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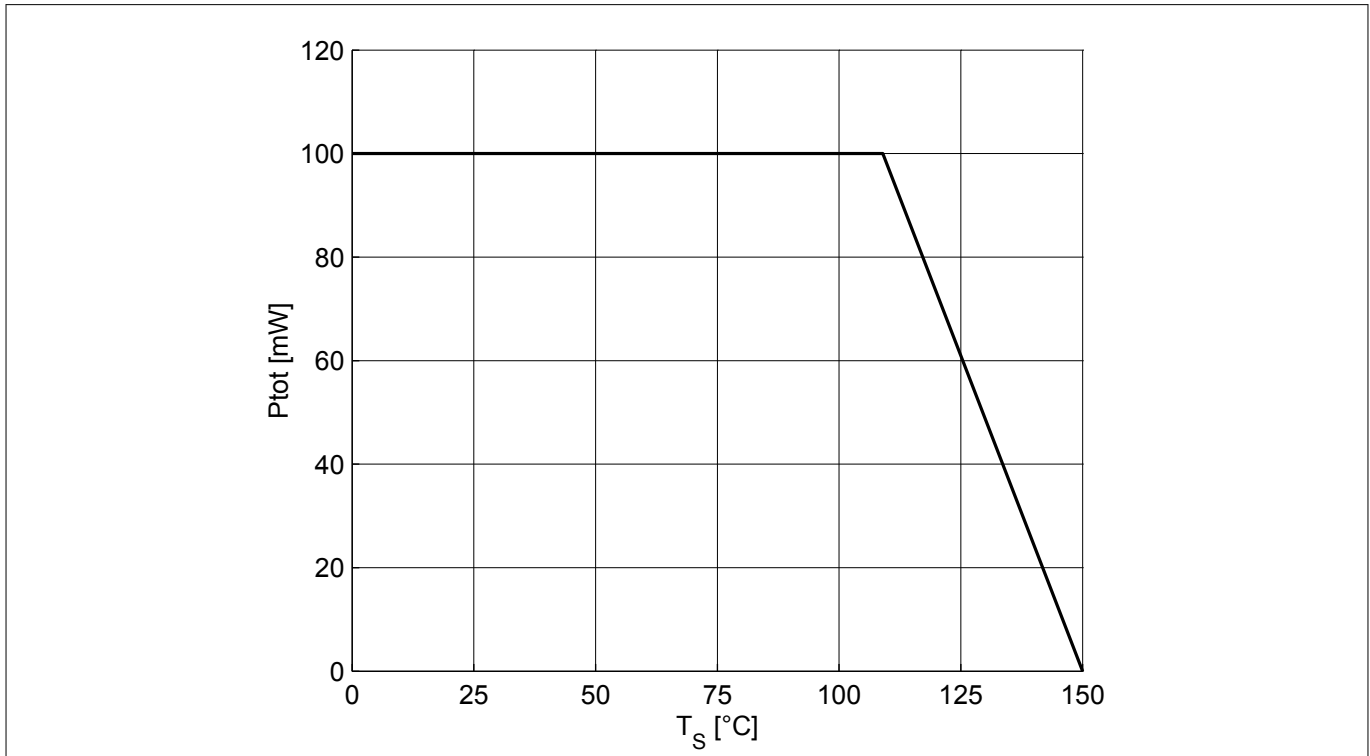2 V_{CES} is identical to V_{CEO} due to design.
3   T_S is the soldering point temperature. T_S is measured on the emitter lead at the soldering point of the PCB.

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

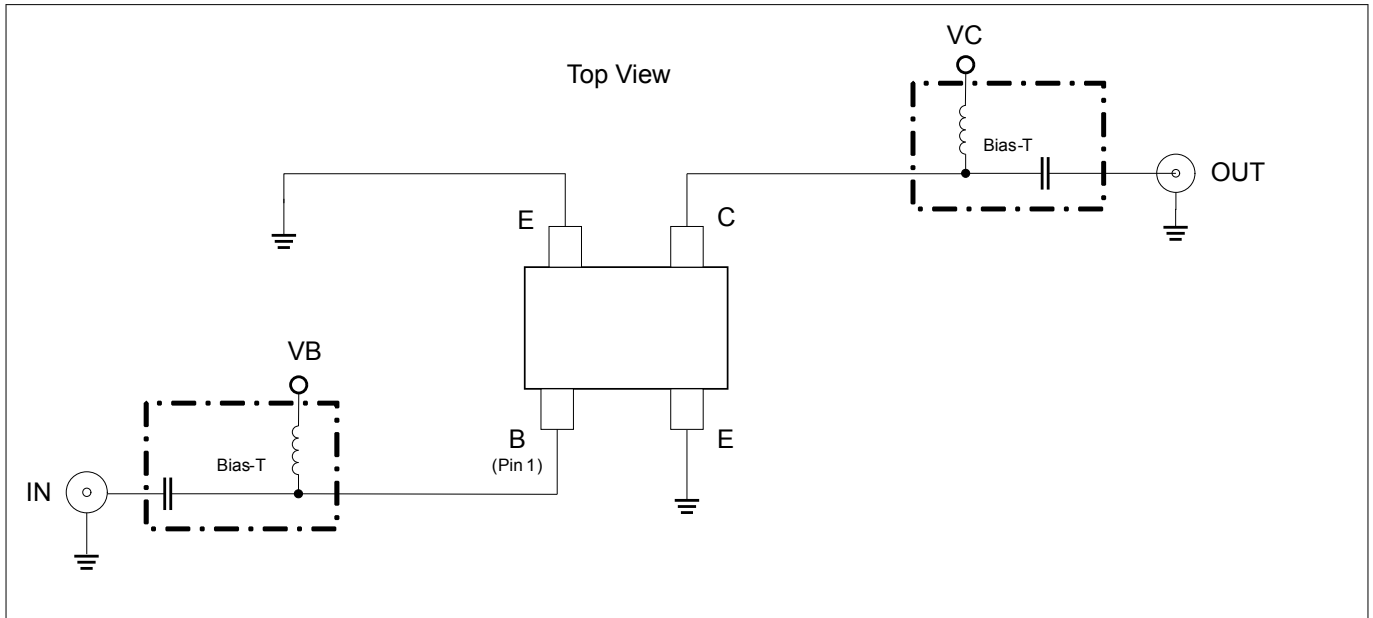| Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Transition frequency	f_T	–	45	–	GHz	V_{CE} = 3 V, I_C = 15 mA, f = 1 GHz
Collector base capacitance	C_{CB}		0.05		pF	V_{CB} = 3 V, V_{BE} = 0, f = 1 MHz, emitter grounded
Collector emitter capacitance	C_{CE}		0.35			V_{CE} = 3 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} $\lvert S_{21}\rvert^2$	– 	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	$Z_S = Z_L = 50\ \Omega$ 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} $\lvert S_{21}\rvert^2$	– 	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	$Z_S = Z_L = 50\ \Omega$ 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} $\lvert S_{21}\rvert^2$	– 	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	$Z_S = Z_L = 50\ \Omega$ 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} $\|S_{21}\|^2$	– 	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 Ω 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} $\|S_{21}\|^2$	– 	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 Ω 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} $\|S_{21}\|^2$	– 	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 Ω 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} $\lvert S_{21}\rvert^2$	–	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} $\lvert S_{21}\rvert^2$	–	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: $G_{ms} = \lvert S_{21} / S_{12} \rvert$ for $k < 1$; $G_{ma} = \lvert S_{21} / S_{12} \rvert (k-(k^2-1)^{1/2})$ 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
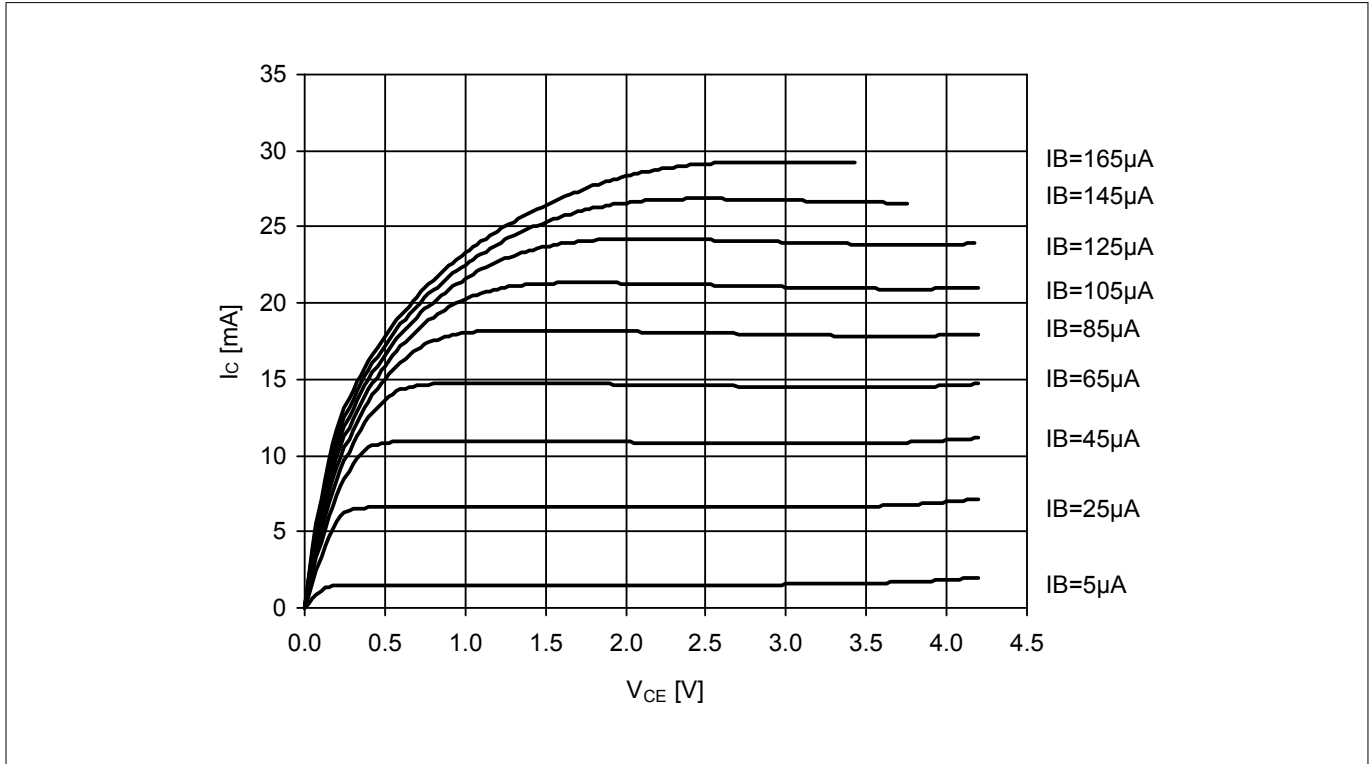
Figure 3   Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, I_B = parameter
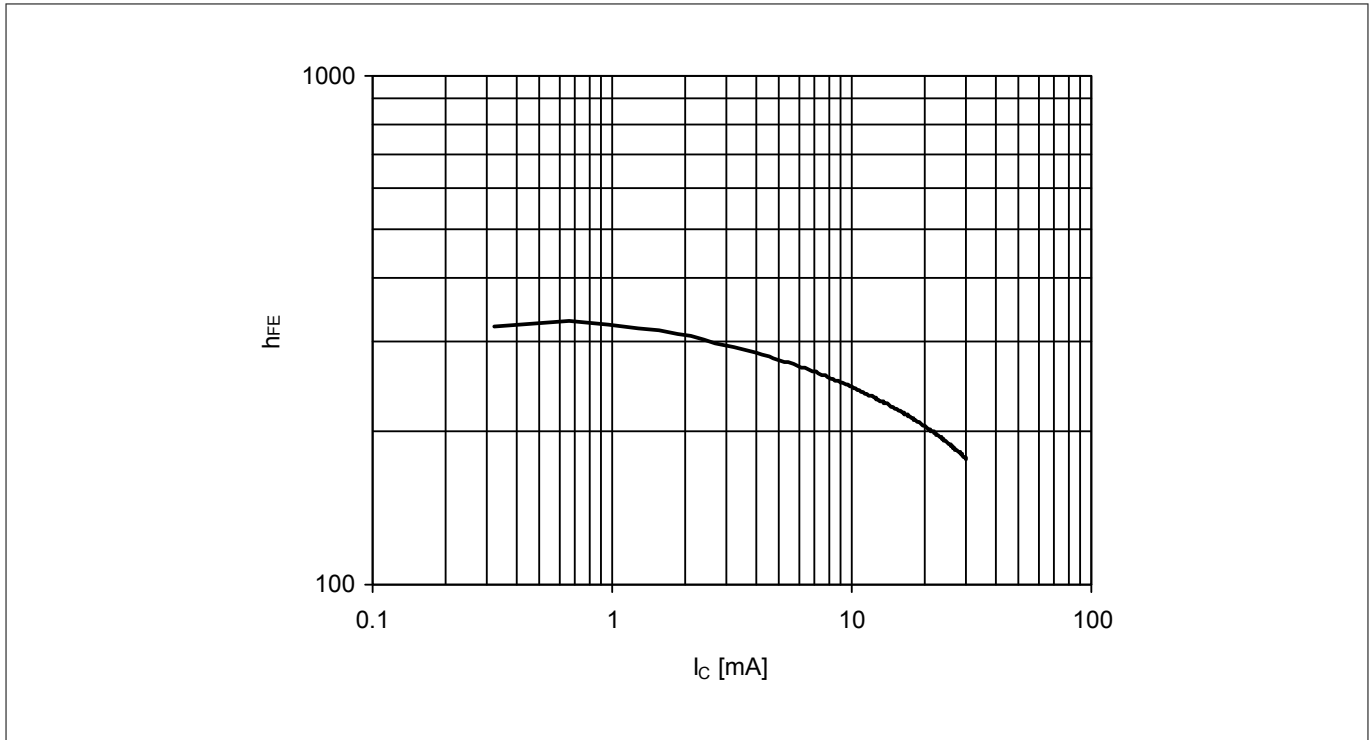
Figure 4   DC current gain $h_{FE} = f(I_C)$, V_{CE} = 3 V
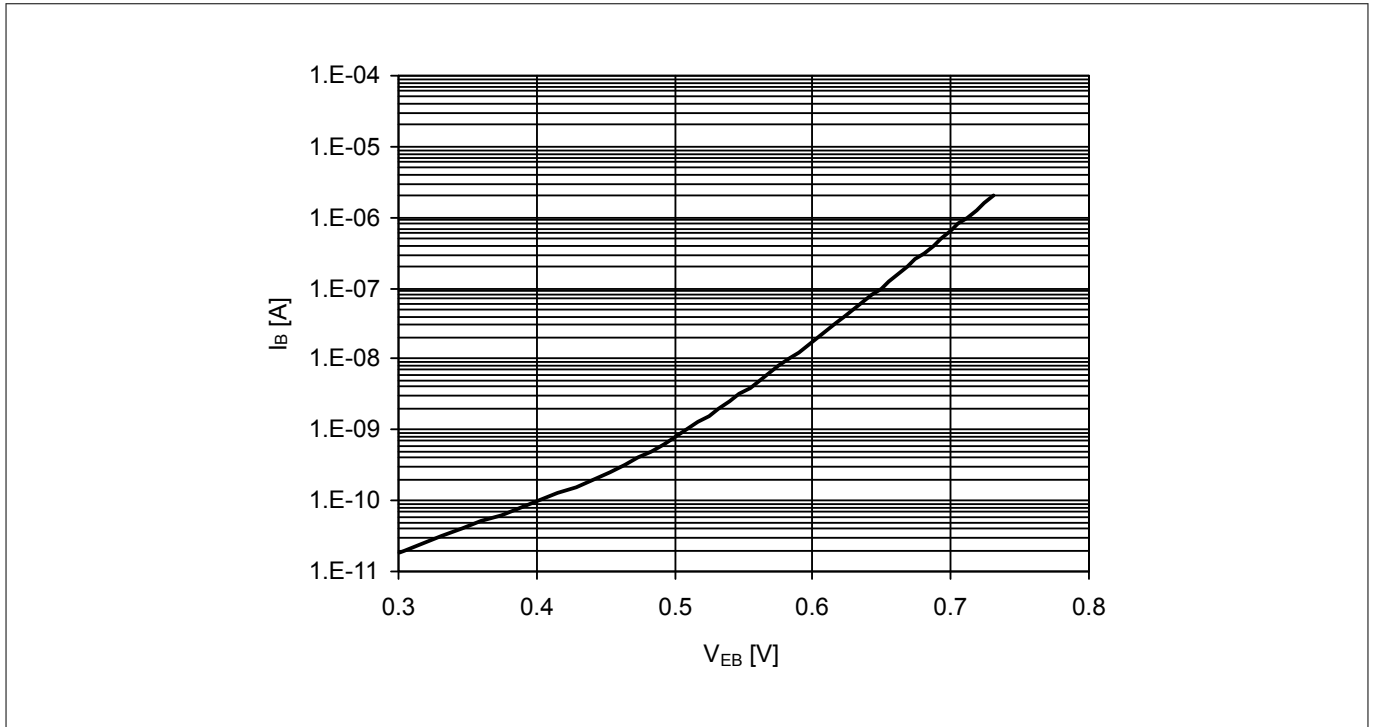
Electrical characteristics
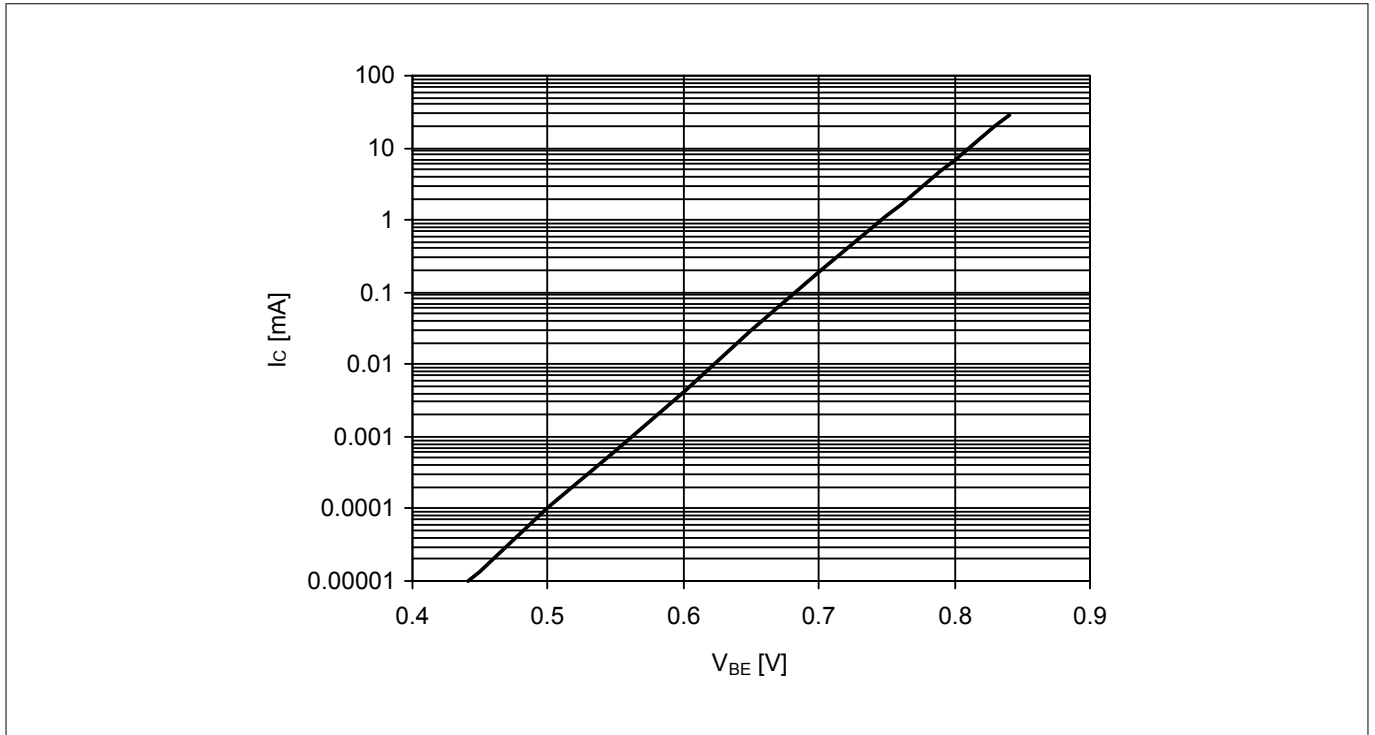
Figure 5   Collector current vs. base emitter voltage $I_C = f(V_{BE})$, $V_{CE} = 2$ V
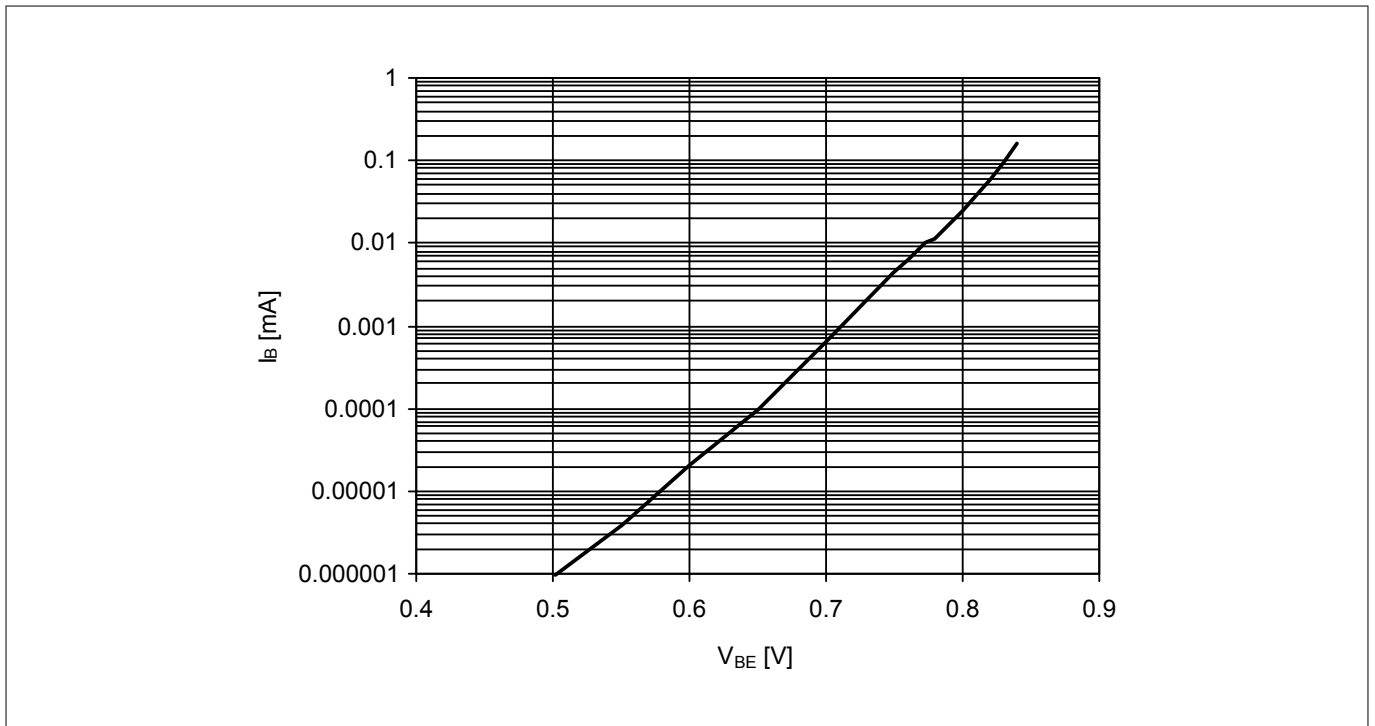
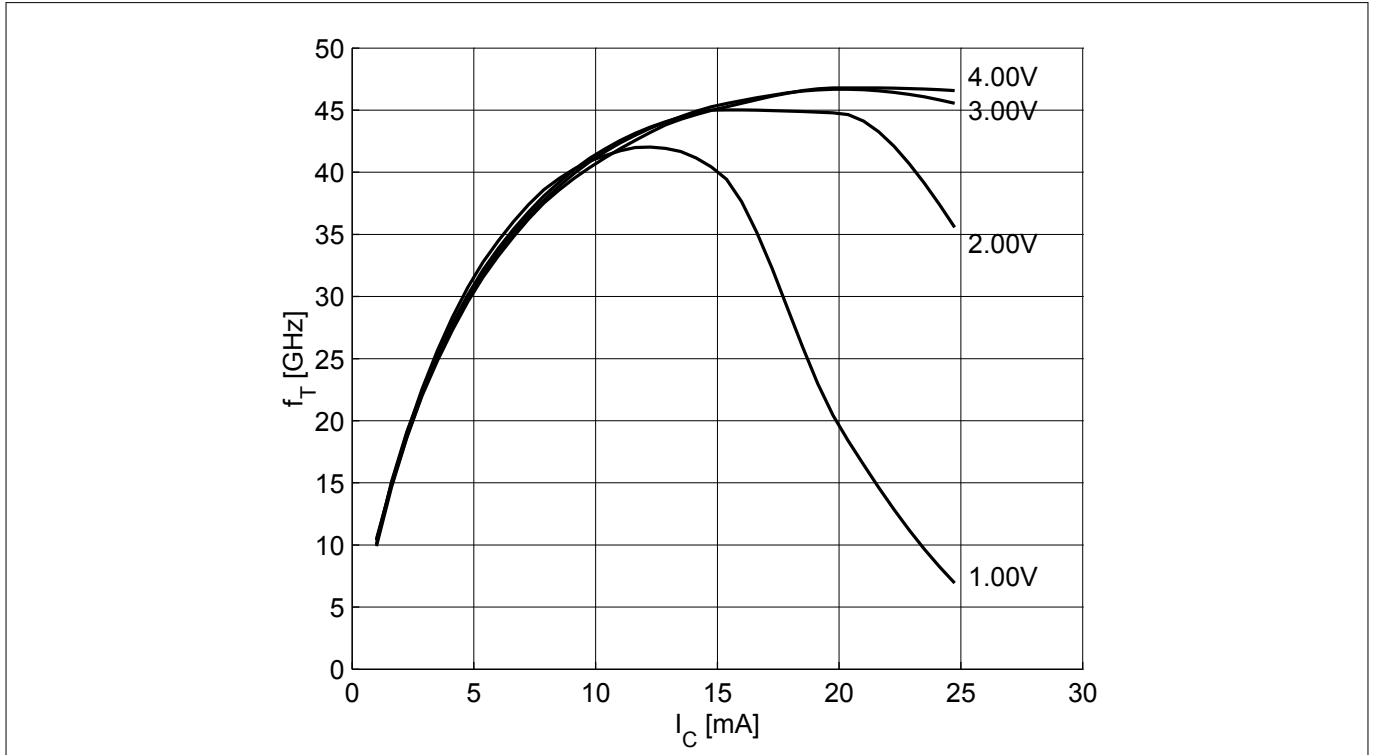**Figure 6**   Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 2$ V
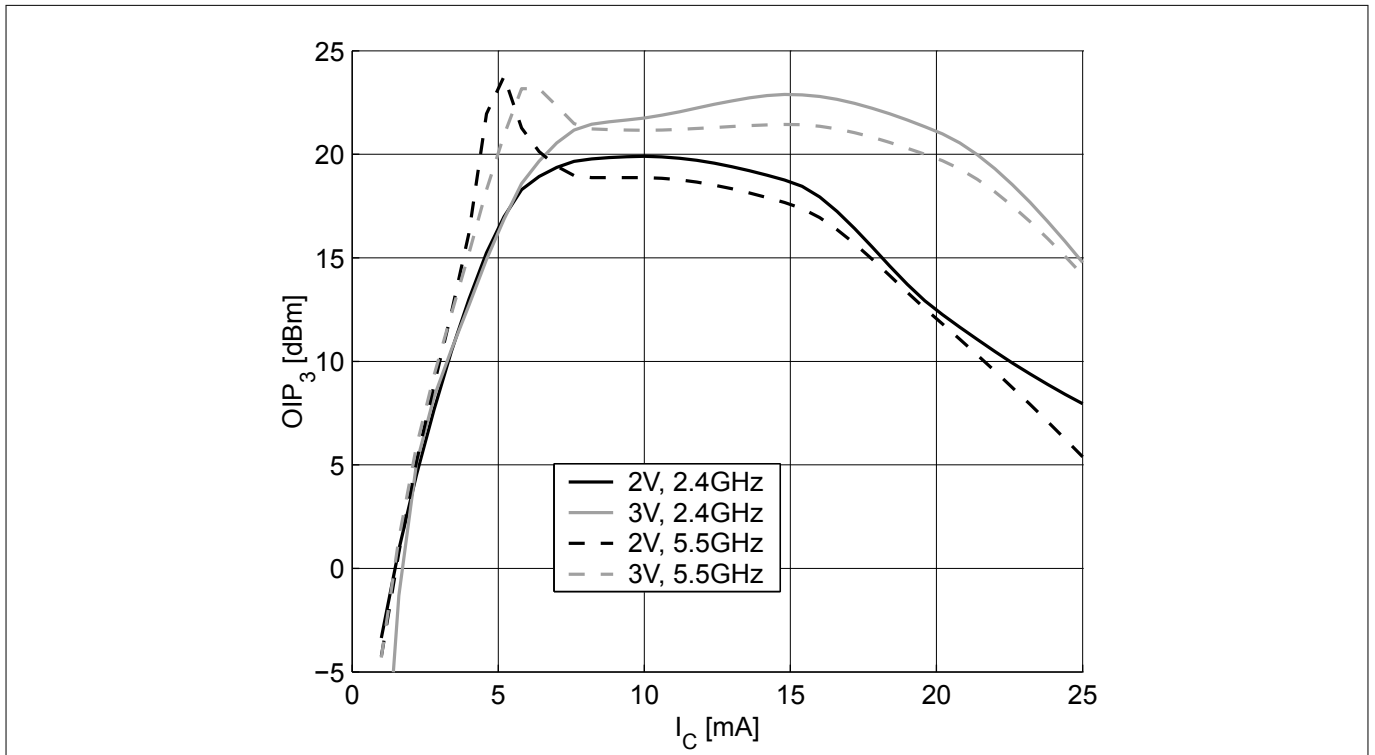
Electrical characteristics

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 Ω, V_{CE}, f = parameters**

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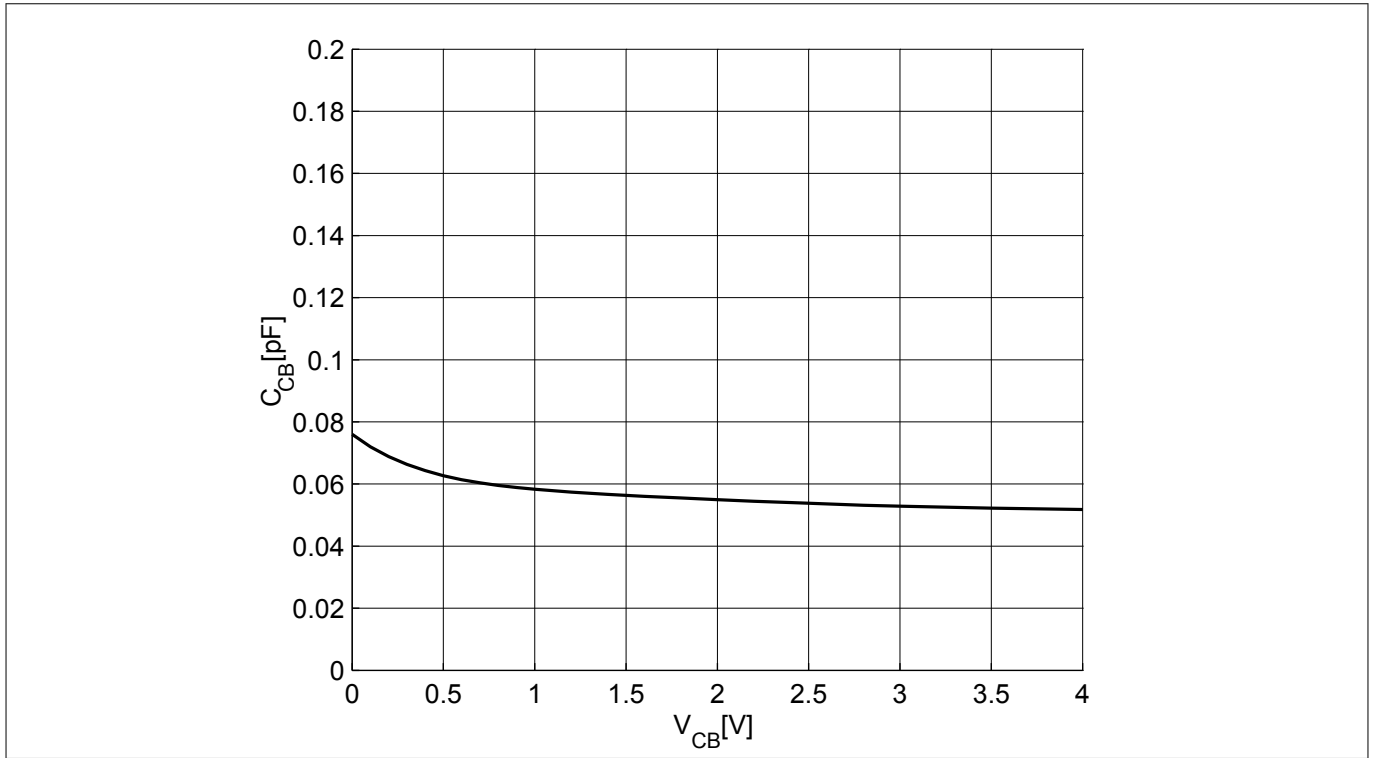
Figure 10   Collector base capacitance C_{CB} = f(V_{CB}), f = 1 MHz
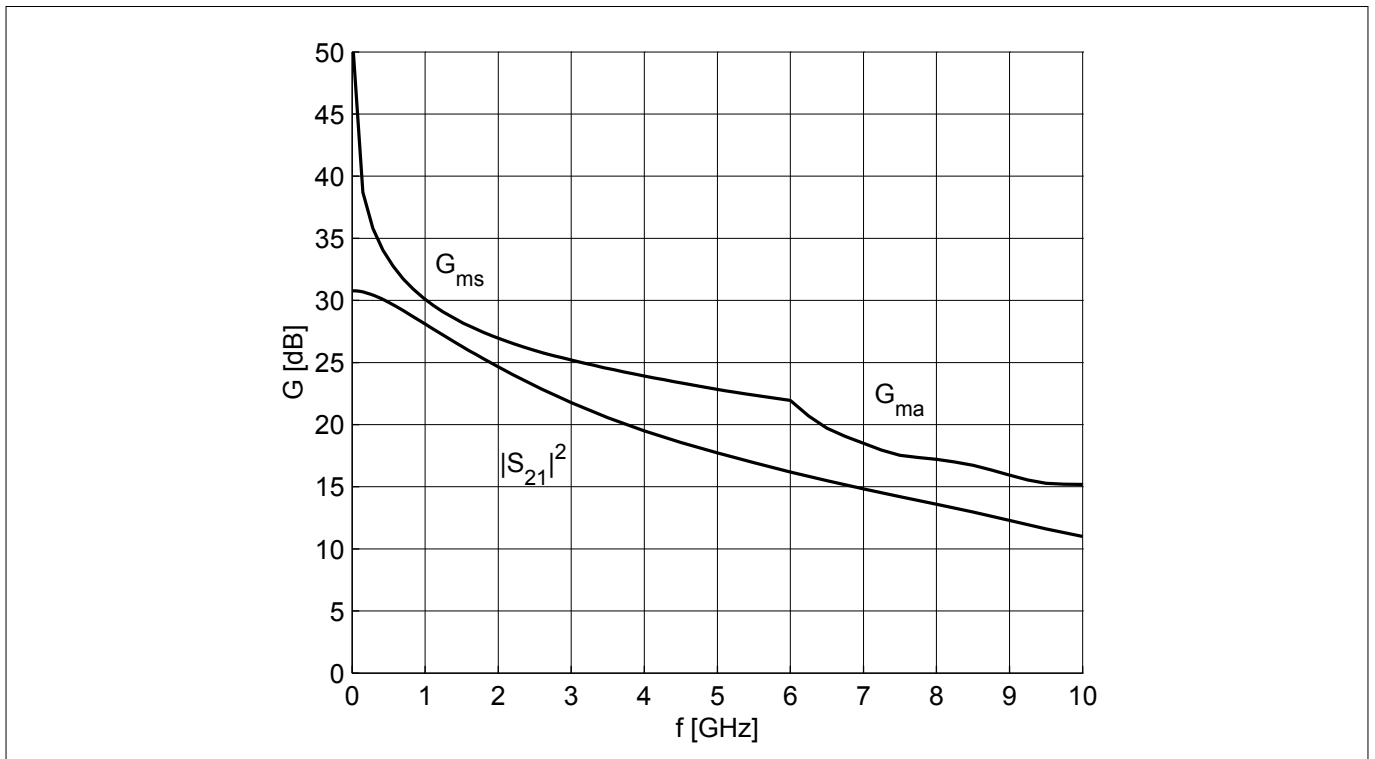
Figure 11   Gain G_{ma}, G_{ms}, $|S_{21}|^2$ = f(f), V_{CE} = 3 V, I_C = 15 mA

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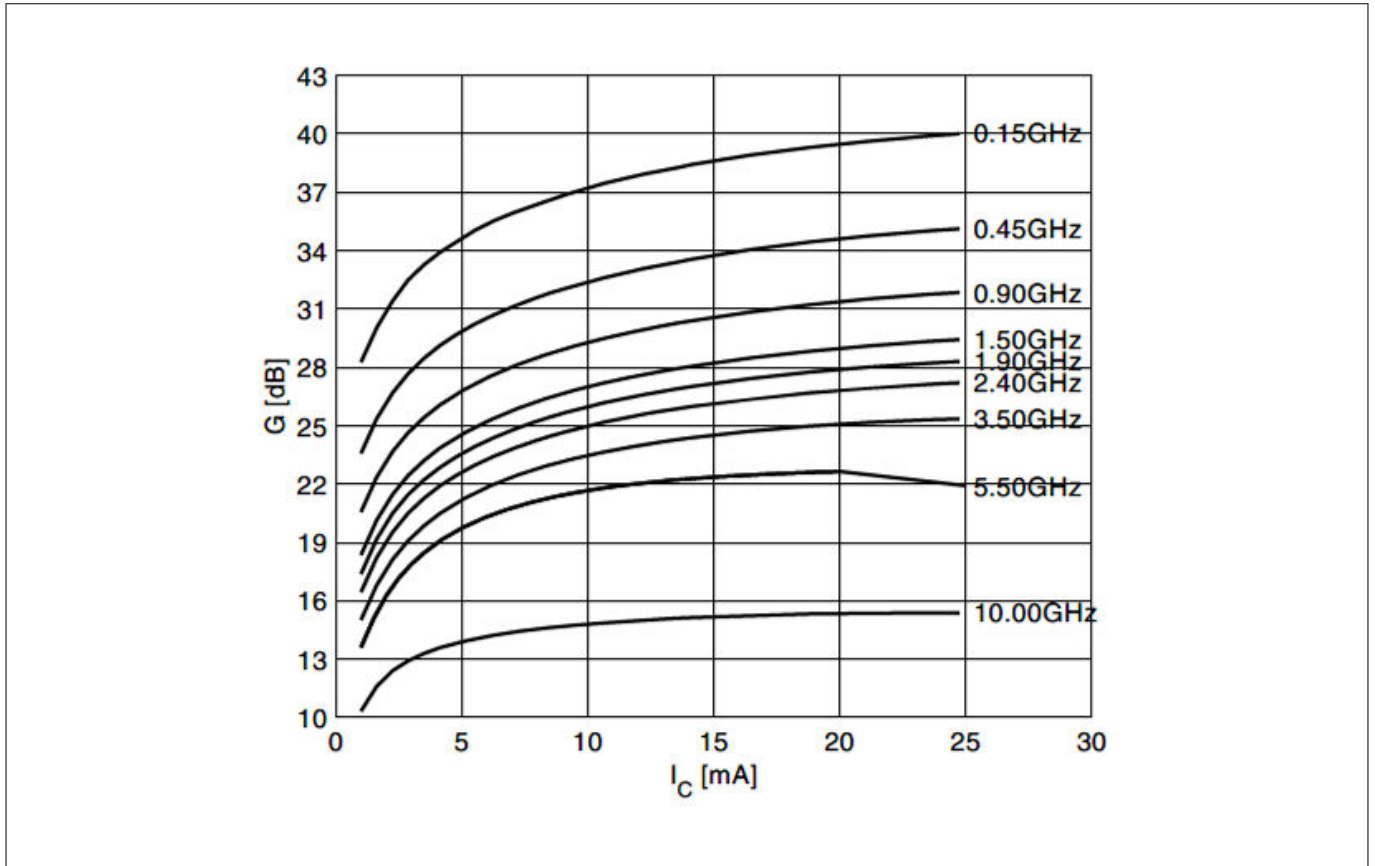
Figure 12   Maximum power gain $G_{max} = f(I_C)$, $V_{CE} = 3$ V, f = parameter in GHz
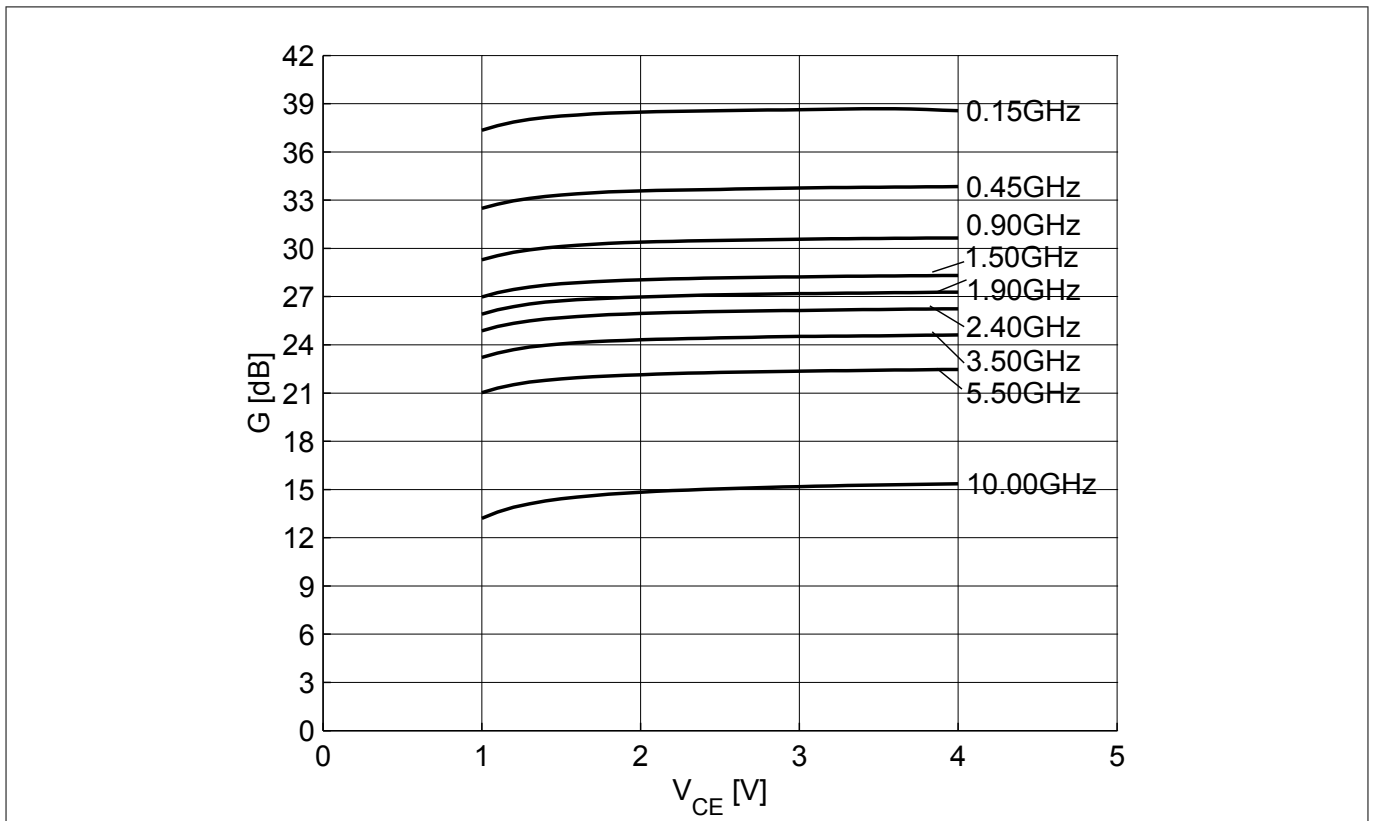
Figure 13   Maximum power gain $G_{max} = f(V_{CE})$, $I_C = 15$ mA, f = parameter in GHz

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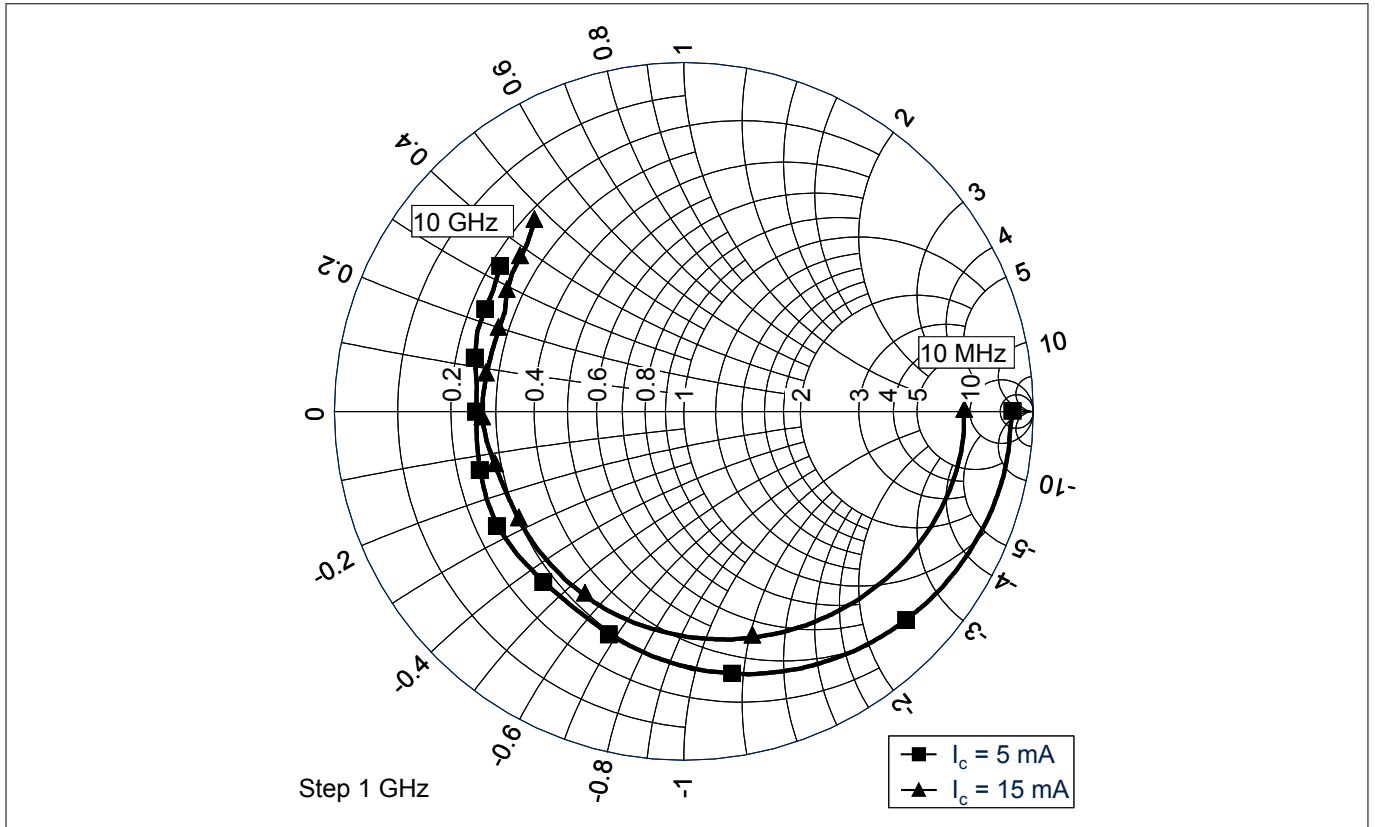
Figure 14   **Input reflection coefficient S_{11} = f(f), V_{CE} = 3 V, I_C = 5 / 15 mA**
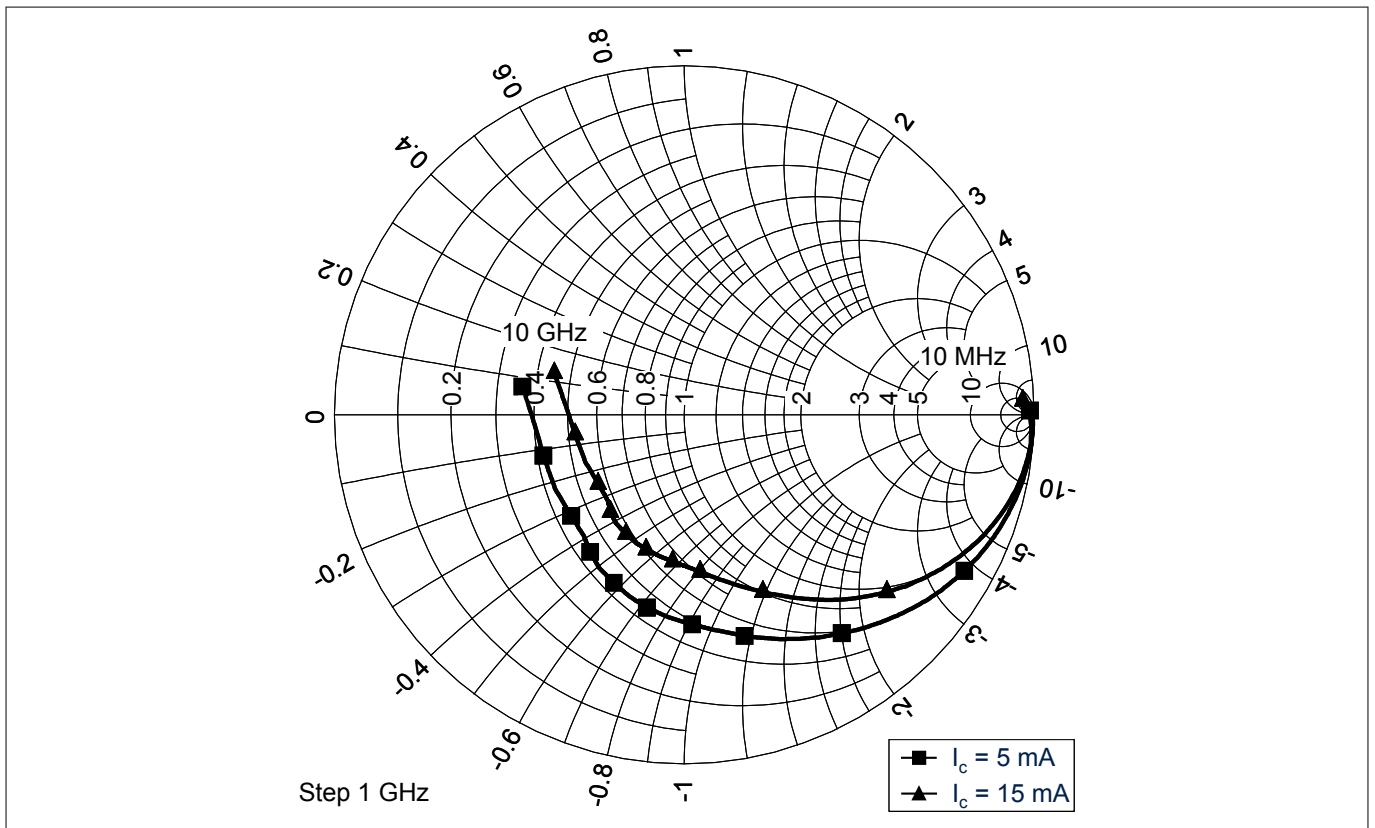
Figure 15   **Output reflection coefficient S_{22} = f(f), V_{CE} = 3 V, I_C = 5 / 15 mA**

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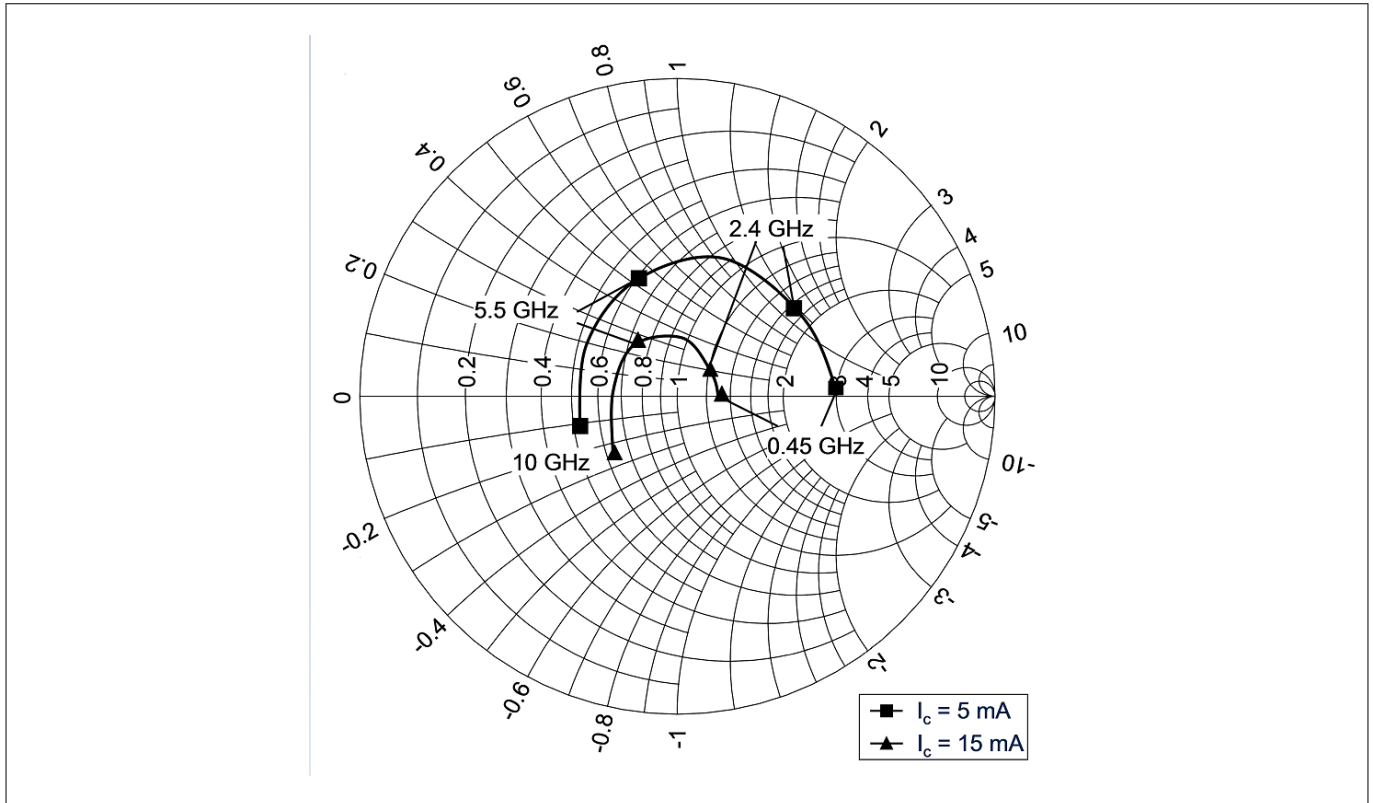
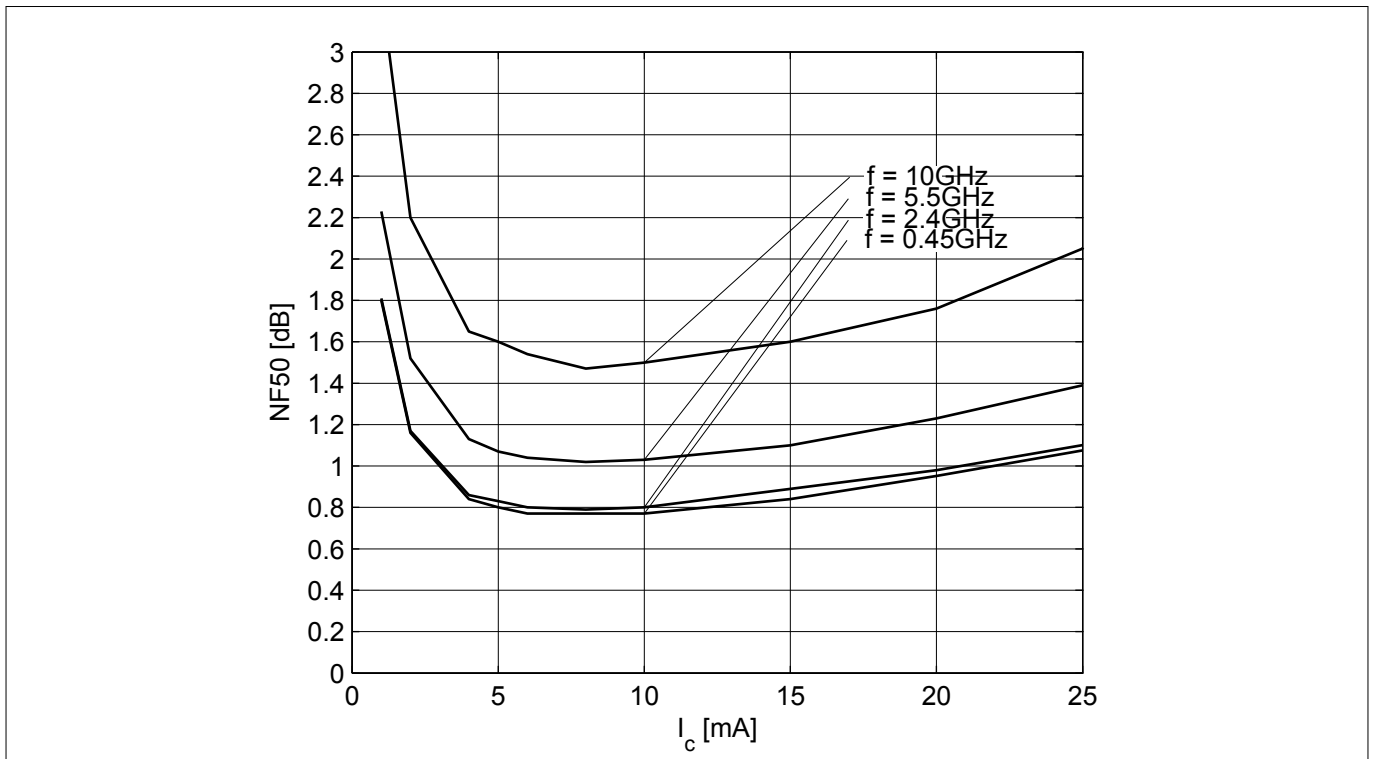**Figure 16**　　　　Source impedance for minimum noise figure $Z_{S,opt}$ = f(f), V_{CE} = 3 V, I_C = 5 / 15 mA
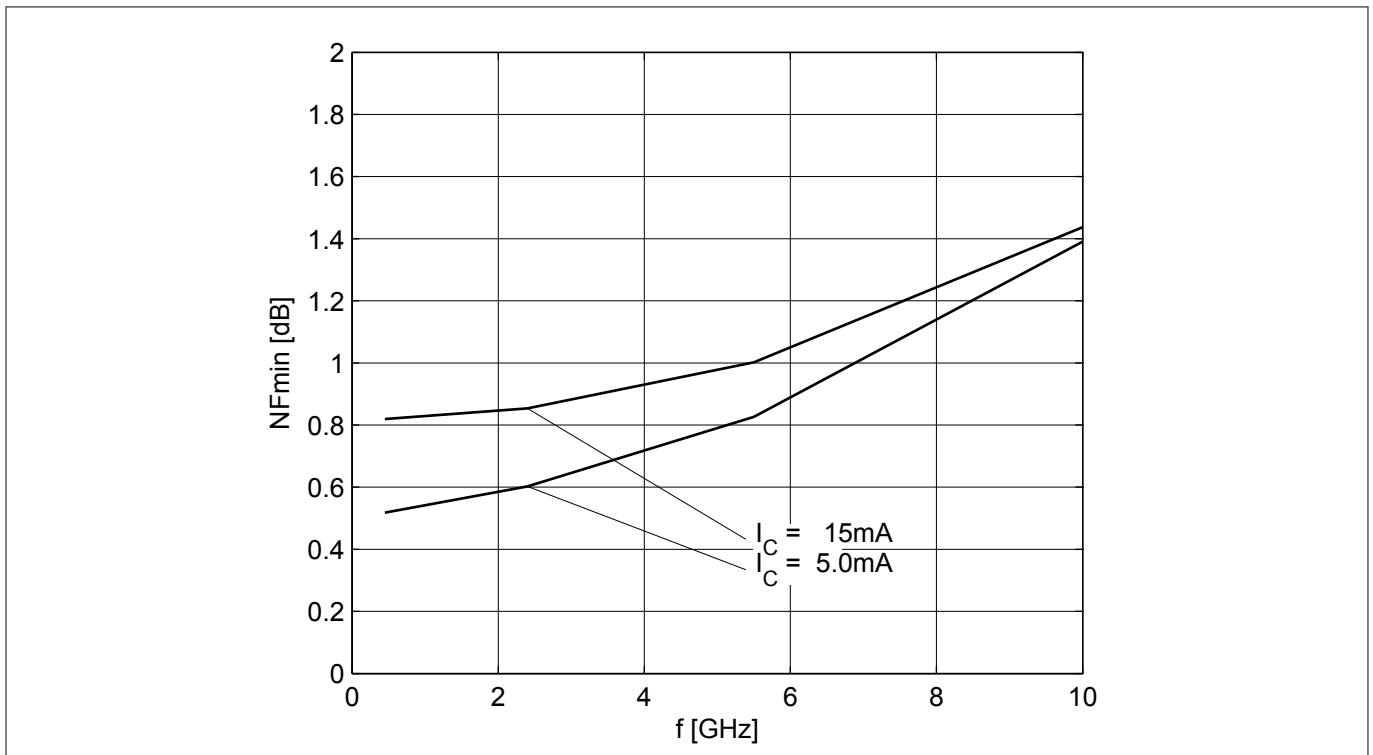
Figure 17　　　　Noise figure NF_{min} = f(f), V_{CE} = 3 V, Z_S = $Z_{S,opt}$, I_C = 5 / 15 mA

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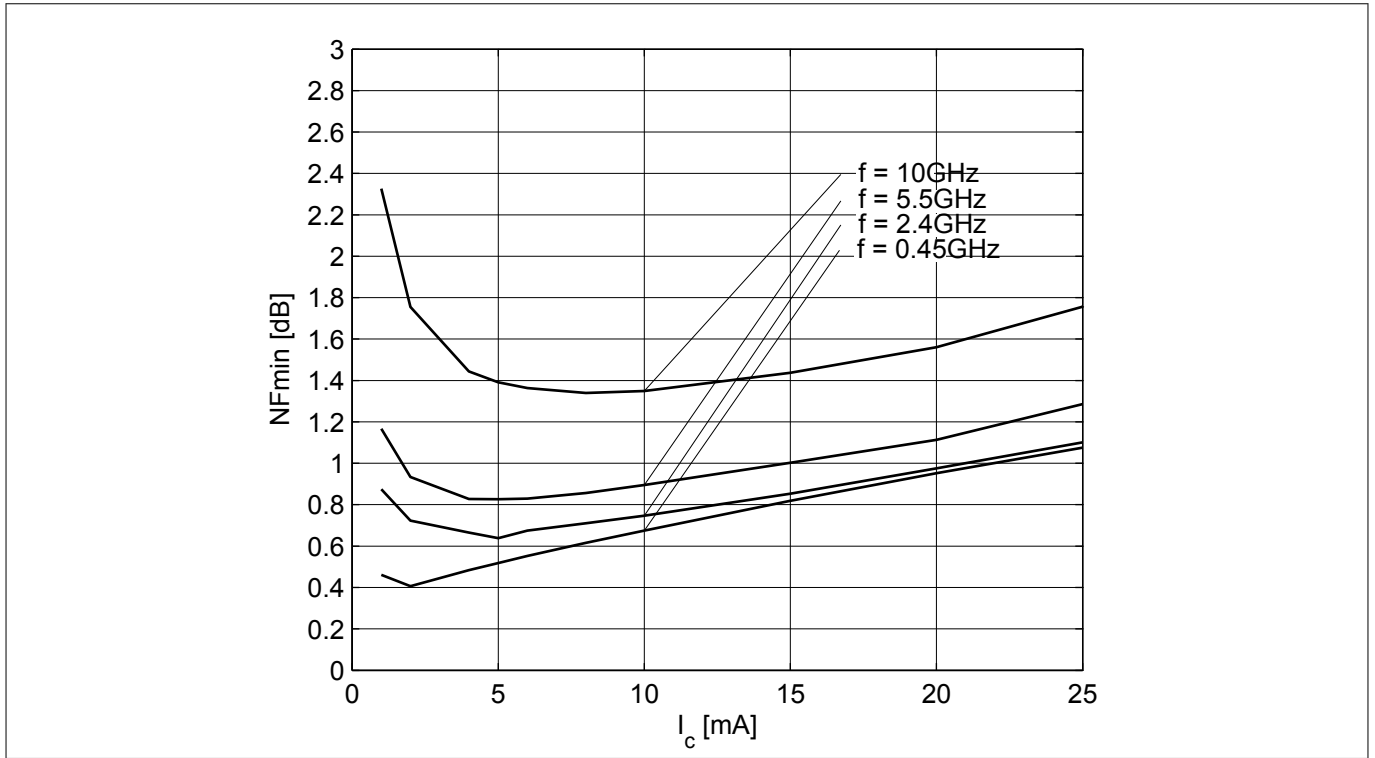
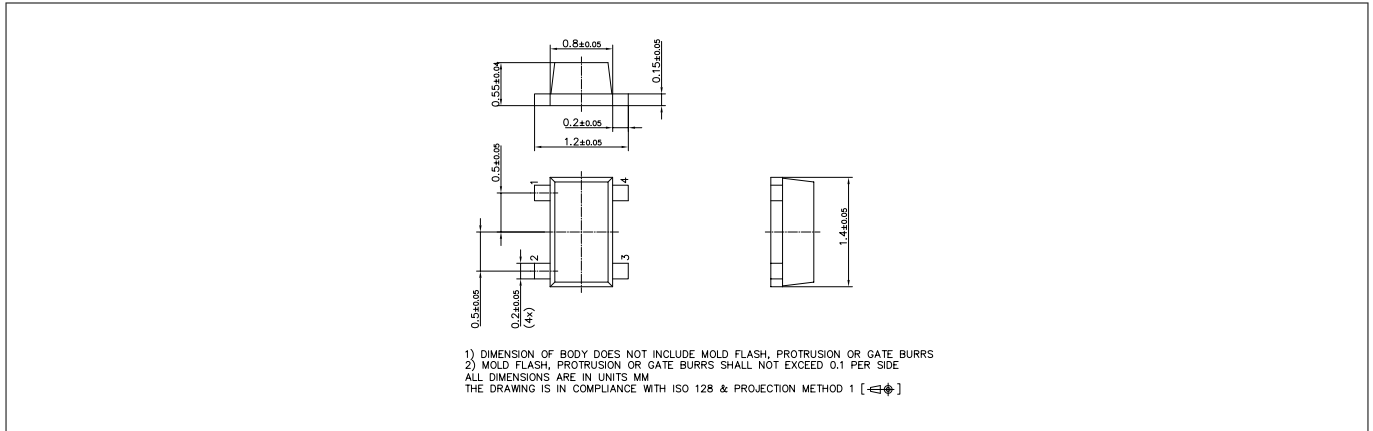**Figure 18**   Noise figure NF_{min} = f(I_C), V_{CE} = 3 V, Z_S = $Z_{S,opt}$, f = parameter in GHz

Figure 19   Noise figure NF_{50} = f(I_C), V_{CE} = 3 V, Z_S = 50 Ω, f = parameter in GHz
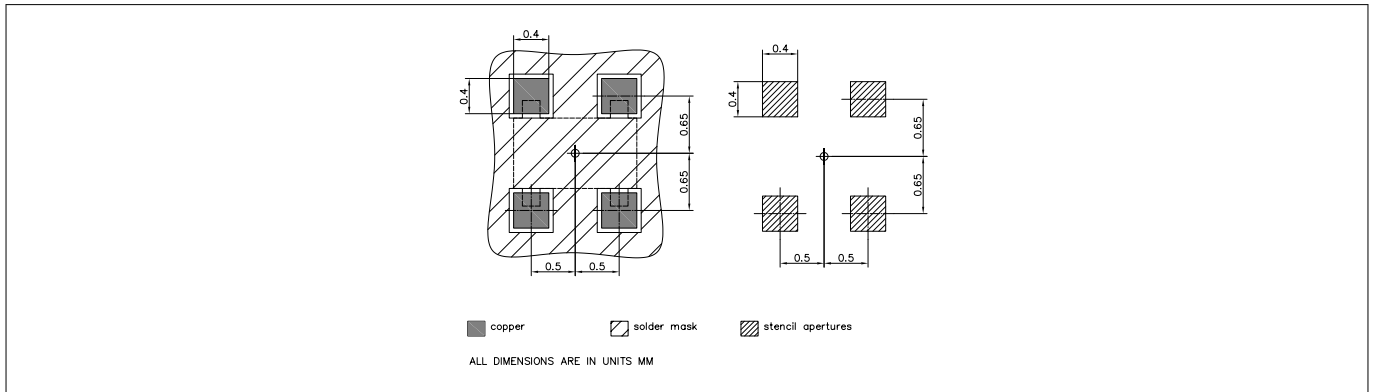
Note: *The curves shown in this chapter have been generated using typical devices but shall not be considered as a guarantee that all devices have identical characteristic curves. T_A = 25 ℃.*
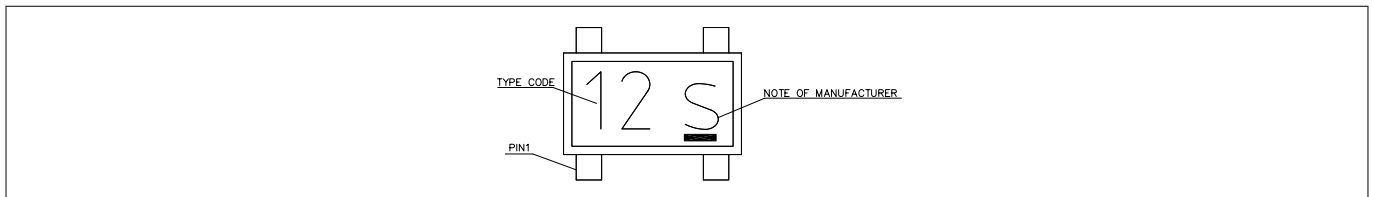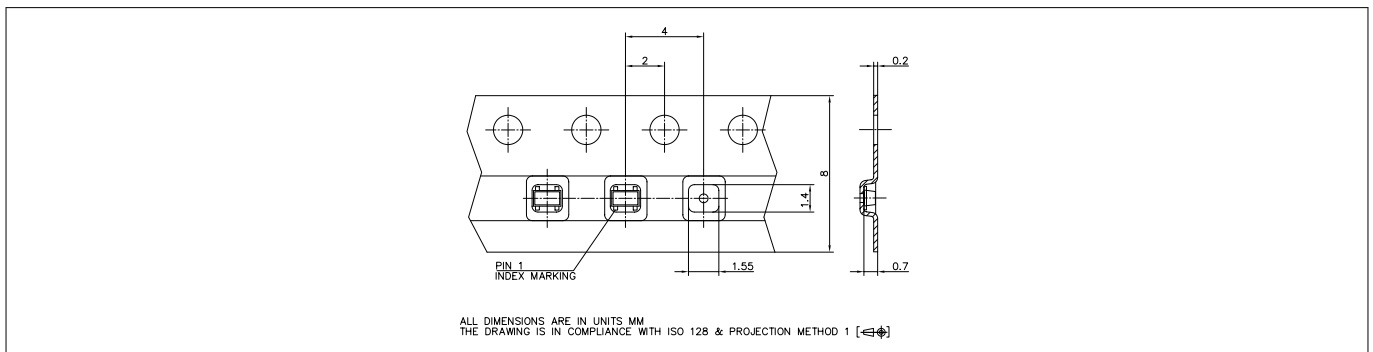
4 Package information TSFP-4-1

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.