BFP640F

Low profile high linearity silicon NPN RF bipolar transistor

Order now   Technical documents   Simulation   Support

Product description

The BFP640F is a RF bipolar transistor based on SiGe:C technology that is part of Infineon's established sixth generation transistor family. Its transition frequency f_T of 42 GHz and high linearity characteristics at low currents make the device suitable for energy efficiency designs at frequency as high as 8 GHz. It remains cost competitive without compromising on ease of use.

Feature list

- Minimum noise figure NF_{min} = 0.65 dB at 2.4 GHz, 3 V, 6 mA
- High gain G_{ma} = 20 dB at 2.4 GHz, 3 V, 25 mA
- OIP_3 = 28 dBm at 2.4 GHz, 3 V, 25 mA

Product validation

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

Potential applications

- Low noise amplifiers (LNAs) in GNSS receivers
- LNAs in satellite radio (SDARs, DAB) receivers
- LNAs in multimedia applications such as CATV and FM radio

Device information

Table 1   **Part information**

Product name / Ordering code	Package	Pin configuration				Marking	Pieces / Reel
BFP640F / BFP640FH6327XTSA1	TSFP-4-1	1 = B	2 = E	3 = C	4 = E	R4s	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}	–	4.1	V	Open base
			3.6		T_A = -55 °C, open base
Collector emitter voltage	V_{CES}		13		E-B short circuited
Collector base voltage	V_{CBO}		13		Open emitter
Emitter base voltage	V_{EBO}		1.2		Open collector
Base current	I_B		3	mA	–
Collector current	I_C		50		
Total power dissipation [1]	P_{tot}		200	mW	$T_S \leq 92$ °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
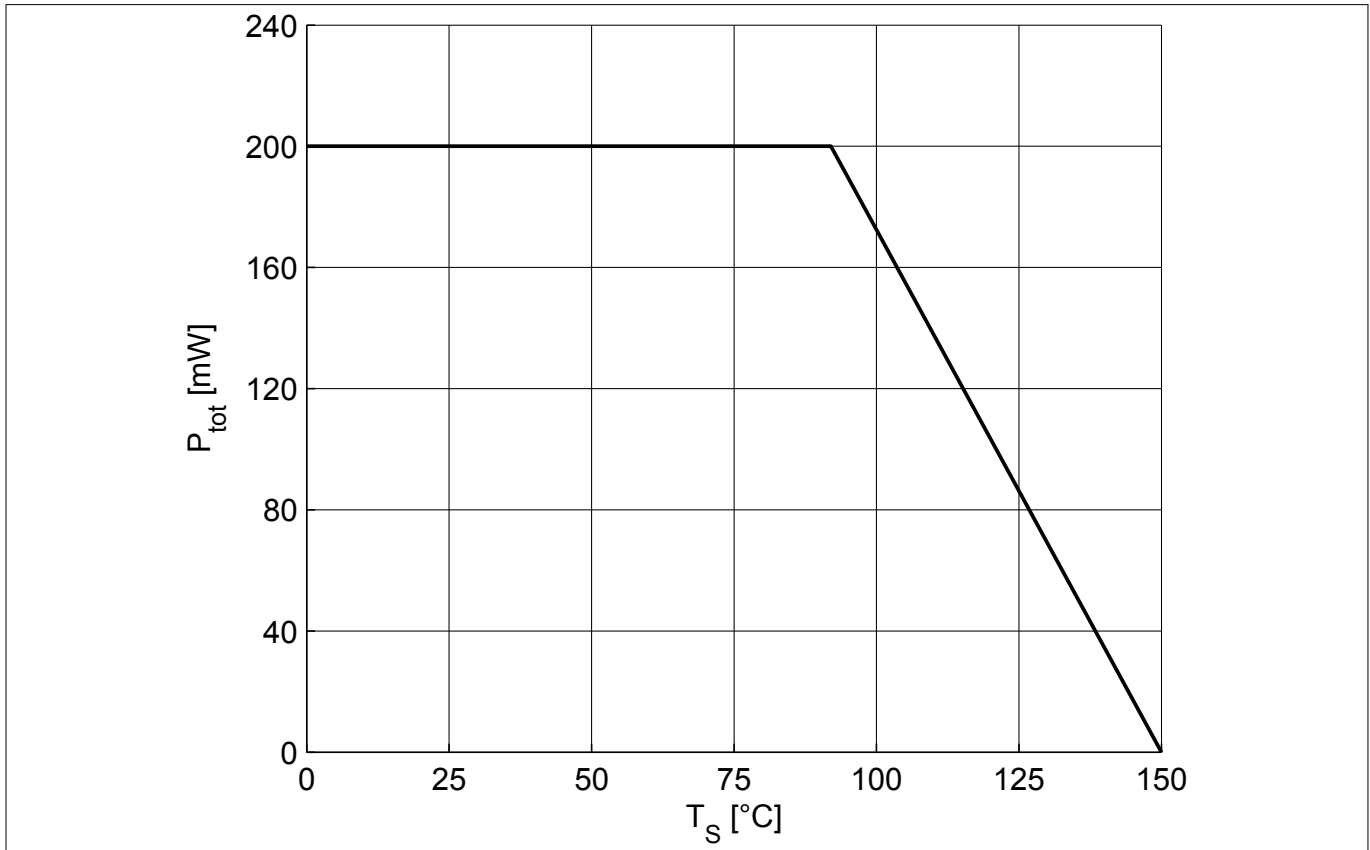*circuit.*

---

1   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}	–	–	290	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	$V_{(BR)CEO}$	4.1	4.7	–	V	I_C = 1 mA, I_B = 0, open base
Collector emitter leakage current	I_{CES}	–	1	400 [2]	nA	V_{CE} = 13 V, V_{BE} = 0, E-B short circuited
			1	40 [2]		V_{CE} = 5 V, V_{BE} = 0, E-B short circuited
Collector base leakage current	I_{CBO}		1	40 [2]		V_{CB} = 5 V, I_E = 0, open emitter
Emitter base leakage current	I_{EBO}		1	40 [2]		V_{EB} = 0.5 V, I_C = 0, open collector
DC current gain	h_{FE}	110	180	270		V_{CE} = 3 V, I_C = 30 mA, pulse measured

3.2 General AC characteristics

Table 5 General AC characteristics at T_A = 25 °C

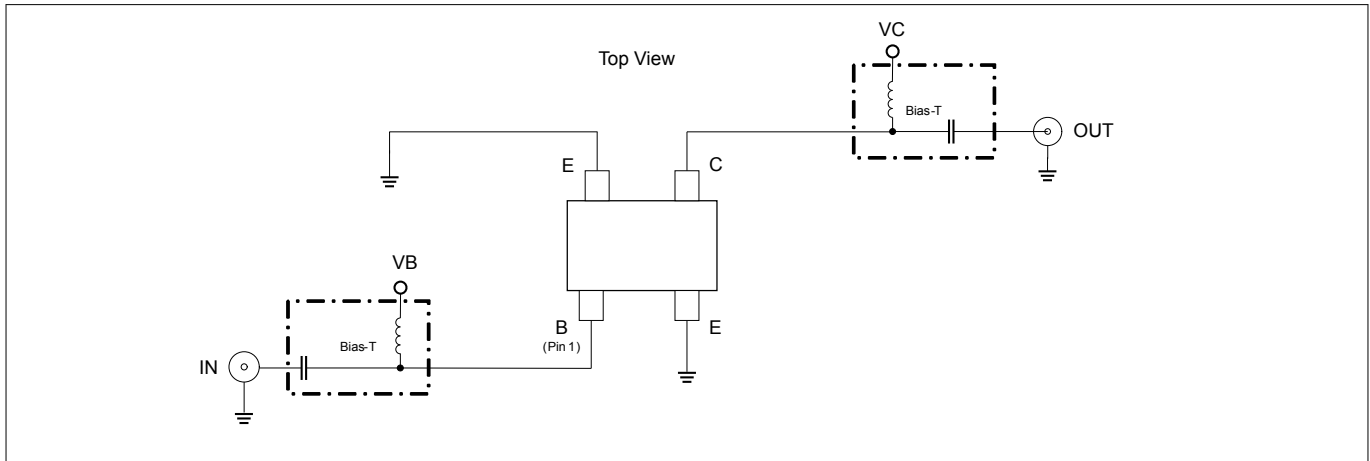| Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Transition frequency	f_T	–	42	–	GHz	V_{CE} = 3 V, I_C = 30 mA, f = 1 GHz
Collector base capacitance	C_{CB}		0.09		pF	V_{CB} = 3 V, V_{BE} = 0, f = 1 MHz, emitter grounded
Collector emitter capacitance	C_{CE}		0.2			V_{CE} = 3 V, V_{BE} = 0, f = 1 MHz, base grounded
Emitter base capacitance	C_{EB}		0.47			V_{EB} = 0.5 V, V_{CB} = 0, f = 1 MHz, collector grounded

---

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

Electrical characteristics

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 = 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 31	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		0.55 26			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		23.5 10.5		dBm	I_C = 25 mA, $Z_S = Z_L$ = 50 Ω

Table 7   **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} $\|S_{21}\|^2$	–	28.5 26.5	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		0.55 23.5			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		26 12.5		dBm	I_C = 25 mA, $Z_S = Z_L$ = 50 Ω

Electrical characteristics

Table 8   **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} $\|S_{21}\|^2$	–	25 22.5	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		0.6 20.5			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		26 12		dBm	I_C = 25 mA, $Z_S = Z_L$ = 50 Ω

Table 9   **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} $\|S_{21}\|^2$	–	23 20.5	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		0.6 19			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		27 12.5		dBm	I_C = 25 mA, $Z_S = Z_L$ = 50 Ω

Table 10   **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_{ma} $\|S_{21}\|^2$	–	20 18.5	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		0.65 17			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		28 12.5		dBm	I_C = 25 mA, $Z_S = Z_L$ = 50 Ω

Electrical characteristics

Table 11   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_{ma} $\lvert S_{21} \rvert^2$	–	16.5 15.5	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		0.75 14			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		27.5 12		dBm	I_C = 25 mA, Z_S = Z_L = 50 Ω

Table 12   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_{ma} $\lvert S_{21} \rvert^2$	–	12.5 11.5	–	dB	I_C = 25 mA
Noise figure • Minimum noise figure • Associated gain	NF_{min} G_{ass}		1.0 11			I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	OIP_3 OP_{1dB}		27.5 12.5		dBm	I_C = 25 mA, Z_S = Z_L = 50 Ω

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
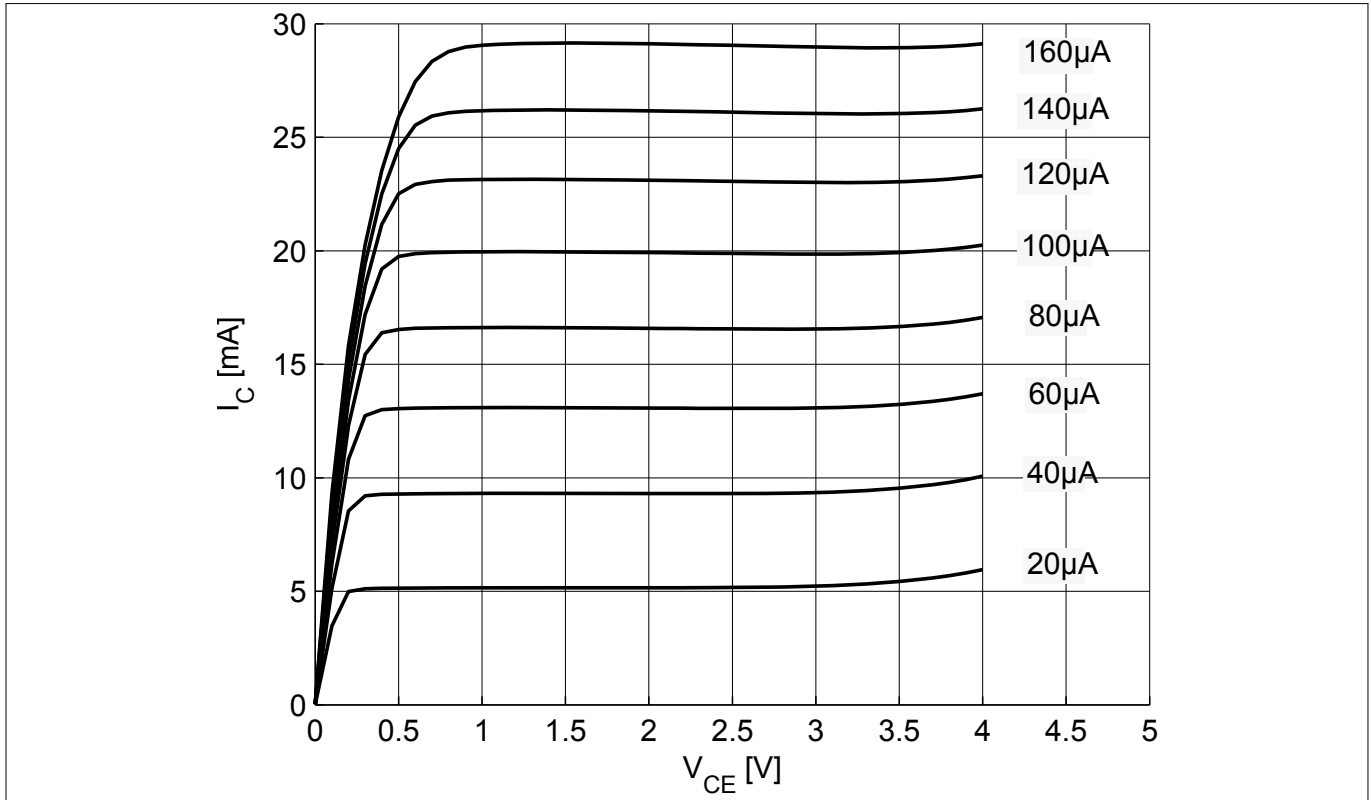
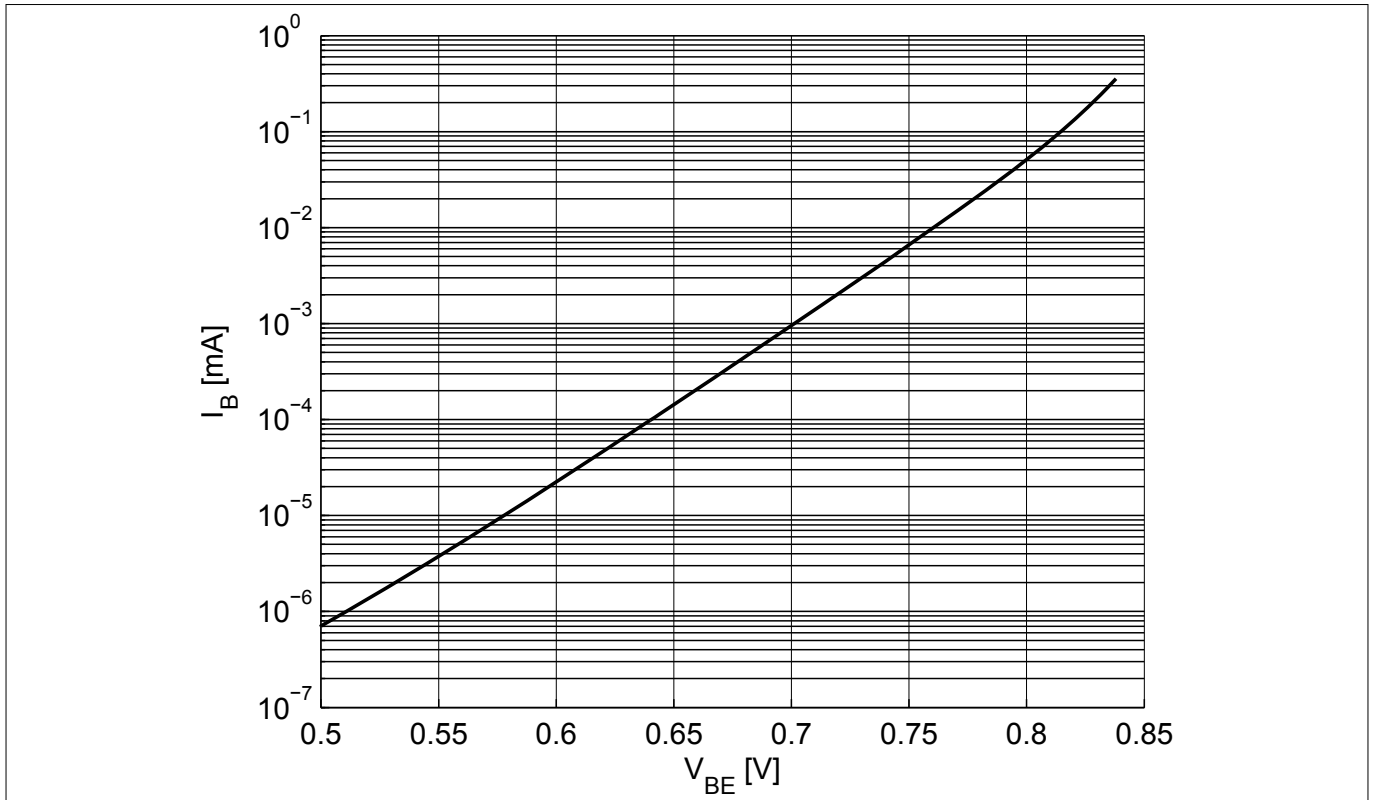**Figure 3** Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, I_B = parameter
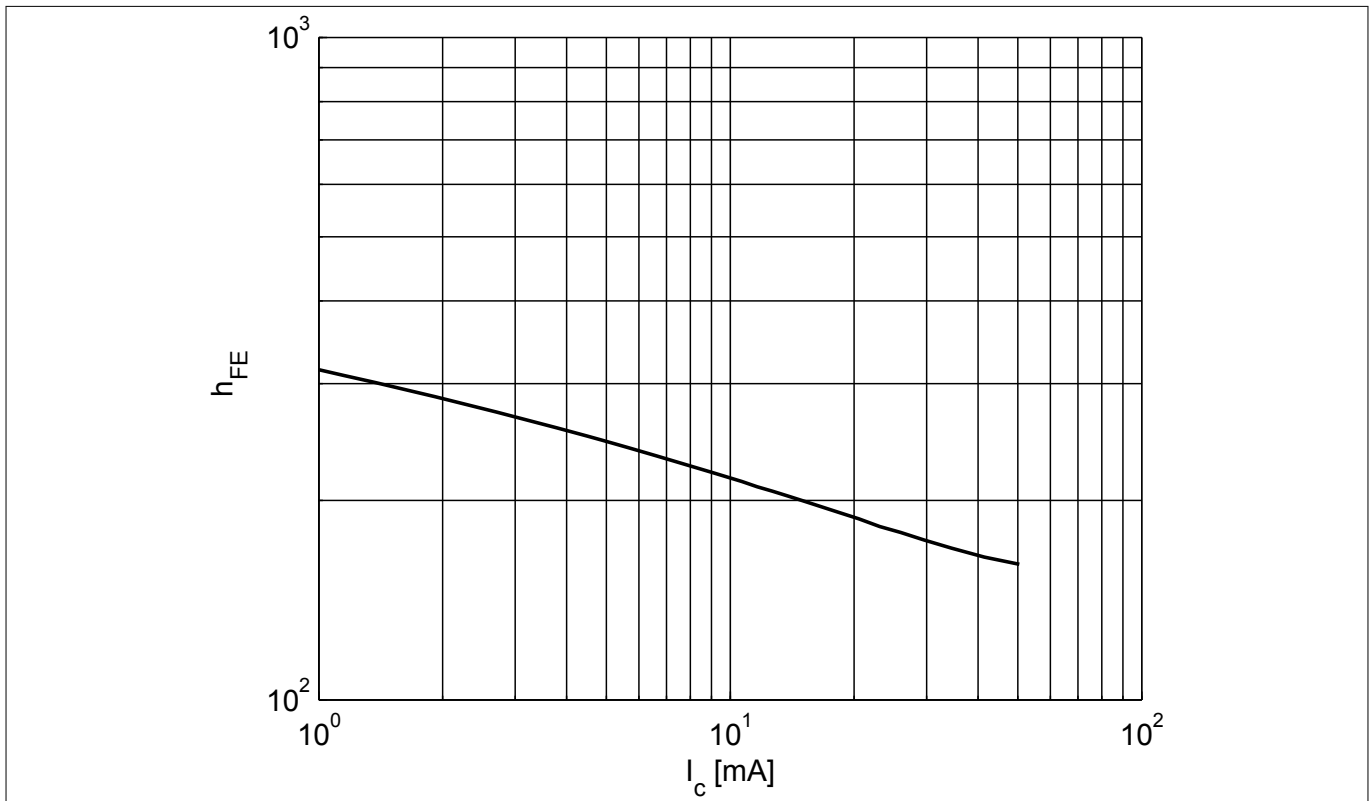
Figure 4 DC current gain $h_{FE} = f(I_C)$, V_{CE} = 3 V
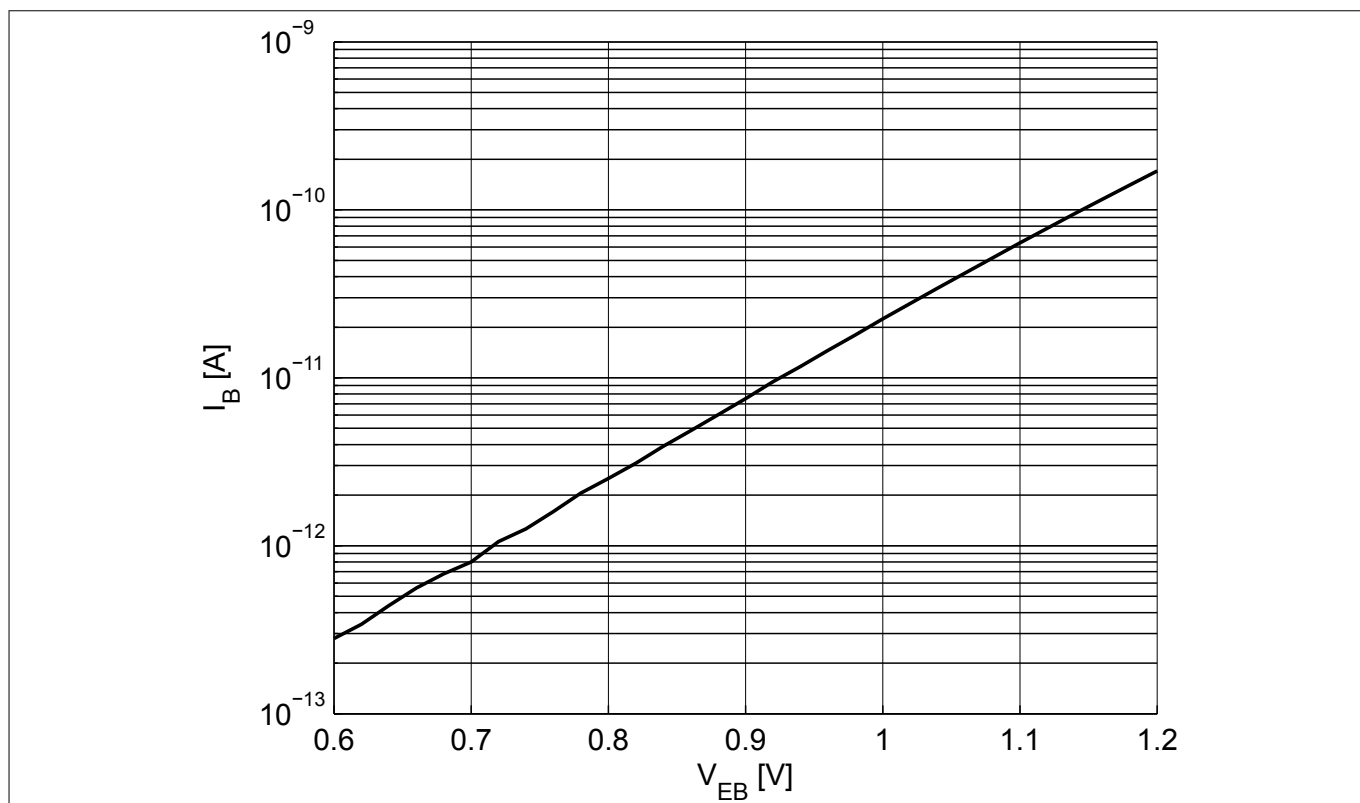
Electrical characteristics
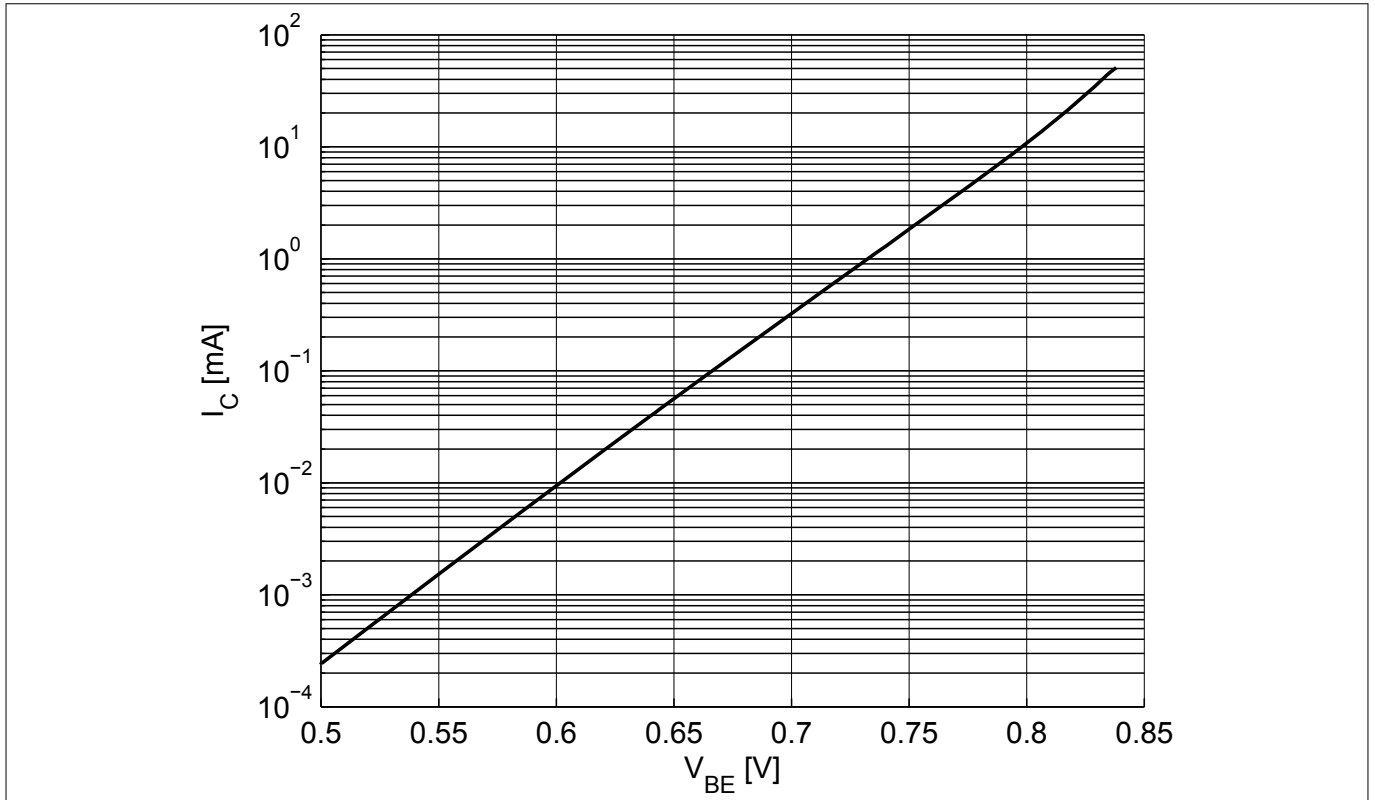
Figure 5   **Collector current vs. base emitter forward voltage** $I_C = f(V_{BE})$, $V_{CE} = 2$ V

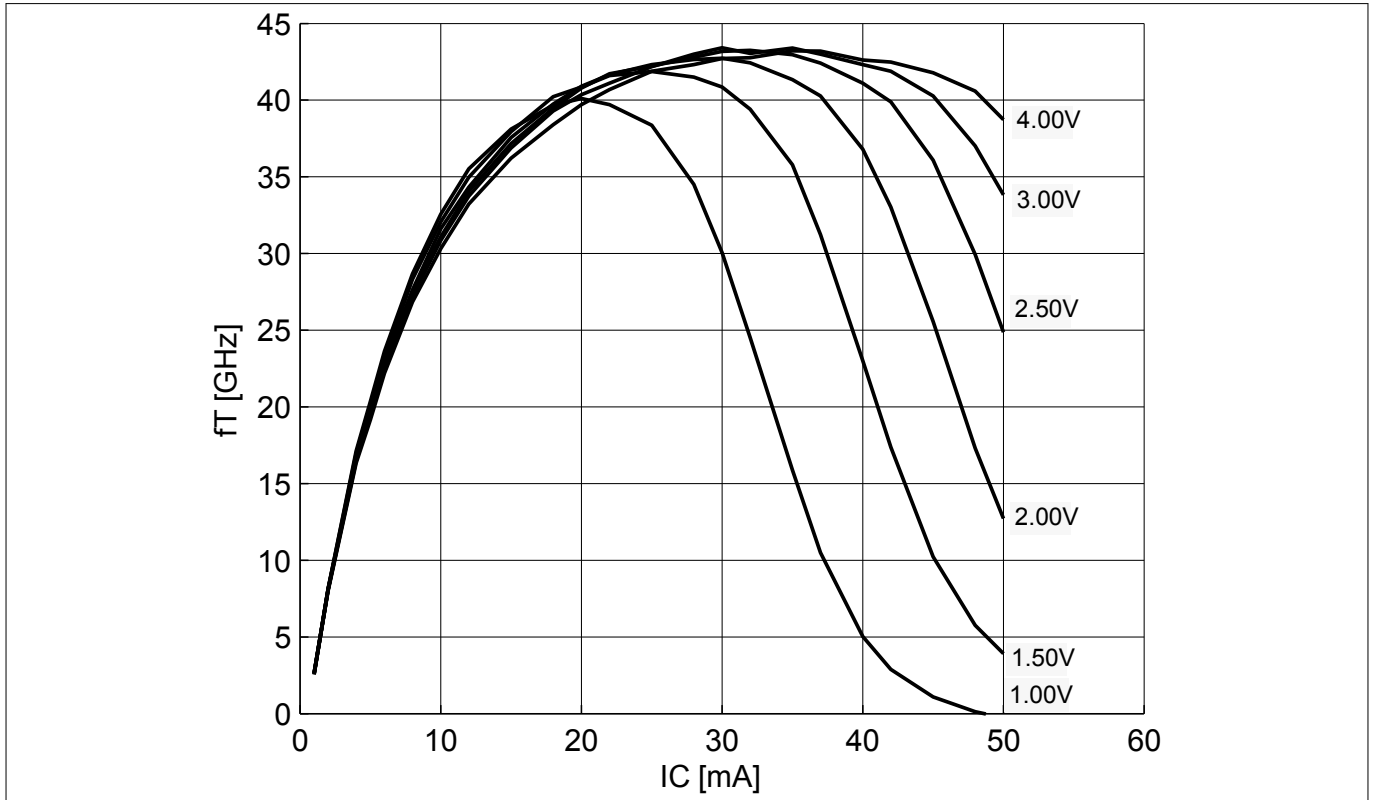**Figure 6**   **Base current vs. base emitter forward voltage** $I_B = f(V_{BE})$, $V_{CE} = 2$ V
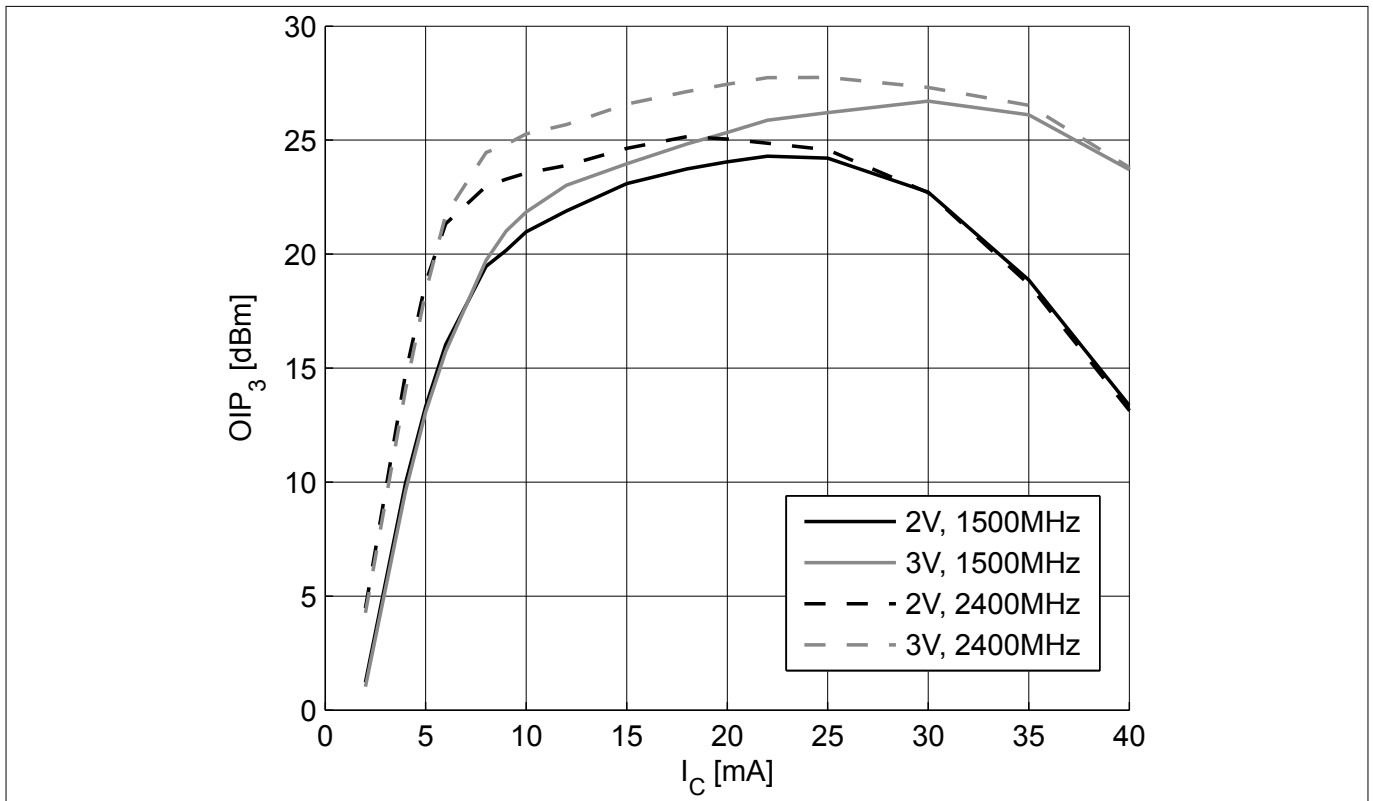
Electrical characteristics

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
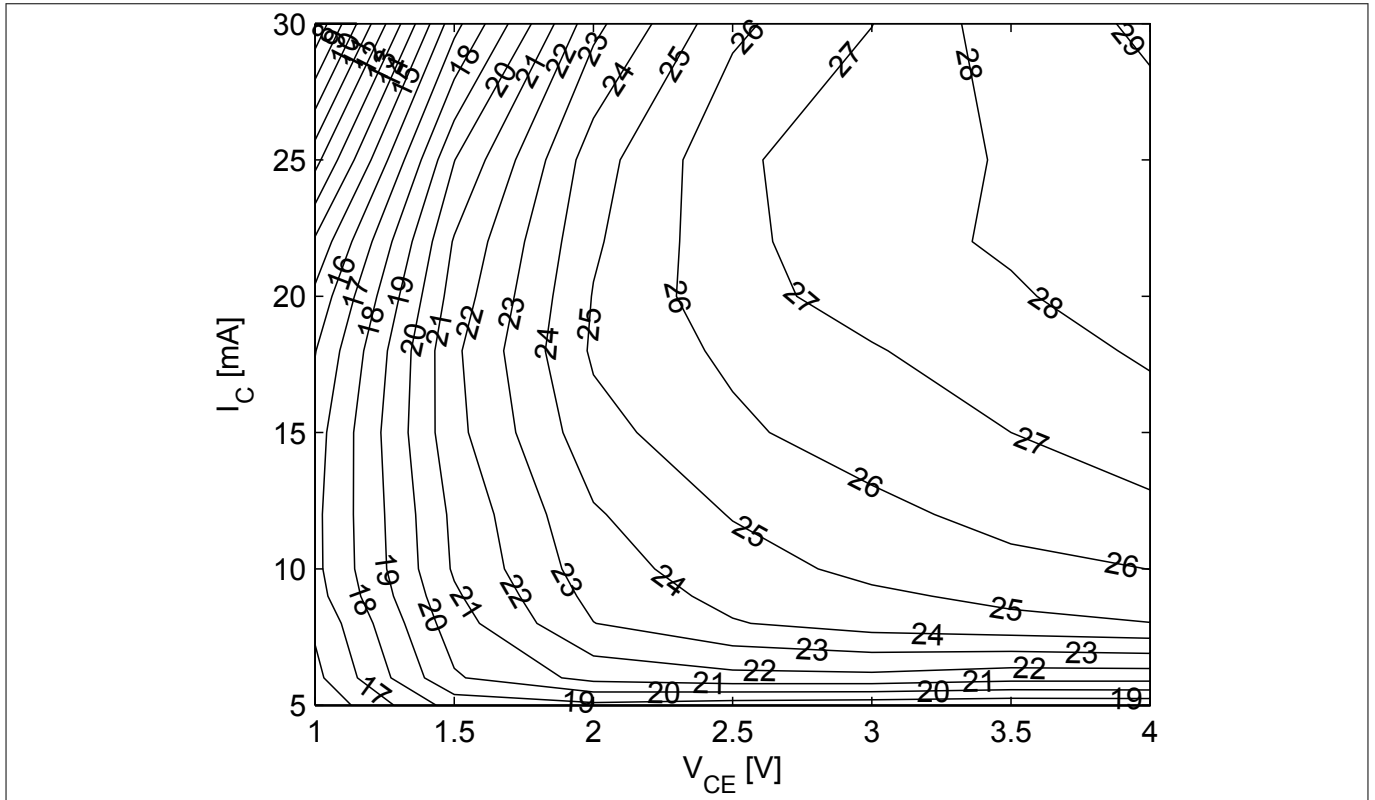
Figure 10   3rd order intercept point at output OIP_3 [dBm] = f(I_C, V_{CE}), $Z_S = Z_L = 50\ \Omega$, $f = 2.4$ GHz
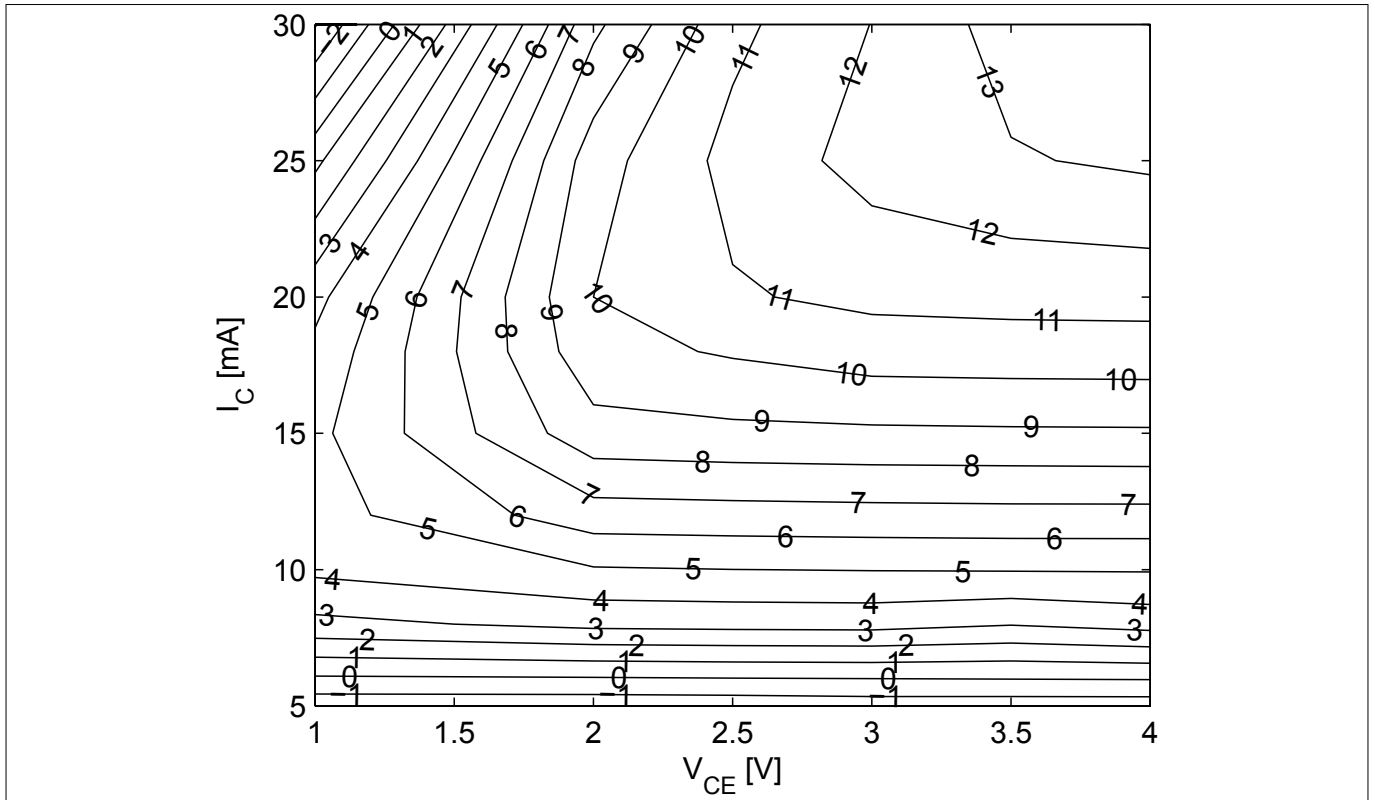
Figure 11   Compression point at output OP_{1dB} [dBm] = f(I_C, V_{CE}), $Z_S = Z_L = 50\ \Omega$, $f = 2.4$ GHz

Electrical characteristics
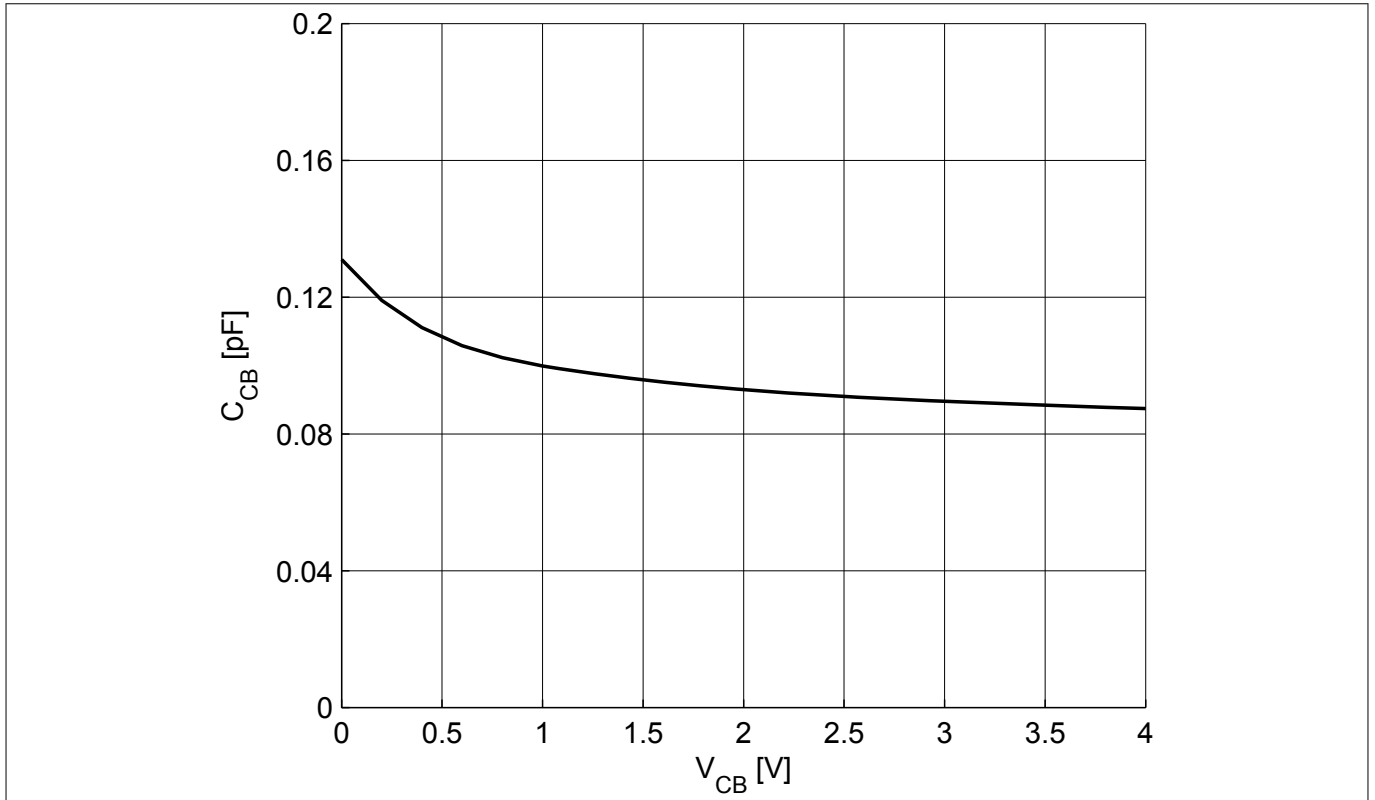
Figure 12   **Collector base capacitance C_{CB} = f(V_{CB}), f = 1 MHz**
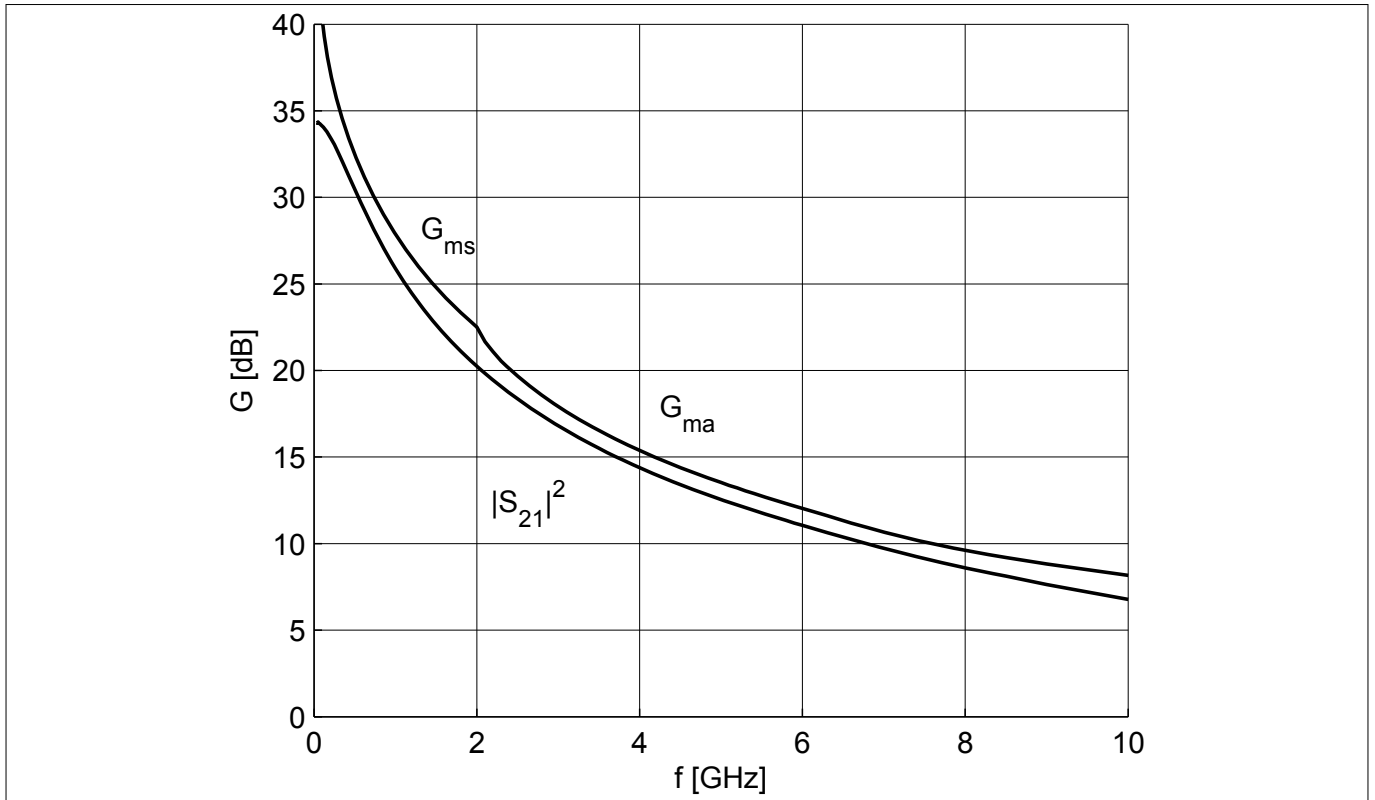
Figure 13   **Gain G_{ma}, G_{ms}, IS_{21}I^2 = f(f), V_{CE} = 3 V, I_C = 25 mA**

Electrical characteristics
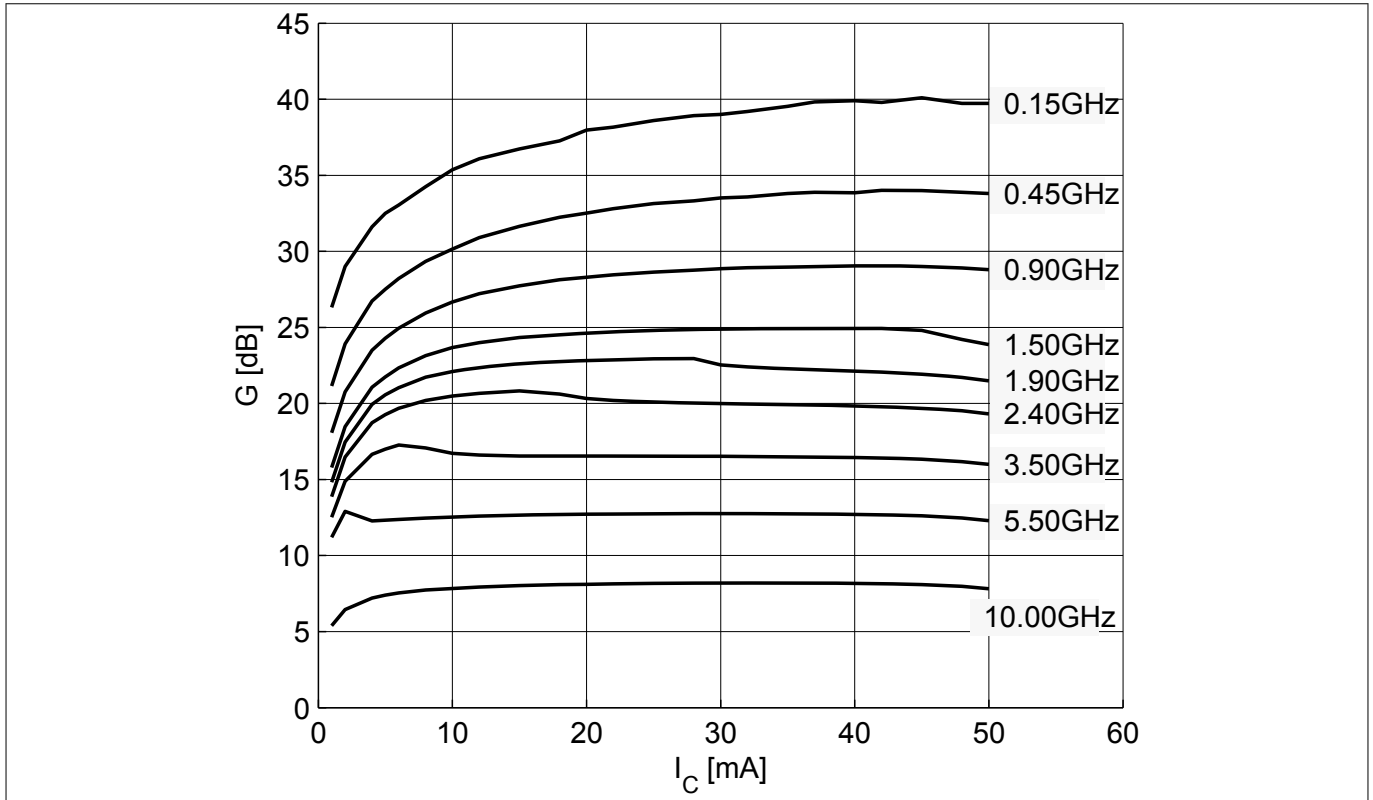
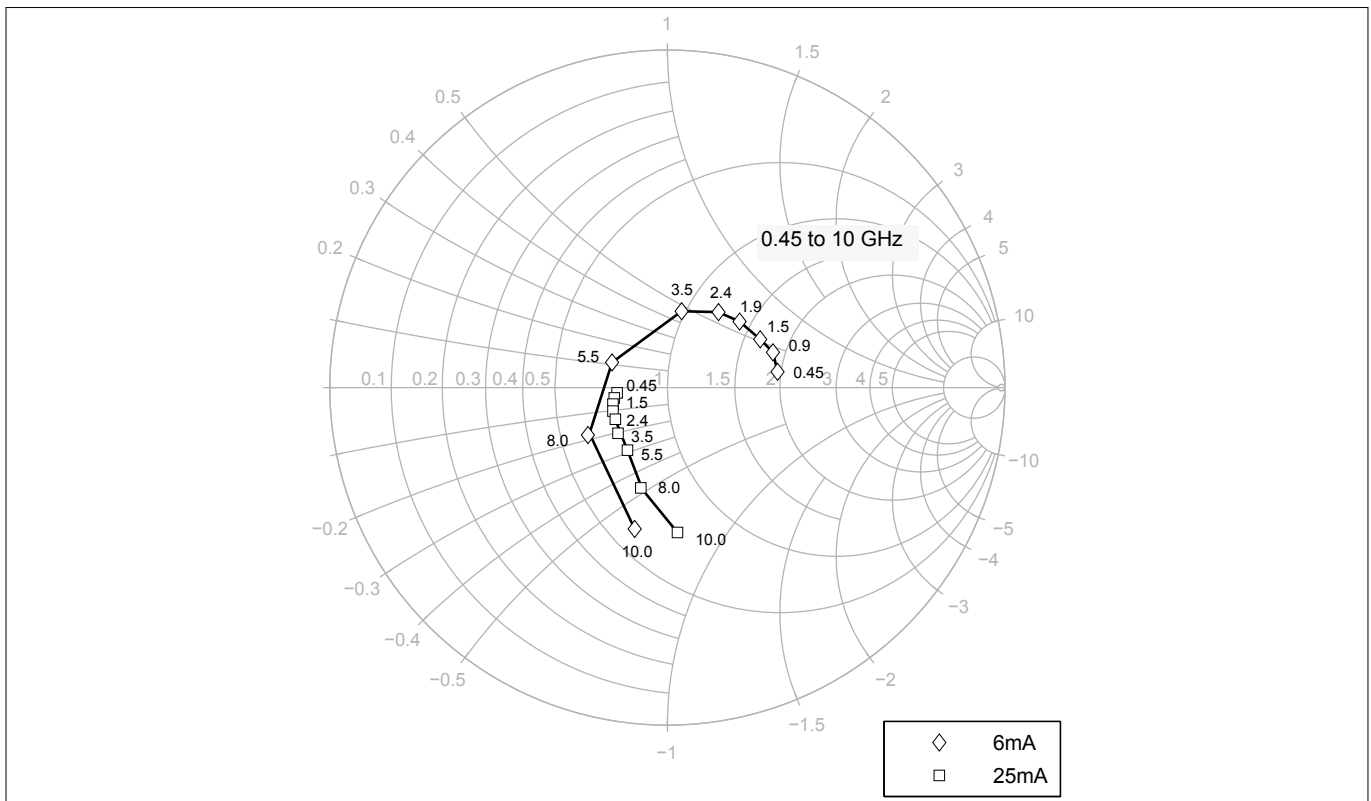**Figure 14**   **Maximum power gain $G_{max} = f(I_C)$, V_{CE} = 3 V, f = parameter in GHz**
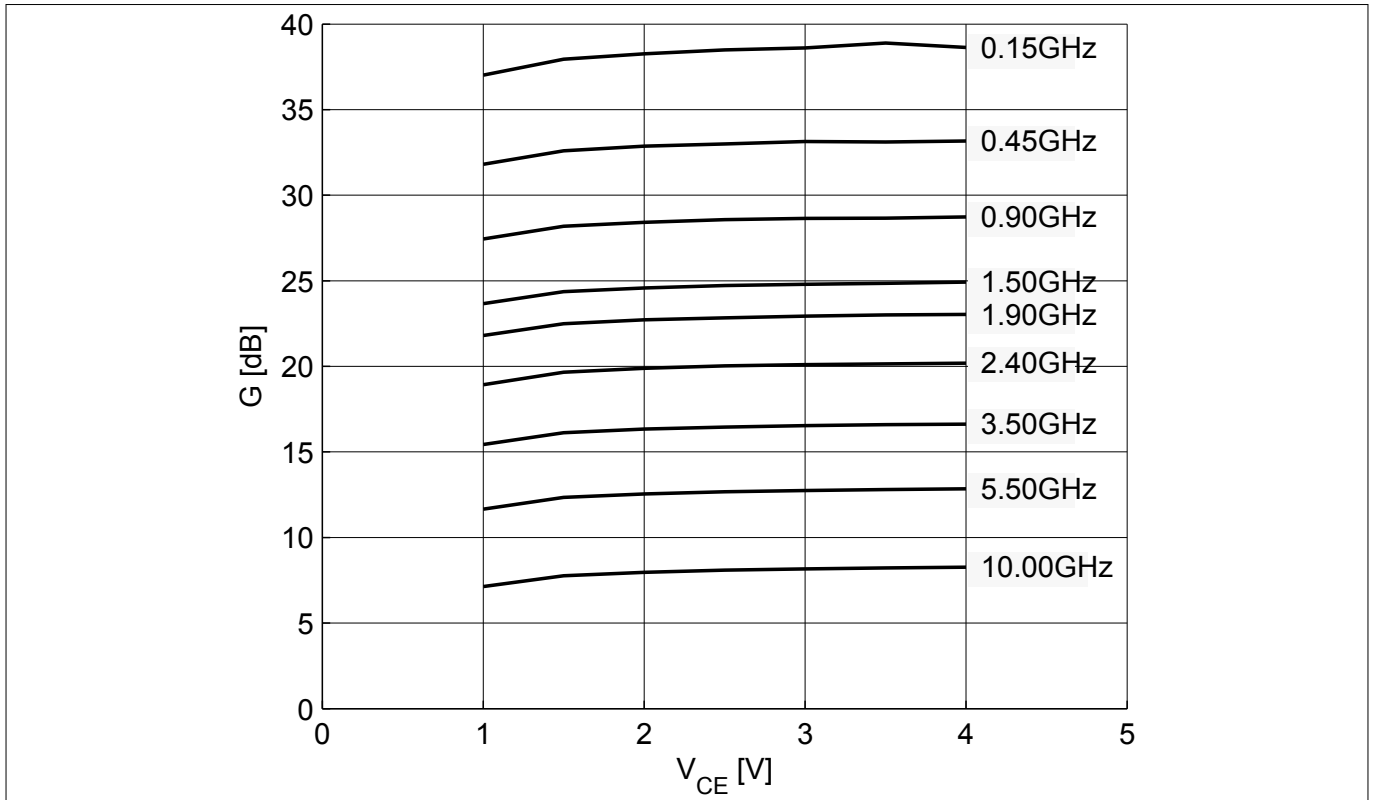
Figure 15   **Maximum power gain $G_{max} = f(V_{CE})$, I_C = 25 mA, f = parameter in GHz**

Electrical characteristics
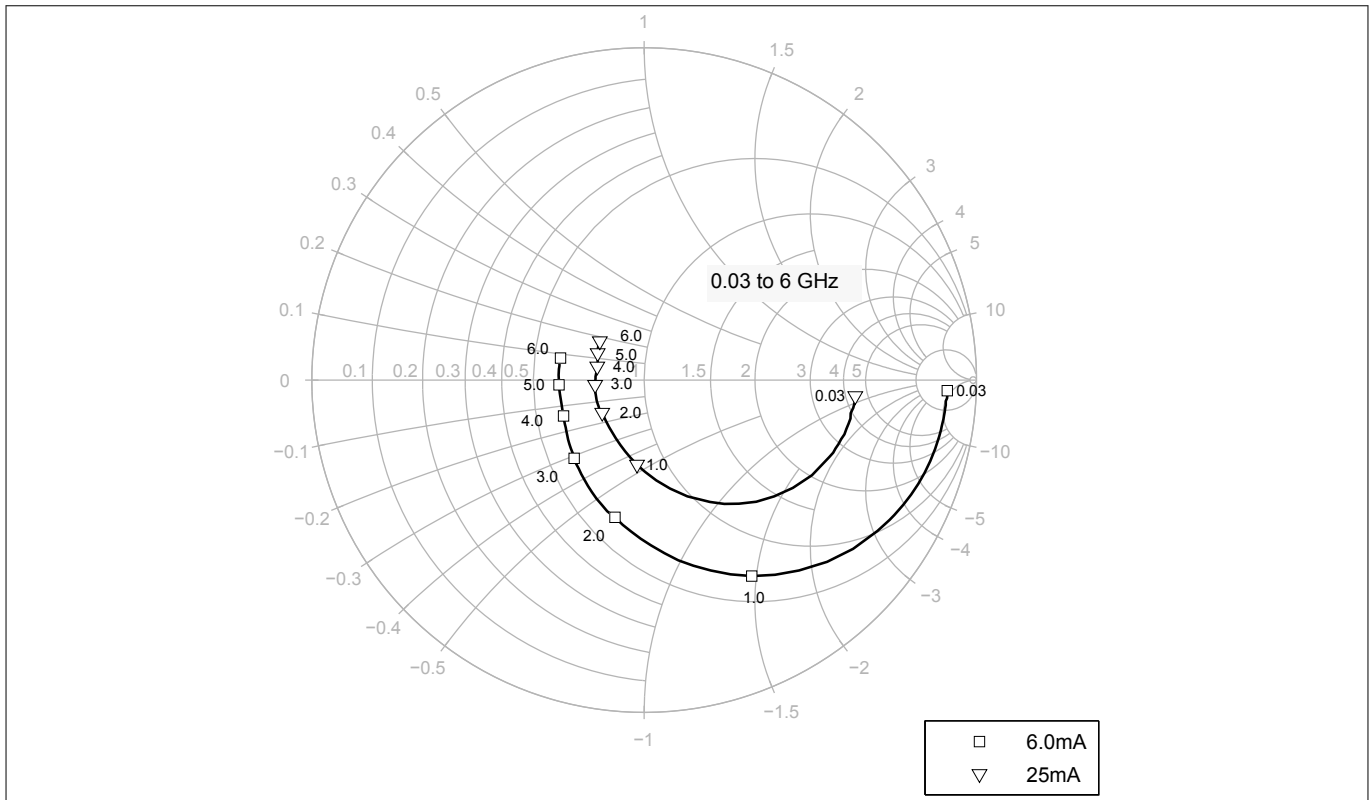
Figure 16   **Input reflection coefficient S_{11} = f(f), V_{CE} = 3 V, I_C = 6 / 25 mA**
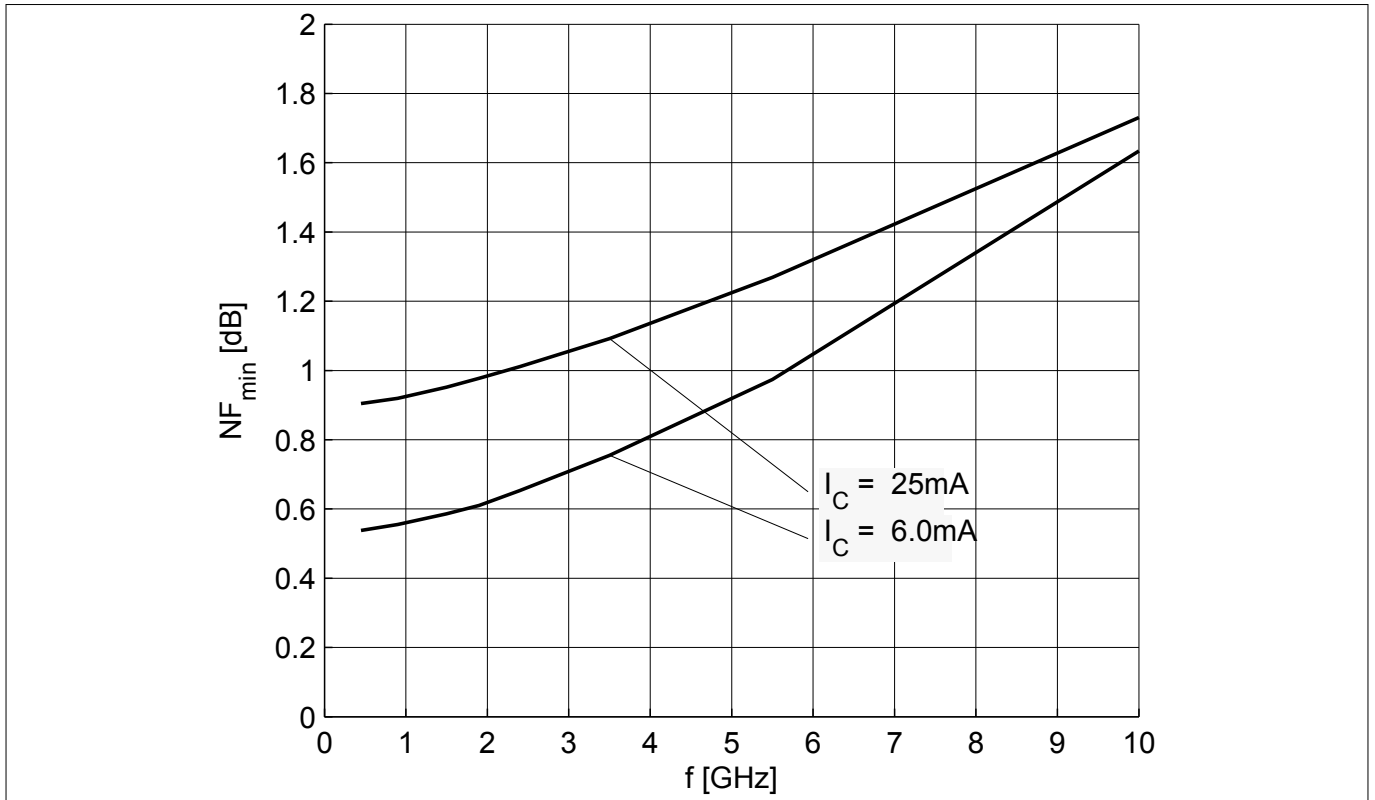

Figure 17   **Source impedance for minimum noise figure $Z_{S,opt}$ = f(f), V_{CE} = 3 V, I_C = 6 / 25 mA**
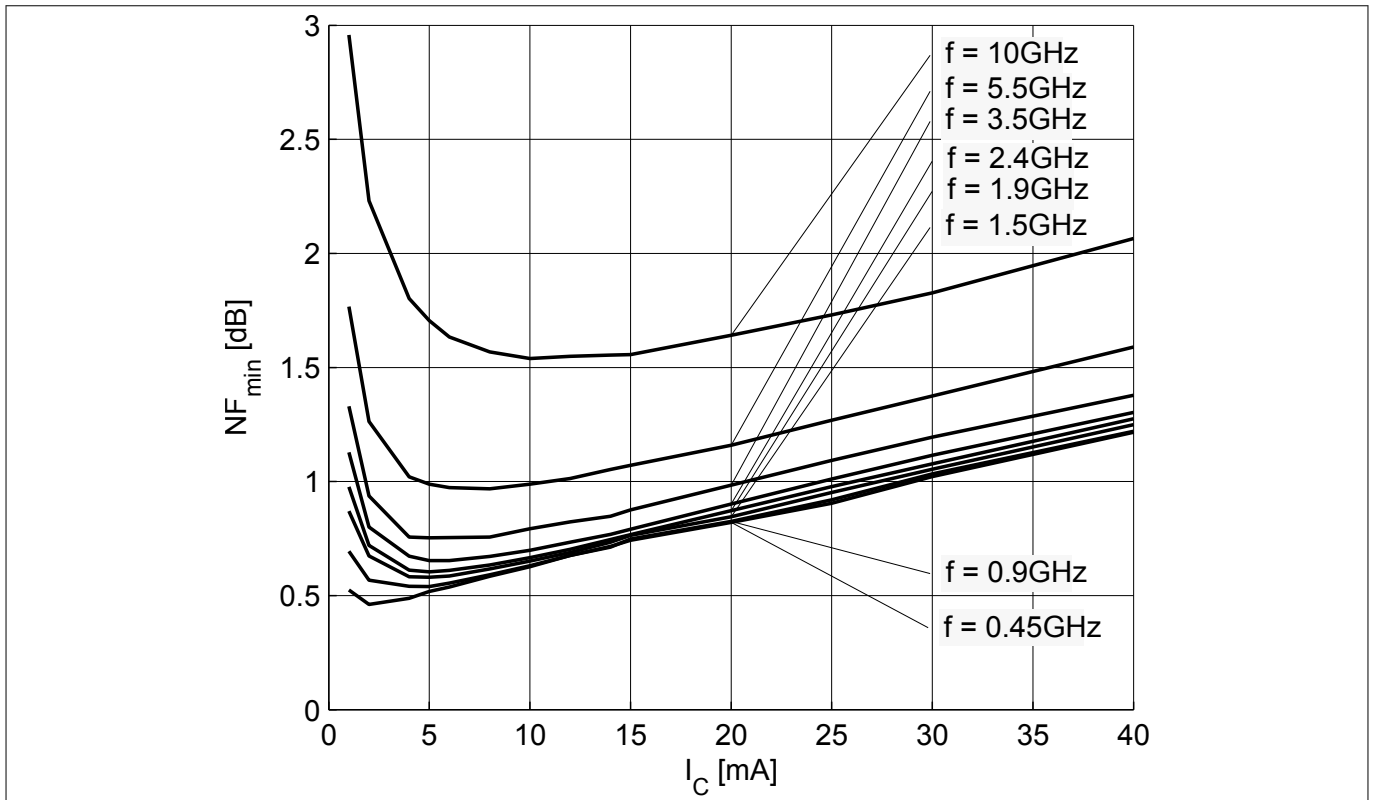
Electrical characteristics
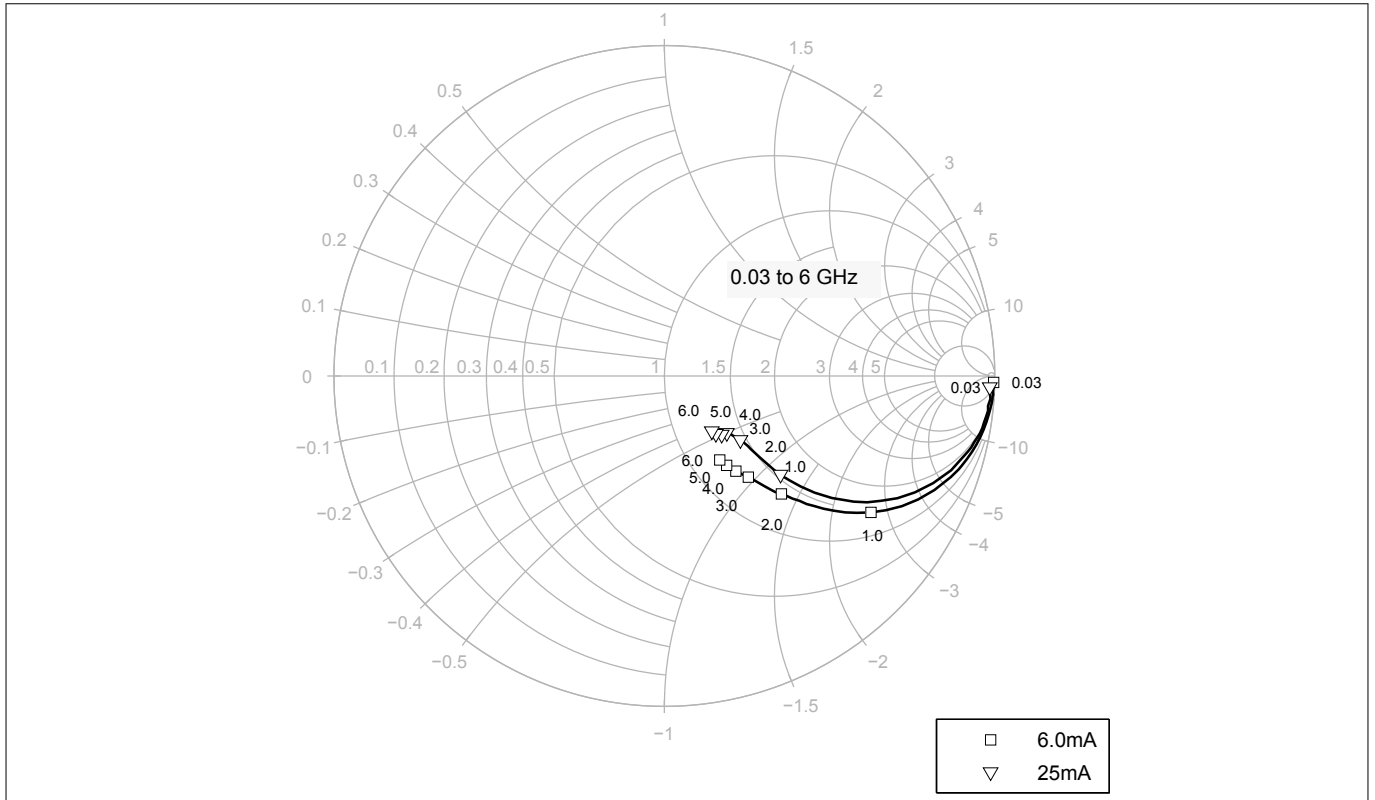
Figure 18   Output reflection coefficient $S_{22} = f(f)$, $V_{CE} = 3$ V, $I_C = 6 / 25$ mA
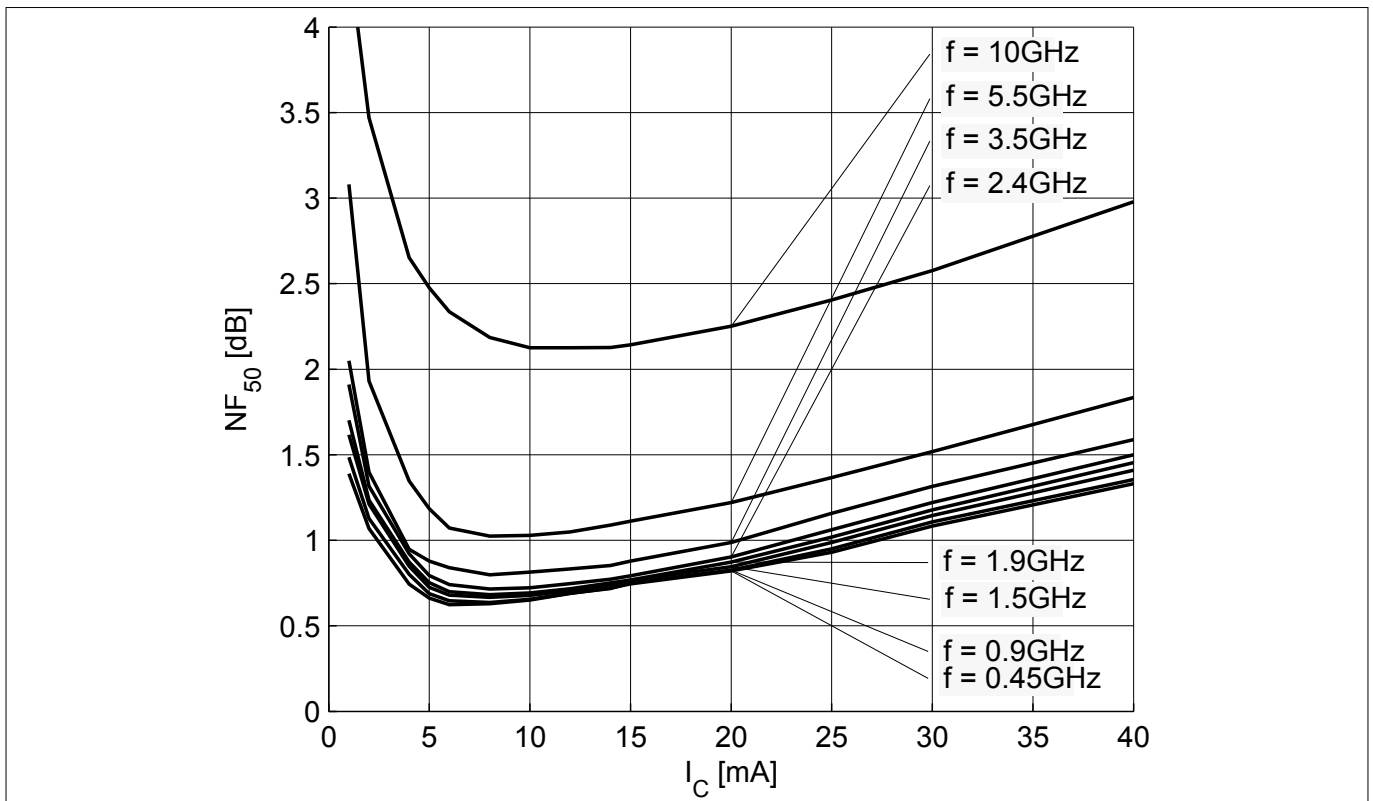

Figure 19   Noise figure $NF_{min} = f(f)$, $Z_S = Z_{S,opt}$, $V_{CE} = 3$ V, $I_C = 6 / 25$ mA

Electrical characteristics

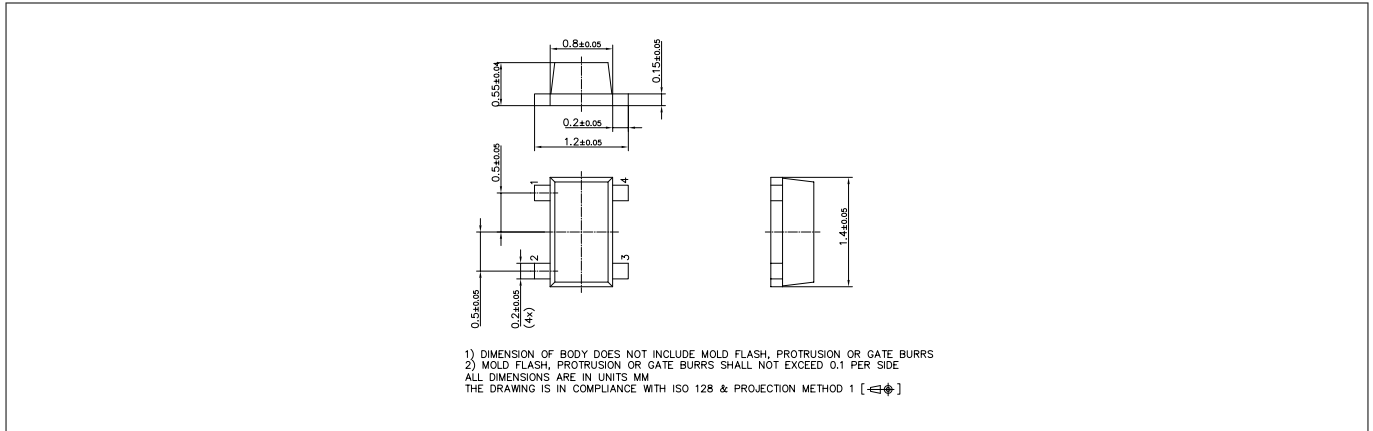**Figure 20**   Noise figure $NF_{min} = f(I_C)$, $Z_S = Z_{S,opt}$, $V_{CE} = 3$ V, f = parameter in GHz

Figure 21   Noise figure $NF_{50} = f(I_C)$, $Z_S = 50$ Ω, $V_{CE} = 3$ V, f = parameter in GHz
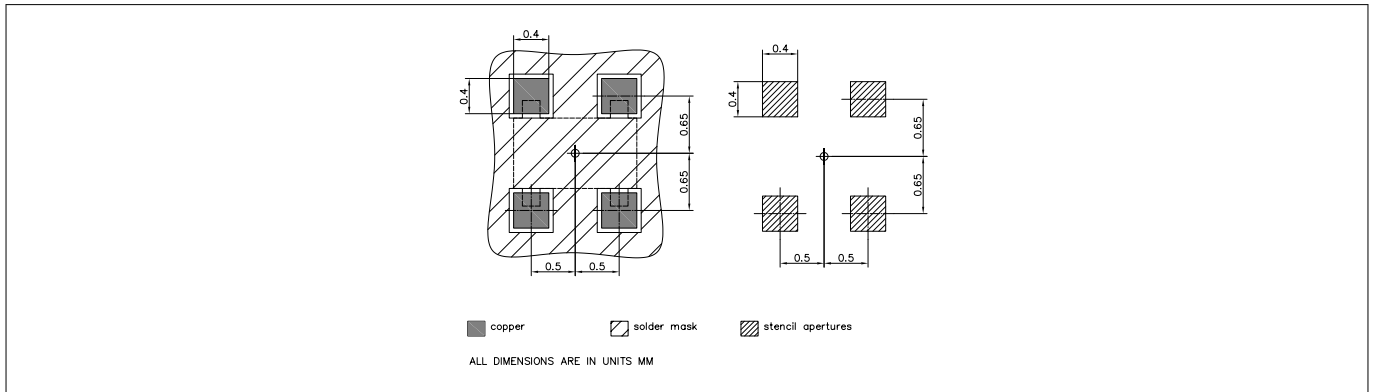
Note: The curves shown in this chapter have been generated using typical devices but shall not be considered as a guarantee that all devices have identical characteristic curves. $T_A = 25$ °C.
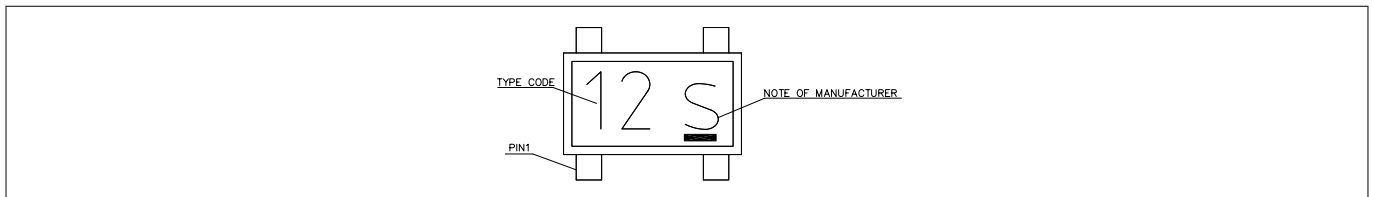
4   Package information TSFP-4-1
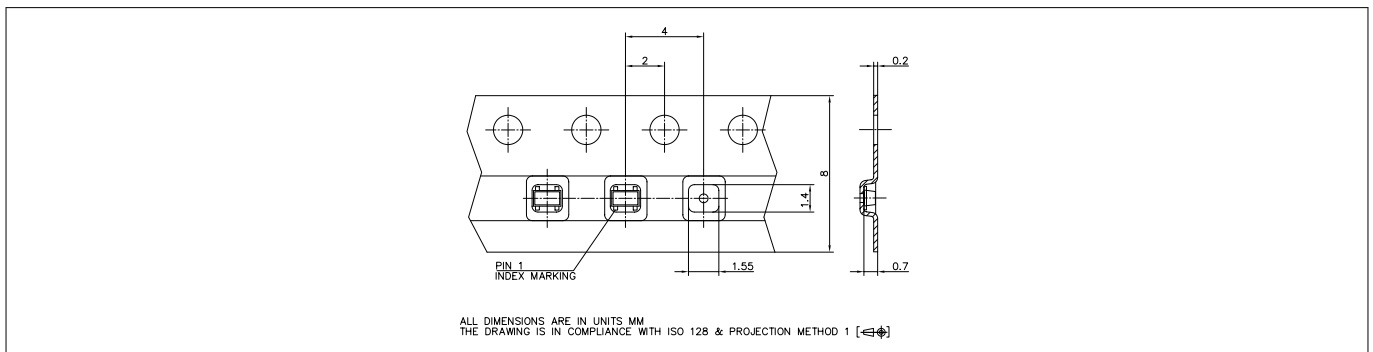

Figure 22   Package outline

Figure 23   Foot print

Figure 24   Marking layout example

Figure 25   Tape dimensions

Revision history

Document version	Date of release	Description of changes
Revision 3.0	2019-01-25	New datasheet layout.

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie") .

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury