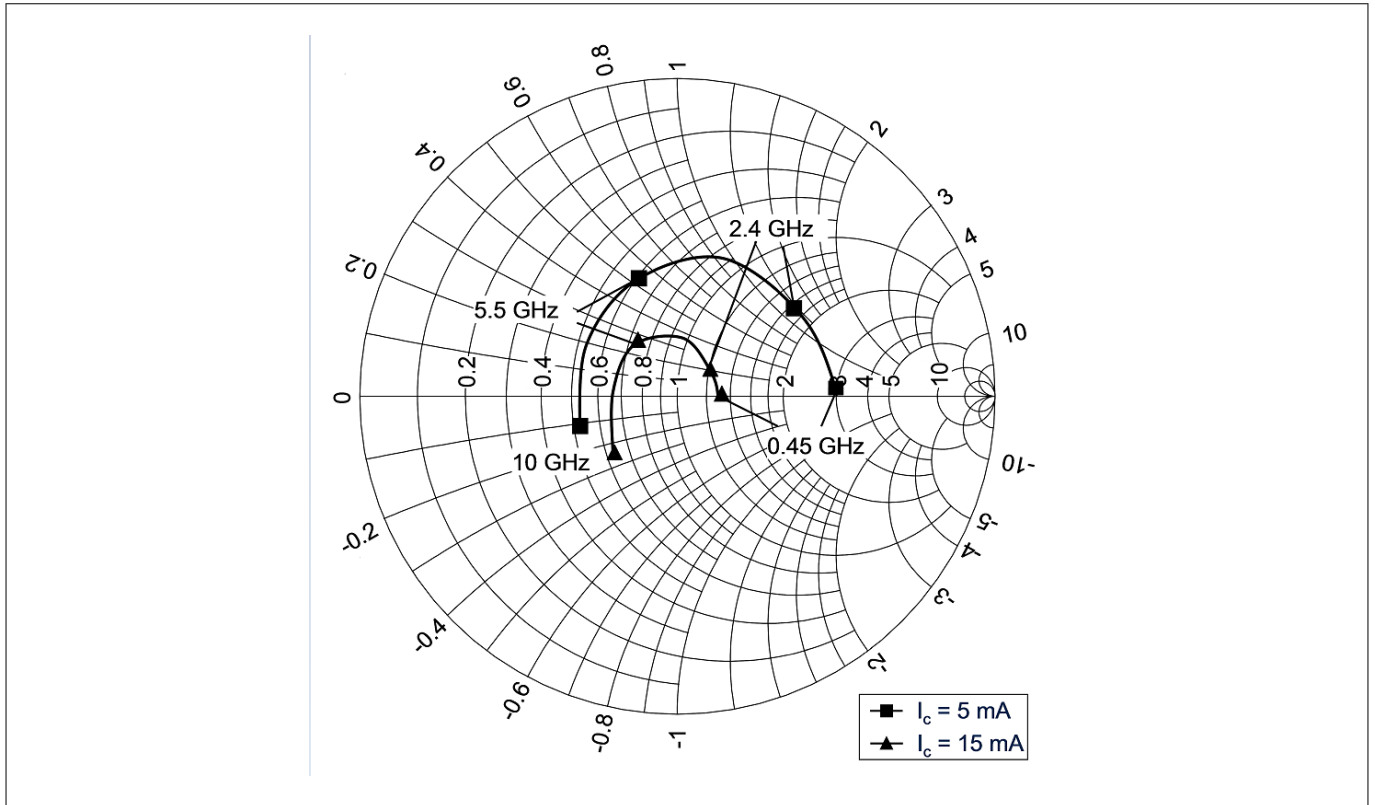
Figure 16   Source impedance for minimum noise figure $Z_{S,opt}$ = f(f), V_{CE} = 3 V, I_C = 5 / 15 mA
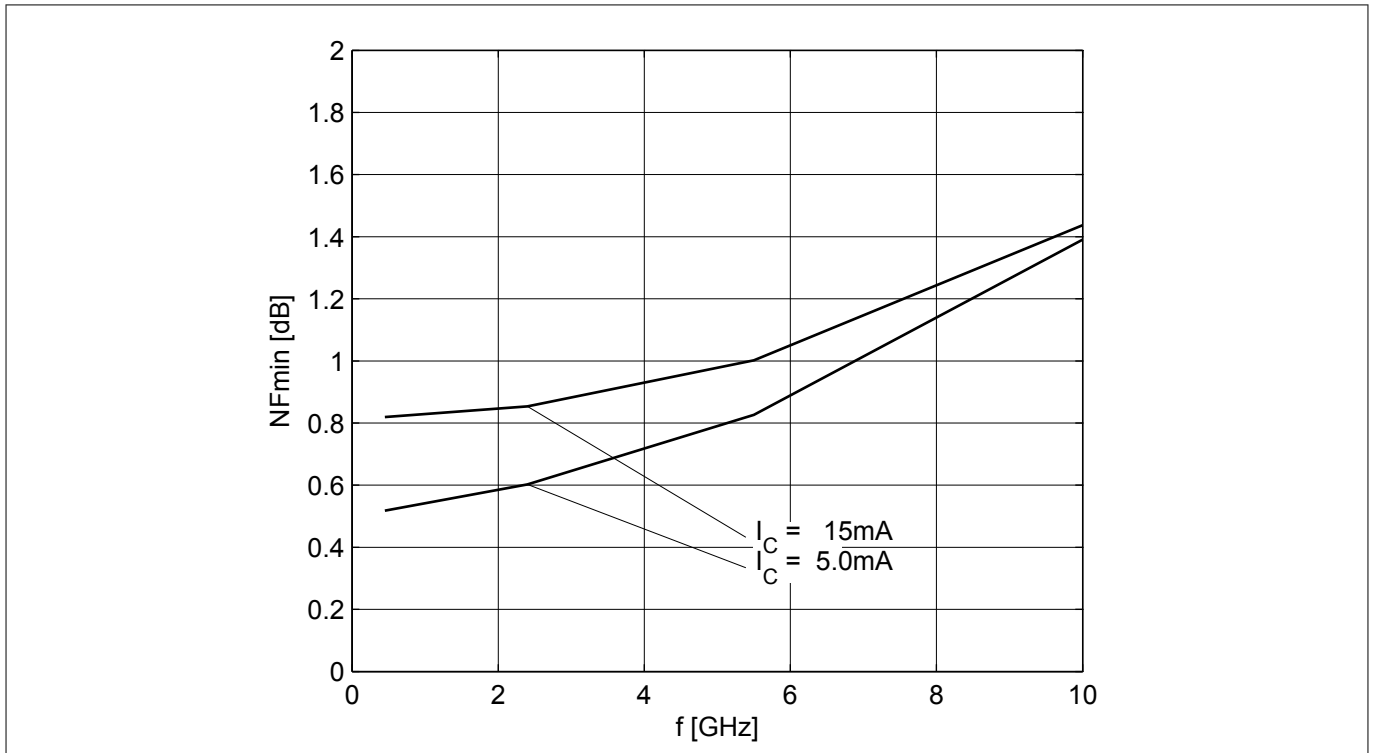
Figure 17   Noise figure NF_{min} = f(f), V_{CE} = 3 V, Z_S = $Z_{S,opt}$, I_C = 5 / 15 mA

Electrical characteristics
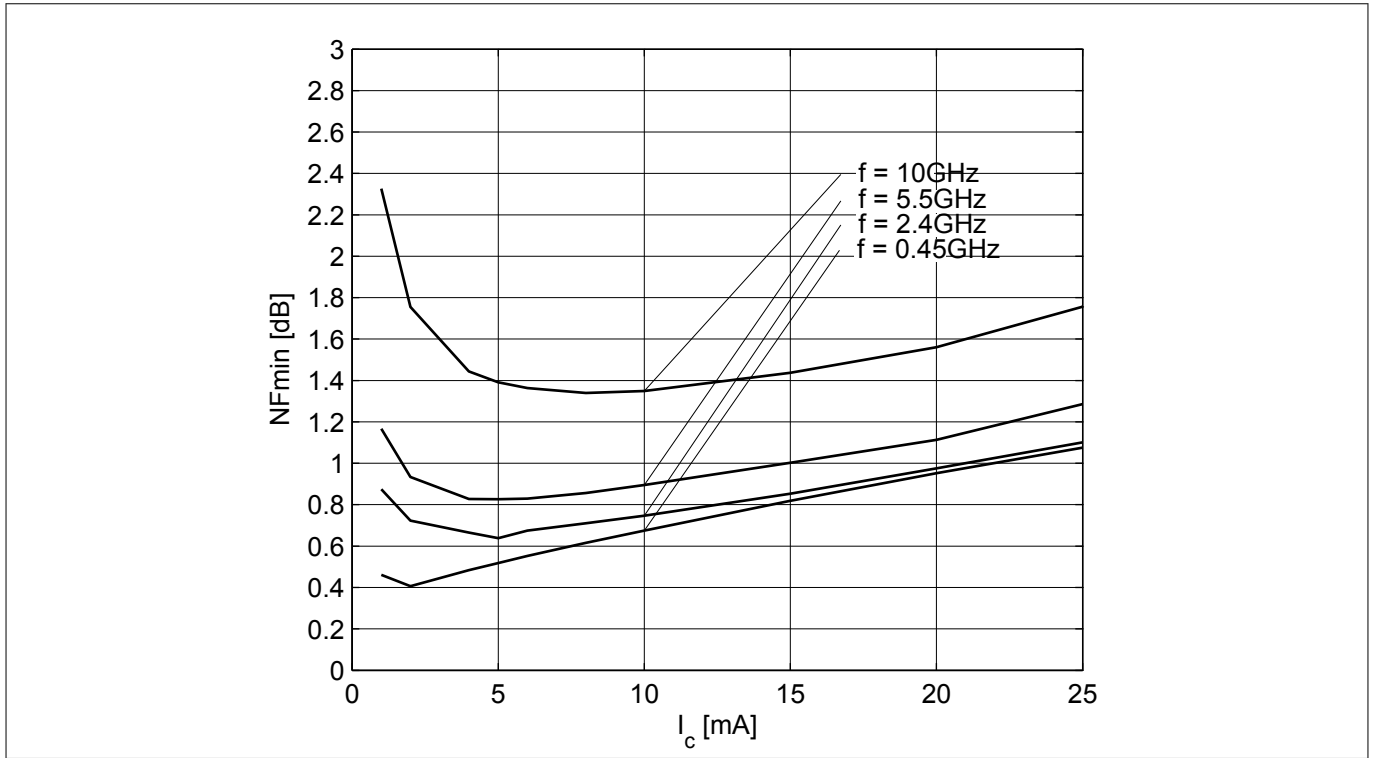
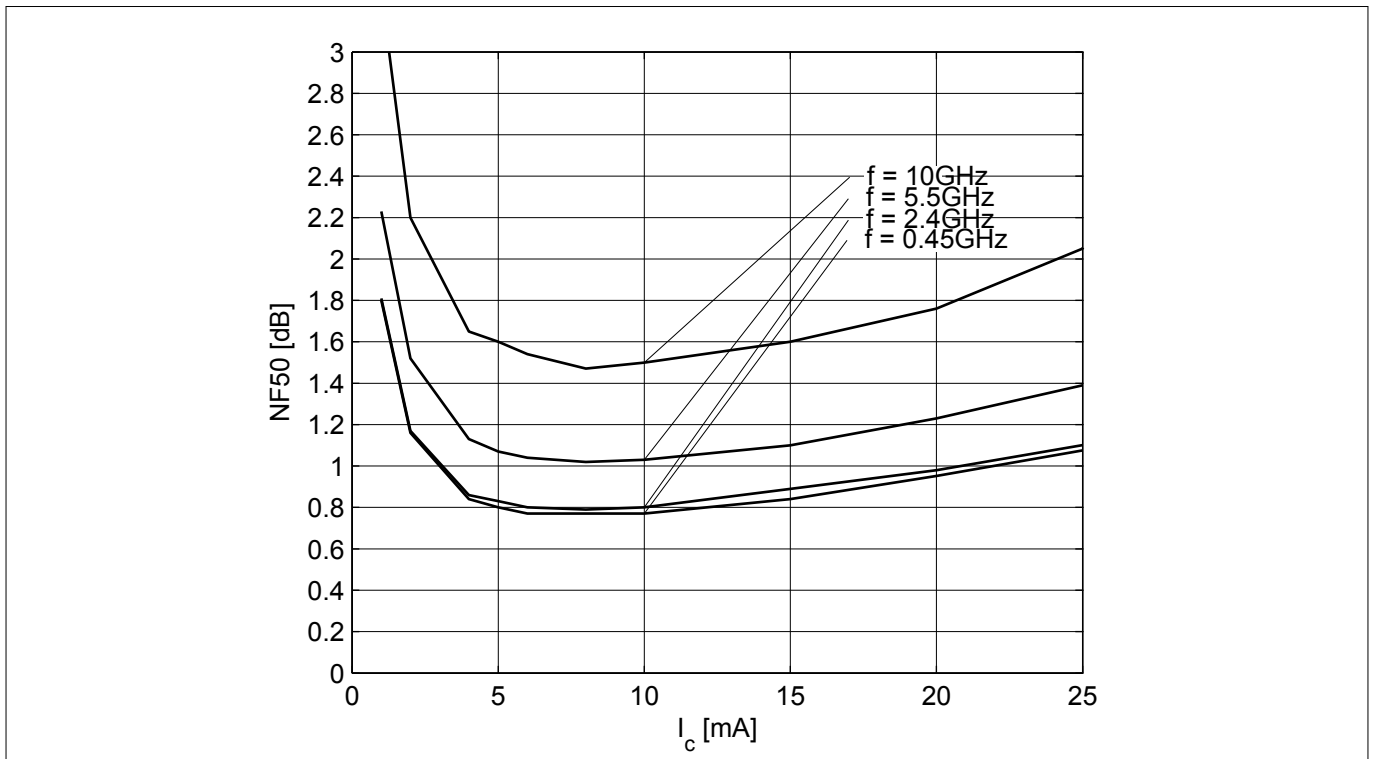**Figure 18**   Noise figure NF_{min} = f(I_C), V_{CE} = 3 V, Z_S = $Z_{S,opt}$, f = parameter in GHz

Figure 19   Noise figure NF_{50} = f(I_C), V_{CE} = 3 V, Z_S = 50 Ω, f = parameter in GHz

Note: *The curves shown in this chapter have been generated using typical devices but shall not be considered as a guarantee that all devices have identical characteristic curves. T_A = 25 °C.*
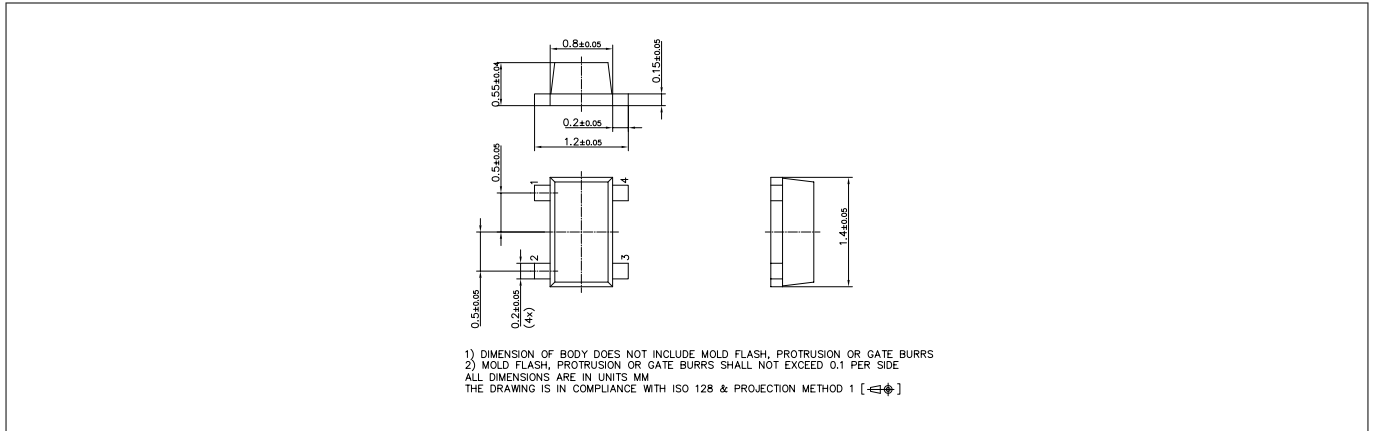
4 Package information TSFP-4-1

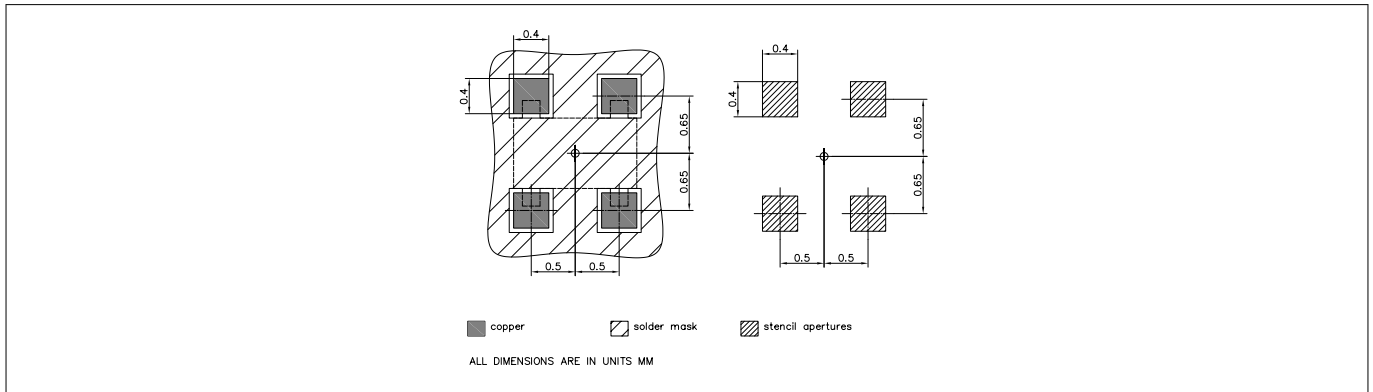

Figure 20 Package outline

Figure 21 Foot print

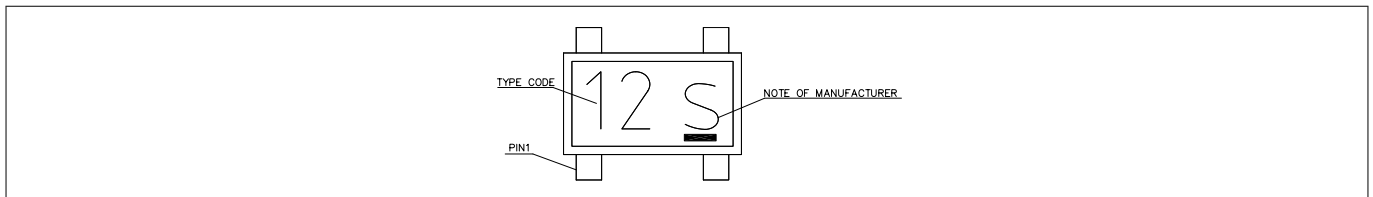**Figure 22** Marking layout example
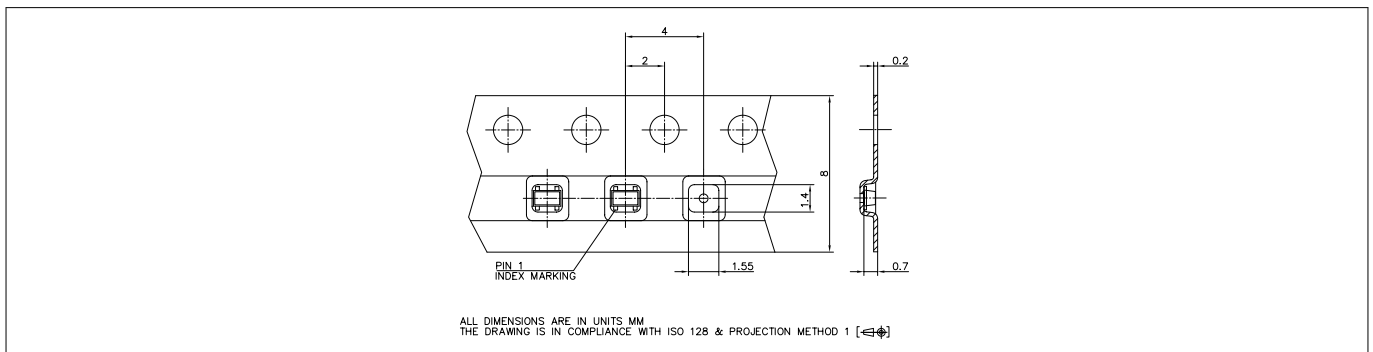
Figure 23 Tape dimensions

Revision history

Document version	Date of release	Description of changes
2.0	2018-09-26	New datasheet layout.

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