BFP640FESD

Low profile robust silicon NPN RF bipolar transistor

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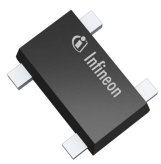
Product description

The BFP640FESD is a RF bipolar transistor based on SiGe:C technology that is part of Infineon's established sixth generation transistor family. Its ESD structure, high RF gain and low noise figure characteristics make the device suitable for a wide range of wireless applications. It remains cost competitive without compromising on ease of use.



Feature list

- Minimum noise figure NF_{min} = 0.75 dB at 3.5 GHz, 3 V, 6 mA
- High gain G_{ma} = 21.5 dB at 3.5 GHz, 3 V, 30 mA
- OIP_3 = 26 dBm at 3.5 GHz, 3 V, 30 mA
- High ESD robustness, typical 2 kV (HBM)

Product validation

Qualified for industrial applications according to the relevant tests of JEDEC JESD47, JESD22, and J-STD-020.
Qualified for industrial applications according to the relevant tests of AEC-Q 101.

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
BFP640FESD / BFP640FESDH6327XTSA1	TSFP-4-1	1 = B	2 = E	3 = C	4 = E	T4s	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 [1]	V_{CES}		4.1		E-B short circuited
			3.6		T_A = -55 °C, E-B short circuited
Collector base voltage [2]	V_{CBO}		4.8		Open emitter
			4.3		T_A = -55 °C, open emitter
Base current	I_B	-10	6	mA	–
Collector current	I_C	–	50		
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}	–	200	mW	$T_S \leq 90$ °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 V_{CES} is similar to V_{CEO} due to design.
2 V_{CBO} is similar 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}	–	300	–	K/W	–

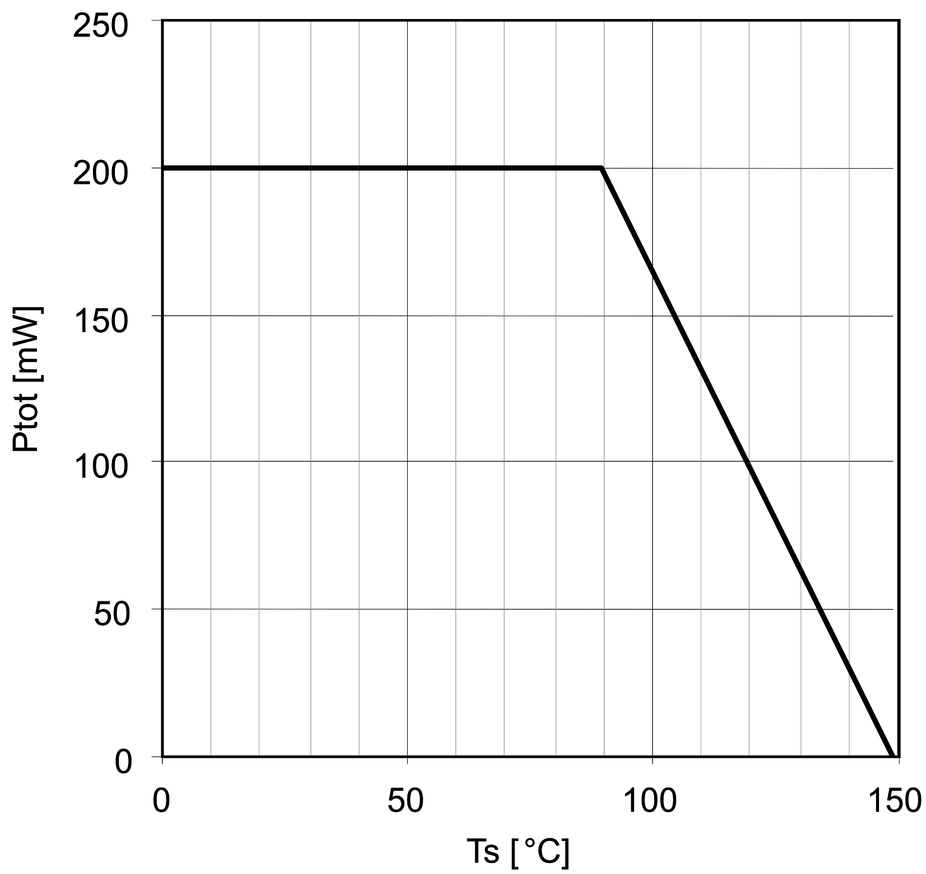


Figure 1 Total power dissipation P_{tot} = f(T_s)

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}	–	–	500 [4]	nA	V_{CE} = 2 V, V_{BE} = 0, E-B short circuited
Collector base leakage current	I_{CBO}			500 [4]		V_{CB} = 2 V, I_E = 0, open emitter
Emitter base leakage current	I_{EBO}			10 [4]	µA	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	–	46	–	GHz	V_{CE} = 3 V, I_C = 30 mA, f = 1 GHz
Collector base capacitance	C_{CB}		0.08		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}		0.6			V_{EB} = 0.4 V, V_{CB} = 0, f = 1 MHz, collector grounded

[4] 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.

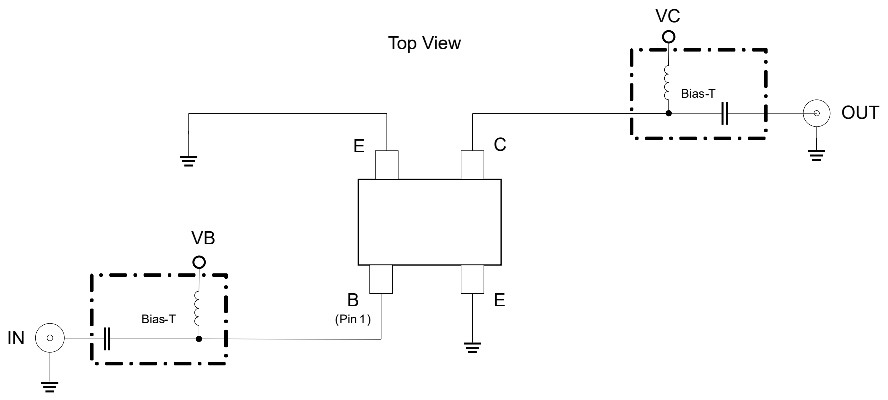


Figure 2 **Testing circuit**

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} $\|S_{21}\|^2$	–	 40 35.5	–	dB	 I_C = 30 mA
Noise figure • Minimum noise figure • Associated gain	 NF_{min} G_{ass}		 0.55 30.5			 I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	 OIP_3 OP_{1dB}		 24.5 11		dBm	 I_C = 30 mA, Z_S = Z_L = 50 Ω

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} $\|S_{21}\|^2$	–	 35 33	–	dB	 I_C = 30 mA
Noise figure • Minimum noise figure • Associated gain	 NF_{min} G_{ass}		 0.55 28.5			 I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	 OIP_3 OP_{1dB}		 24.5 11		dBm	 I_C = 30 mA, Z_S = Z_L = 50 Ω

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		31.5			I_C = 30 mA
• Transducer gain	$\|S_{21}\|^2$		29.5			
Noise figure						
• Minimum noise figure	NF_{min}		0.55			I_C = 6 mA
• Associated gain	G_{ass}		26			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		25			I_C = 30 mA, Z_S = Z_L = 50 Ω
• 1 dB gain compression point at output	OP_{1dB}		11			

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		–		–	dB	
• Maximum power gain	G_{ms}		28.5			I_C = 30 mA
• Transducer gain	$\|S_{21}\|^2$		25.5			
Noise figure						
• Minimum noise figure	NF_{min}		0.6			I_C = 6 mA
• Associated gain	G_{ass}		22.5			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		25.5			I_C = 30 mA, Z_S = Z_L = 50 Ω
• 1 dB gain compression point at output	OP_{1dB}		11.5			

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		–		–	dB	
• Maximum power gain	G_{ms}		26.5			I_C = 30 mA
• Transducer gain	$\|S_{21}\|^2$		23.5			
Noise figure						
• Minimum noise figure	NF_{min}		0.6			I_C = 6 mA
• Associated gain	G_{ass}		21			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		26			I_C = 30 mA, Z_S = Z_L = 50 Ω
• 1 dB gain compression point at output	OP_{1dB}		11.5			

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} $\|S_{21}\|^2$	–	 25 21.5	–	dB	 I_C = 30 mA
Noise figure • Minimum noise figure • Associated gain	 NF_{min} G_{ass}		 0.65 19.5			 I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	 OIP_3 OP_{1dB}		 26 11.5		dBm	 I_C = 30 mA, Z_S = Z_L = 50 Ω

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_{ma} $\|S_{21}\|^2$	–	 21.5 18	–	dB	 I_C = 30 mA
Noise figure • Minimum noise figure • Associated gain	 NF_{min} G_{ass}		 0.75 15.5			 I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	 OIP_3 OP_{1dB}		 26 11.5		dBm	 I_C = 30 mA, Z_S = Z_L = 50 Ω

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_{ma} $\|S_{21}\|^2$	–	 16.5 14	–	dB	 I_C = 30 mA
Noise figure • Minimum noise figure • Associated gain	 NF_{min} G_{ass}		 0.95 13			 I_C = 6 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	 OIP_3 OP_{1dB}		 25.5 11		dBm	 I_C = 30 mA, Z_S = Z_L = 50 Ω

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ma}		11			I_C = 30 mA
• Transducer gain	$\|S_{21}\|^2$		8			
Noise figure						
• Minimum noise figure	NF_{min}		1.7			I_C = 6 mA
• Associated gain	G_{ass}		8			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		24.5			I_C = 30 mA, $Z_S = Z_L$ = 50 Ω
• 1 dB gain compression point at output	OP_{1dB}		11			

***Note**:* *$G_{ms} = IS_{21} / S_{12}I$ for k < 1; $G_{ma} = IS_{21} / S_{12}\ I(k-(k^2-1)^{1/2})$ 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

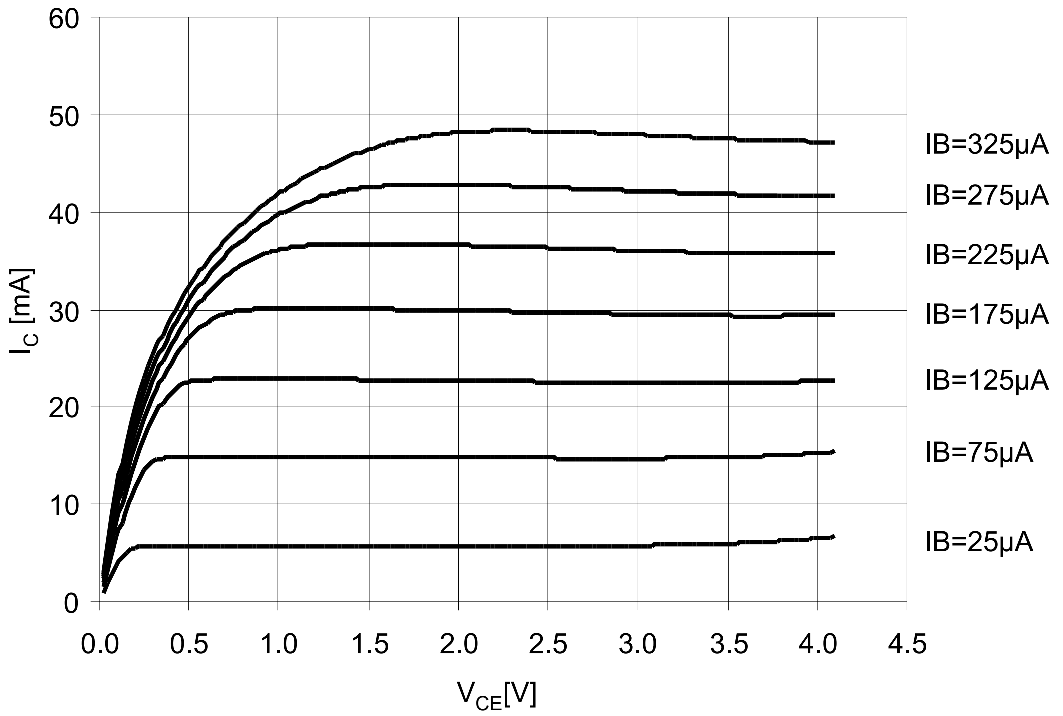


Figure 3 Collector current vs. collector emitter voltage I_C = f(V_{CE}), I_B = parameter

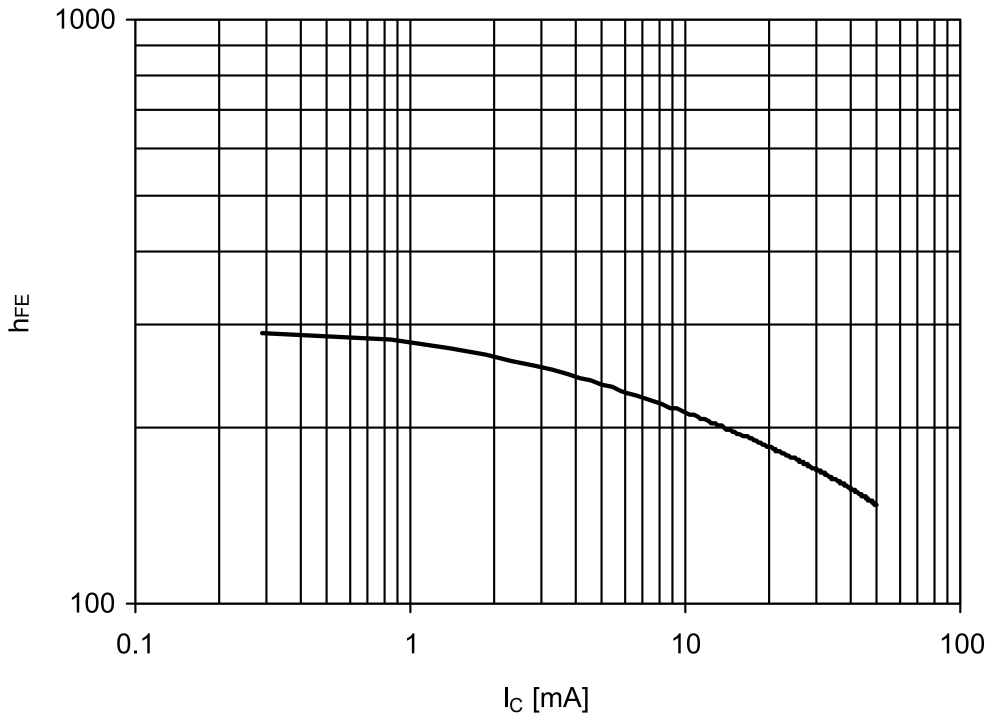


Figure 4 DC current gain h_{FE} = f(I_C), V_{CE} = 3 V

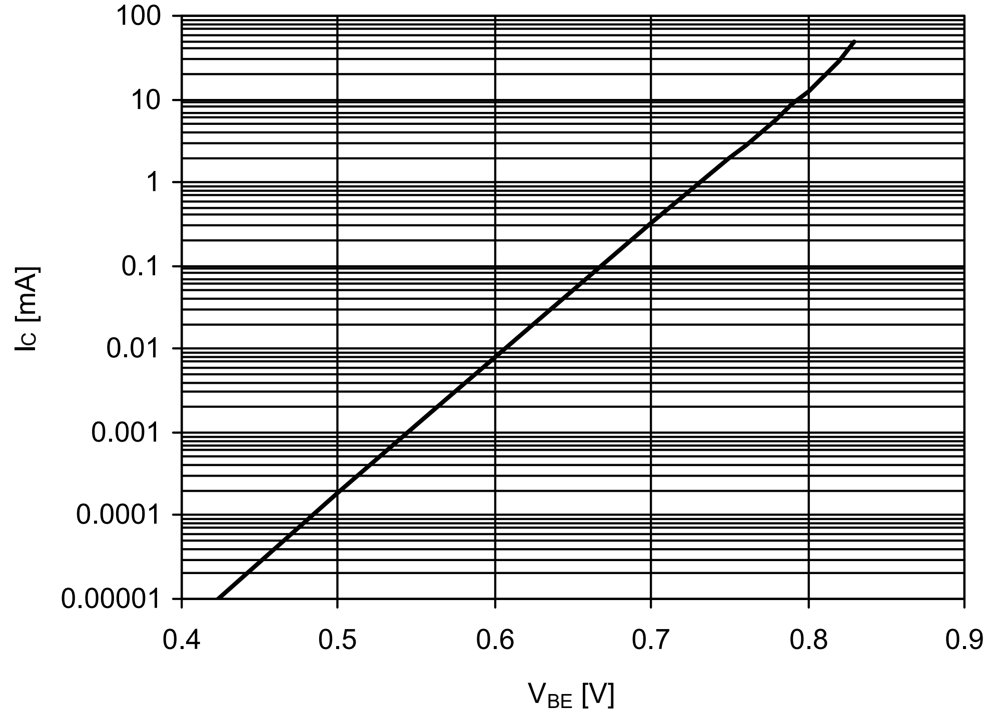


Figure 5 **Collector current vs. base emitter forward voltage I_C = f(V_{BE}), V_{CE} = 2 V**

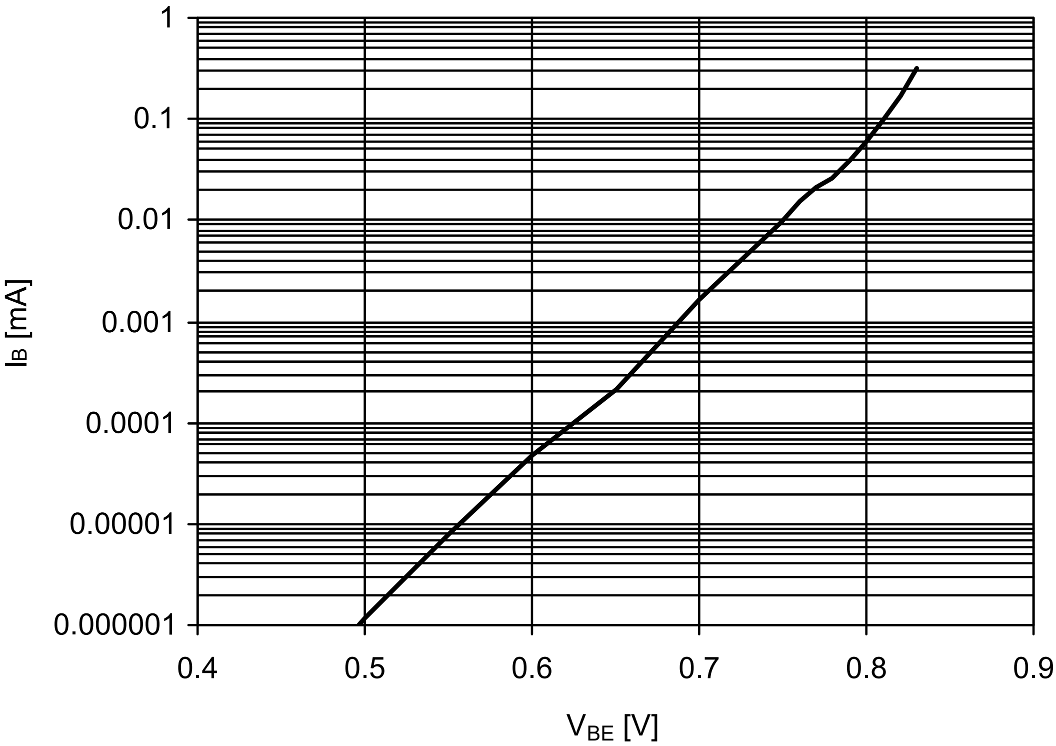


Figure 6 **Base current vs. base emitter forward voltage I_B = f(V_{BE}), V_{CE} = 2 V**

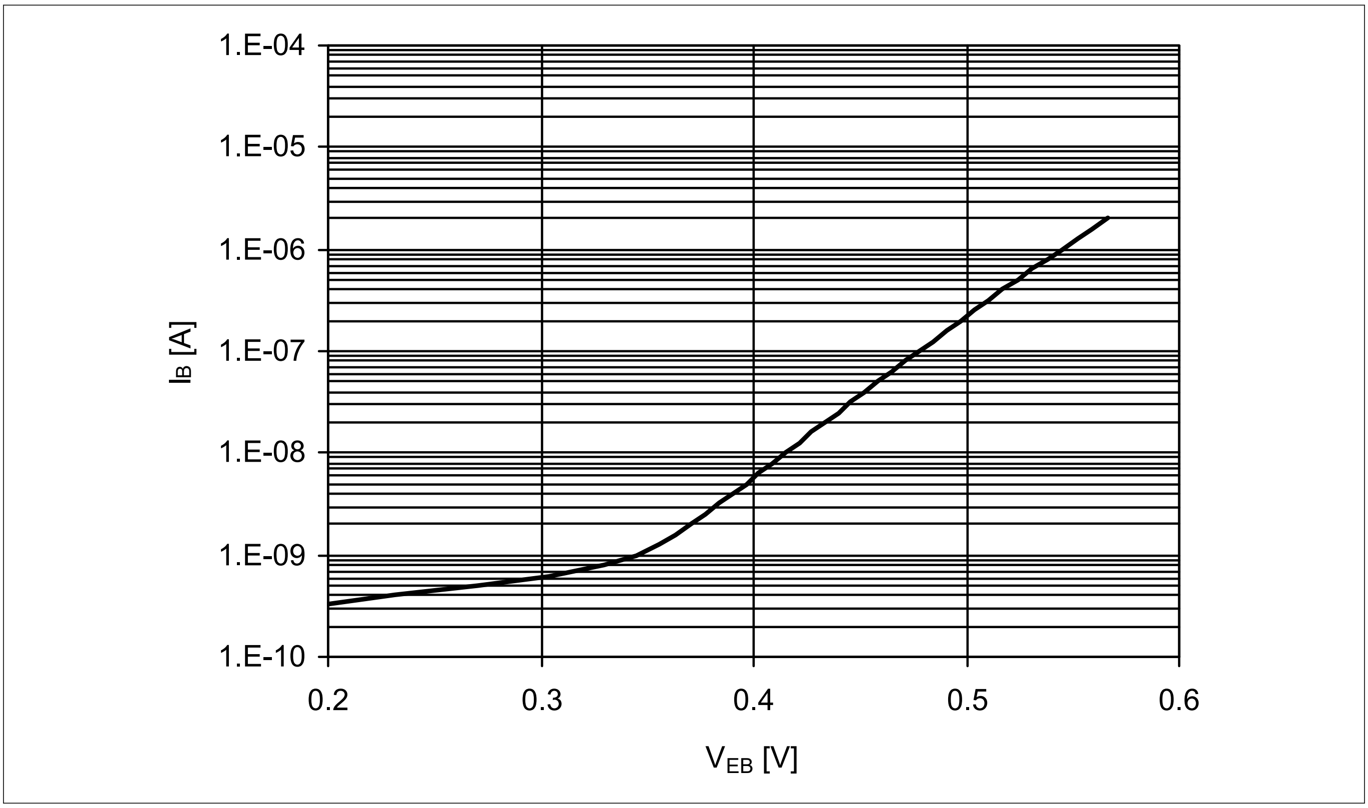


Figure 7 **Base current vs. base emitter reverse voltage I_B = f(V_{EB}), V_{CE} = 2 V**

3.5 Characteristic AC diagrams

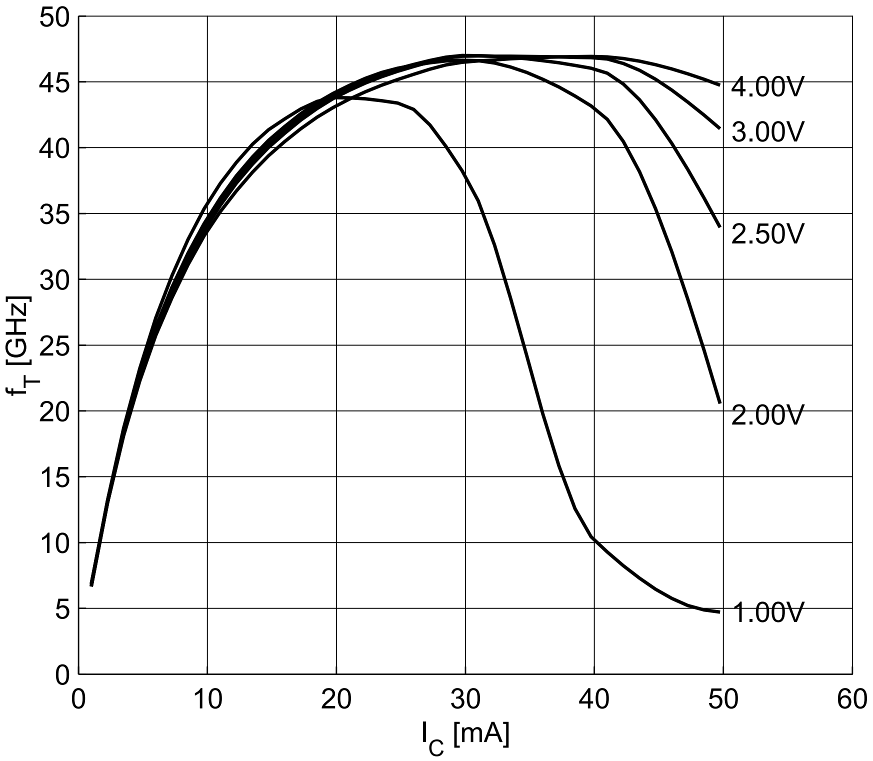


Figure 8 **Transition frequency f_T = f(I_C), f = 1 GHz, V_{CE} = parameter**

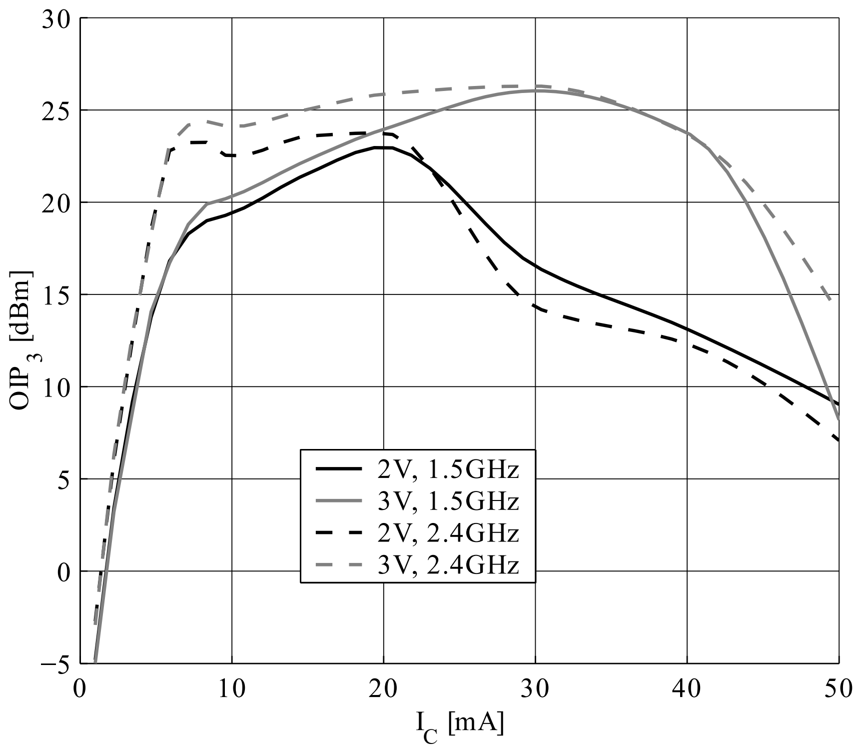


Figure 9 **3rd order intercept point OIP_3 = f(I_C), Z_S = Z_L = 50 Ω, V_{CE}, f = parameters**

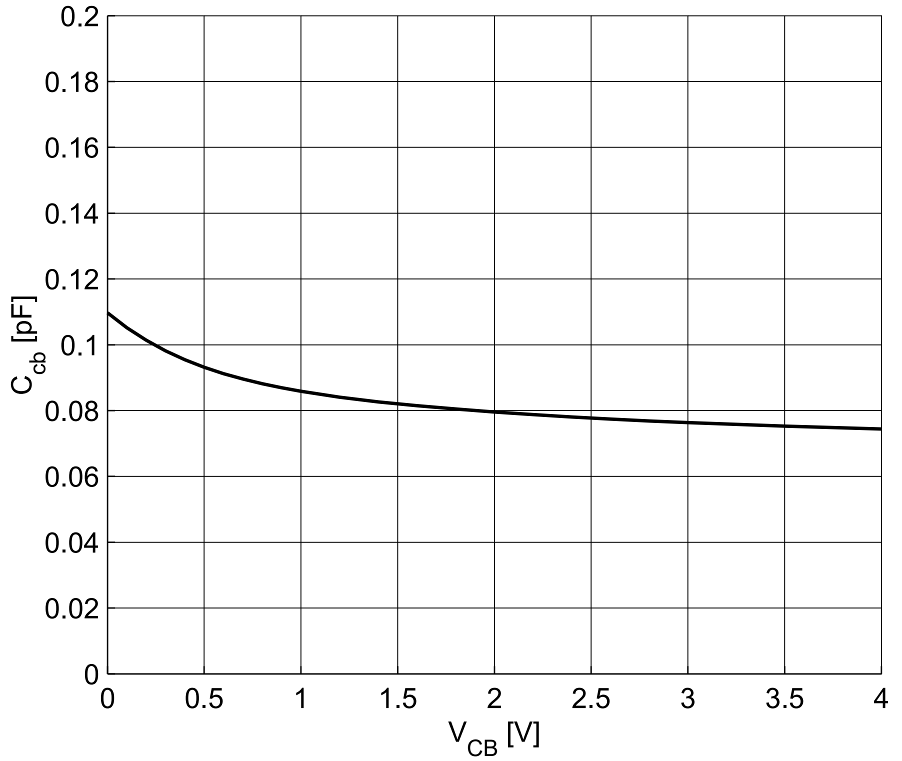


Figure 10 **Collector base capacitance C_{CB} = f(V_{CB}), f = 1 MHz**

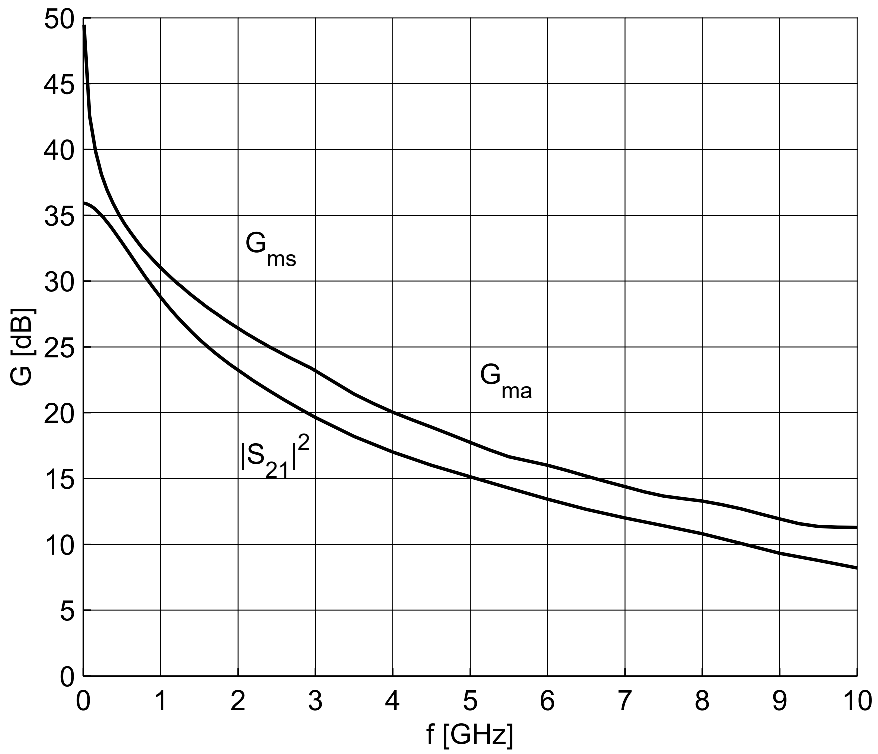


Figure 11 **Gain G_{ma}, G_{ms}, $|S_{21}|^2$ = f(f), V_{CE} = 3 V, I_C = 30 mA**

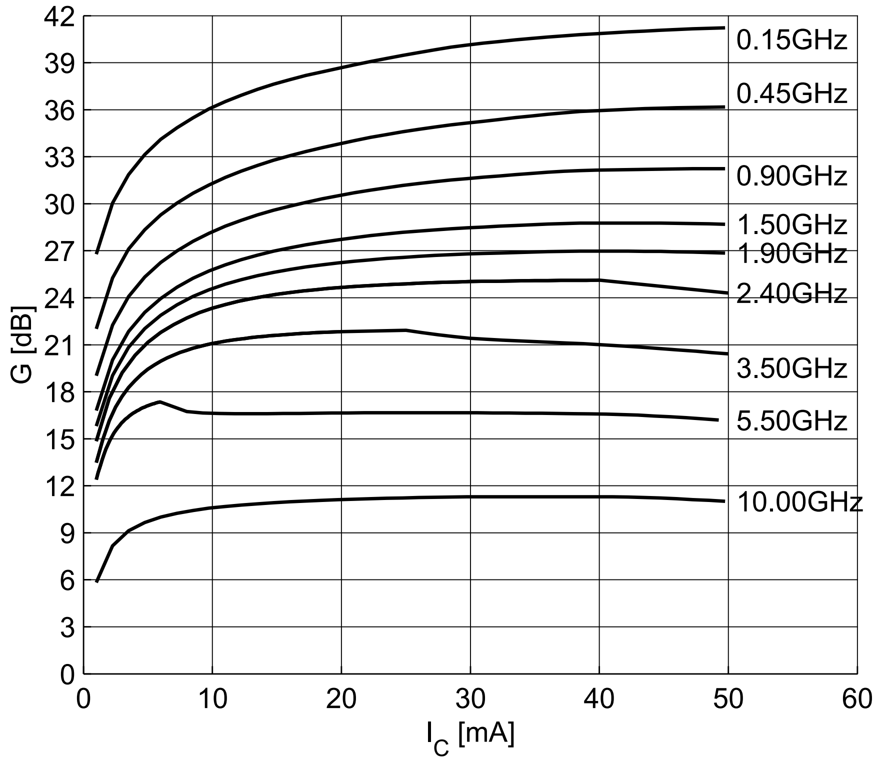


Figure 12 **Maximum power gain G_{max} = f(I_C), V_{CE} = 3 V, f = parameter in GHz**

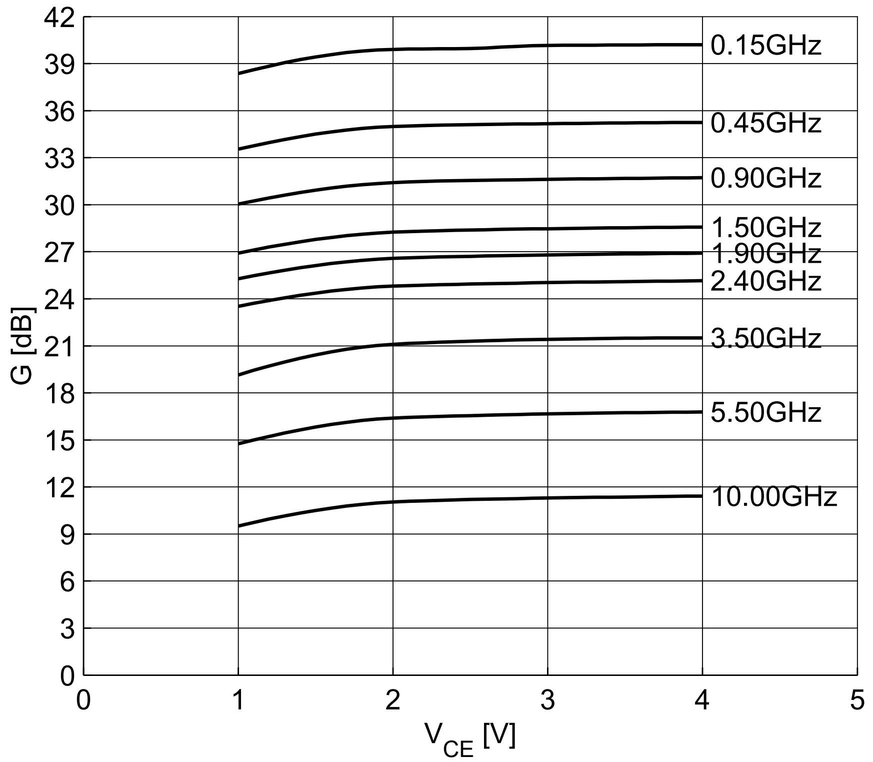


Figure 13 **Maximum power gain G_{max} = f(V_{CE}), I_C = 30 mA, f = parameter in GHz**

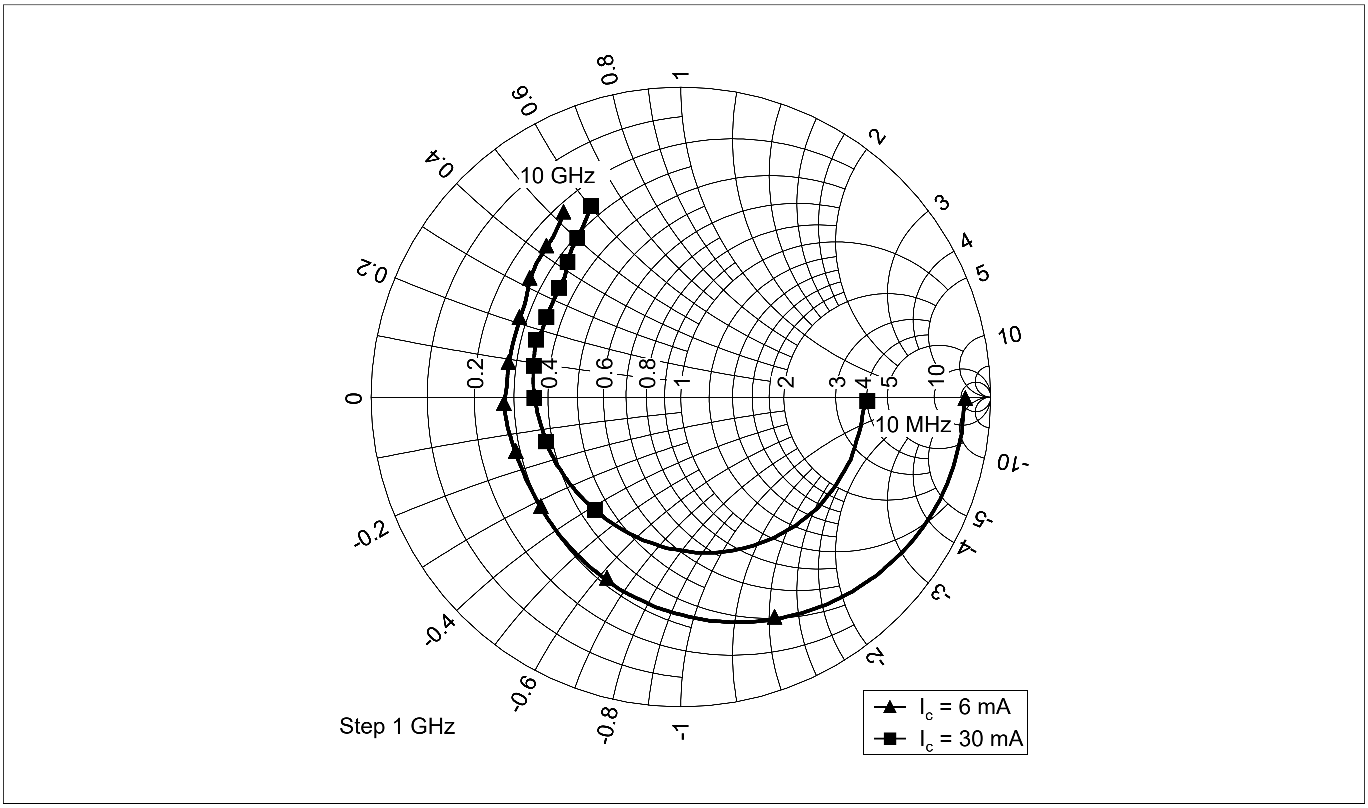


Figure 14 **Input reflection coefficient S_{11} = f(f), V_{CE} = 3 V, I_C = 6 / 30 mA**

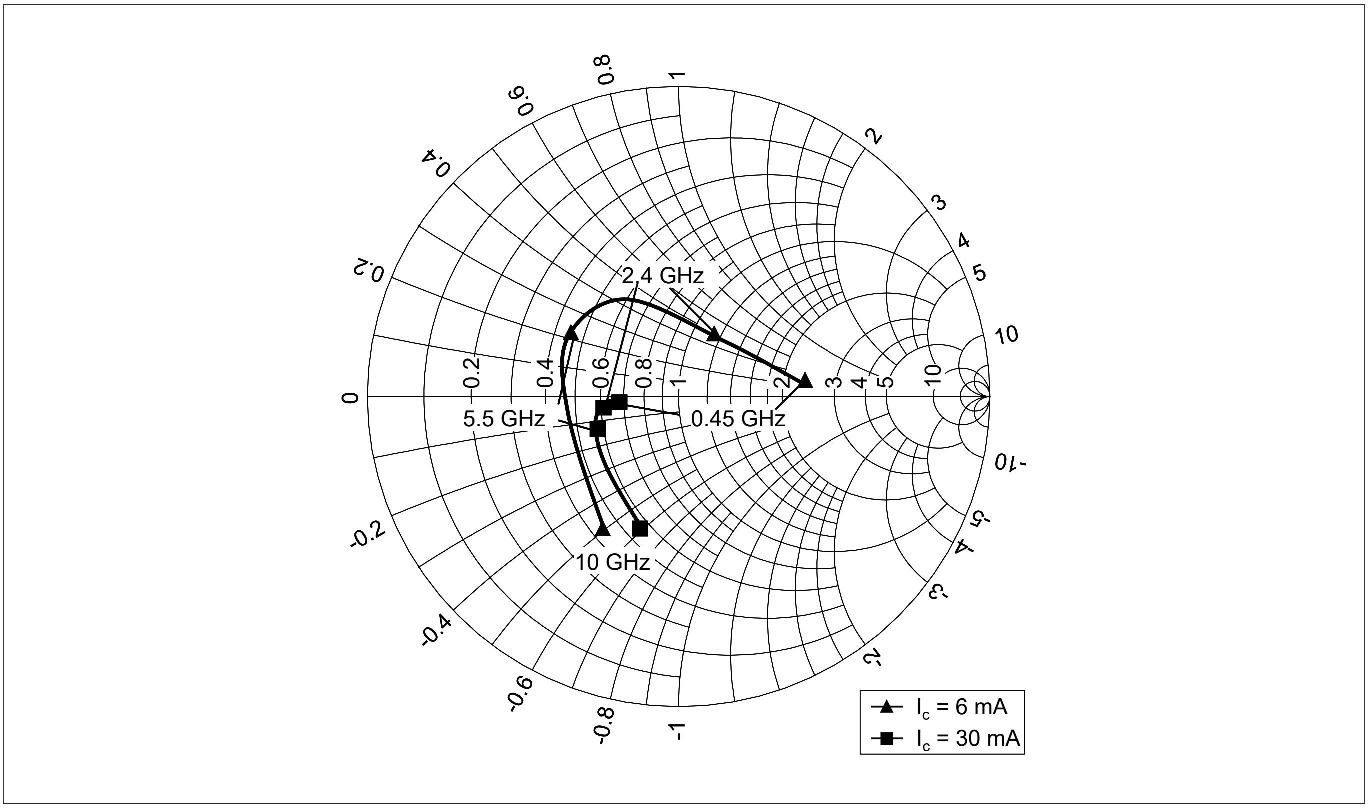


Figure 15 **Source impedance for minimum noise figure $Z_{S,opt}$ = f(f), V_{CE} = 3 V, I_C = 6 / 30 mA**

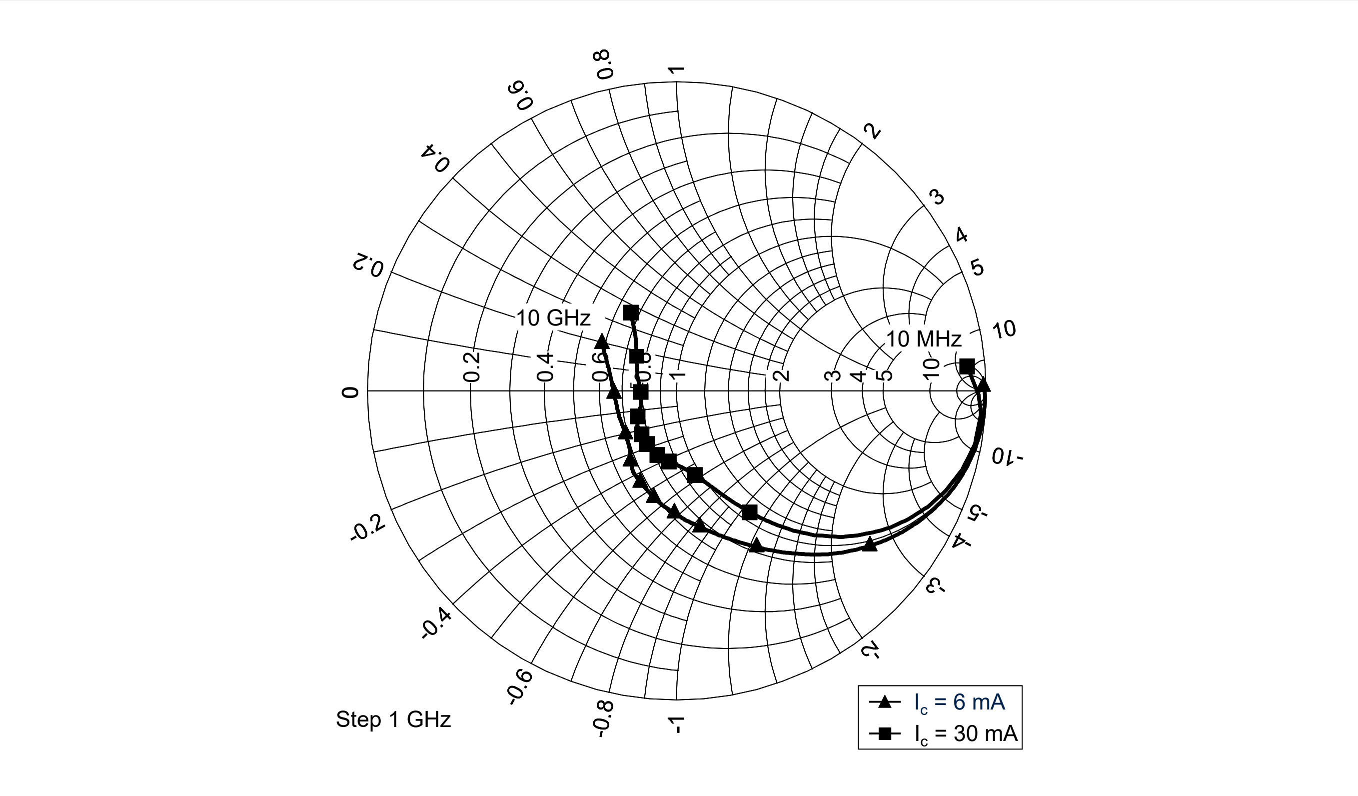


Figure 16 **Output reflection coefficient S_{22} = f(f), V_{CE} = 3 V, I_C = 6 / 30 mA**

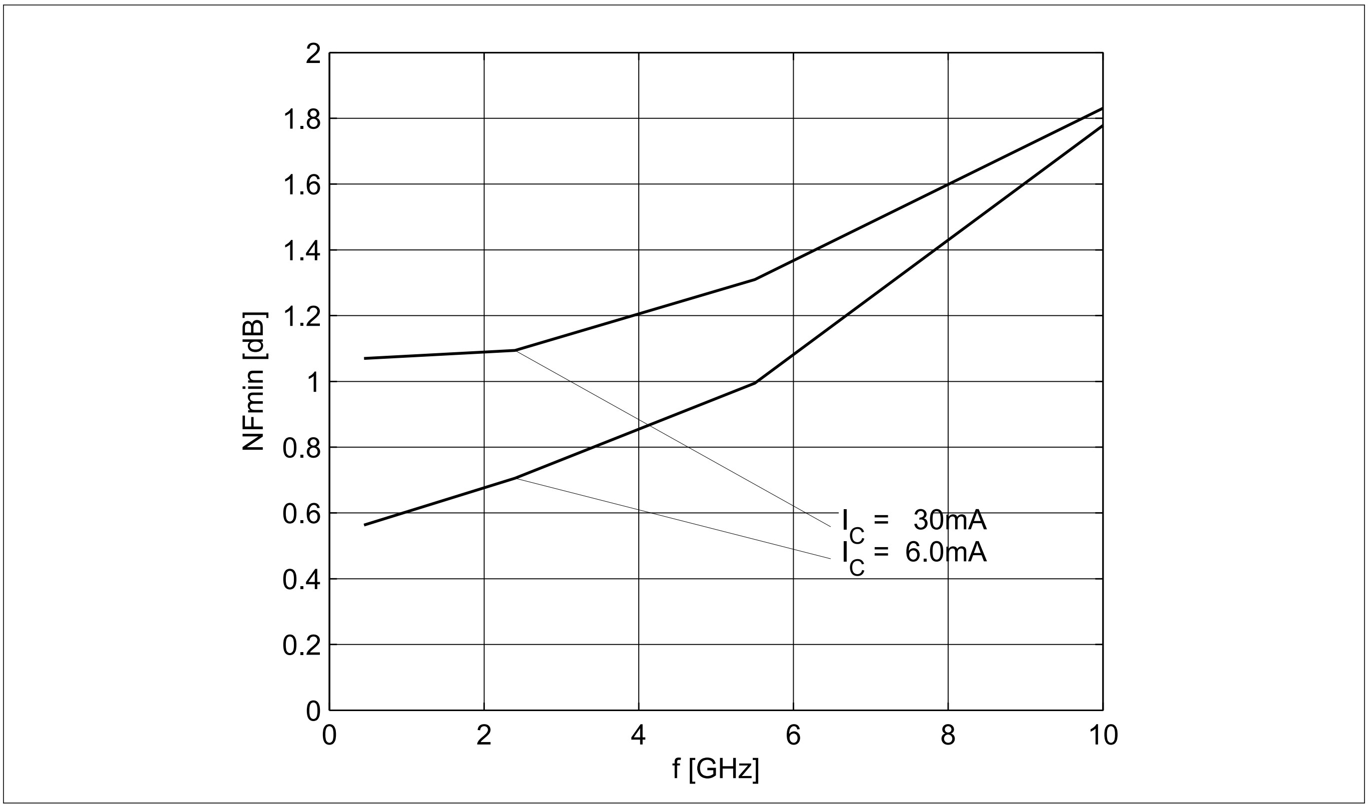


Figure 17 **Noise figure NF_{min} = f(f), Z_S = $Z_{S,opt}$, V_{CE} = 3 V, I_C = 6 / 30 mA**

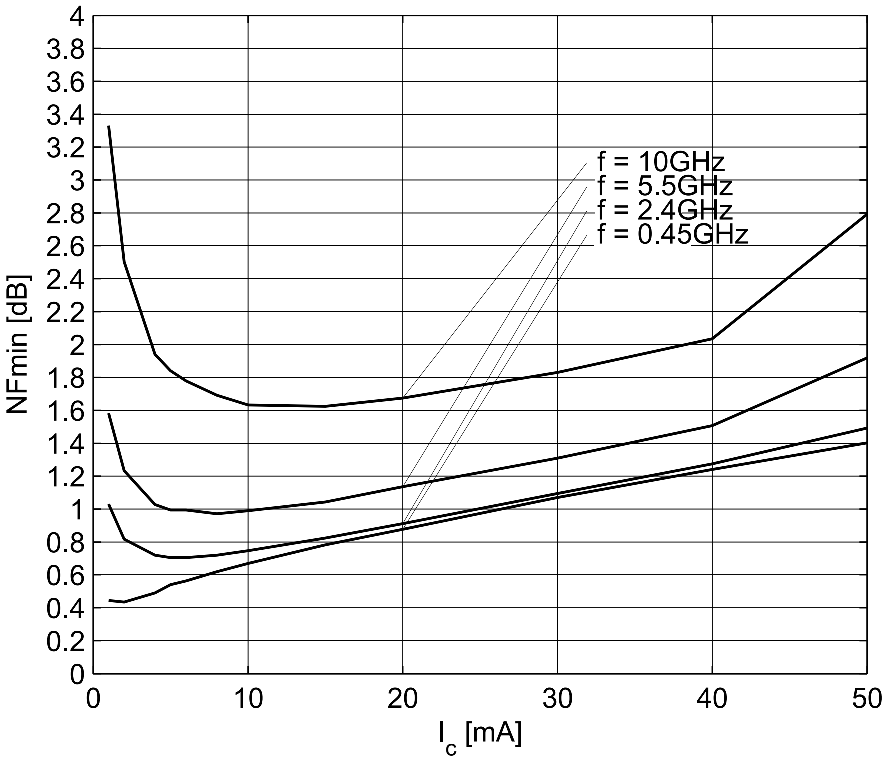


Figure 18 **Noise figure NF_{min} = f(I_C), Z_S = $Z_{S,opt}$, V_{CE} = 3 V, f = parameter in GHz**

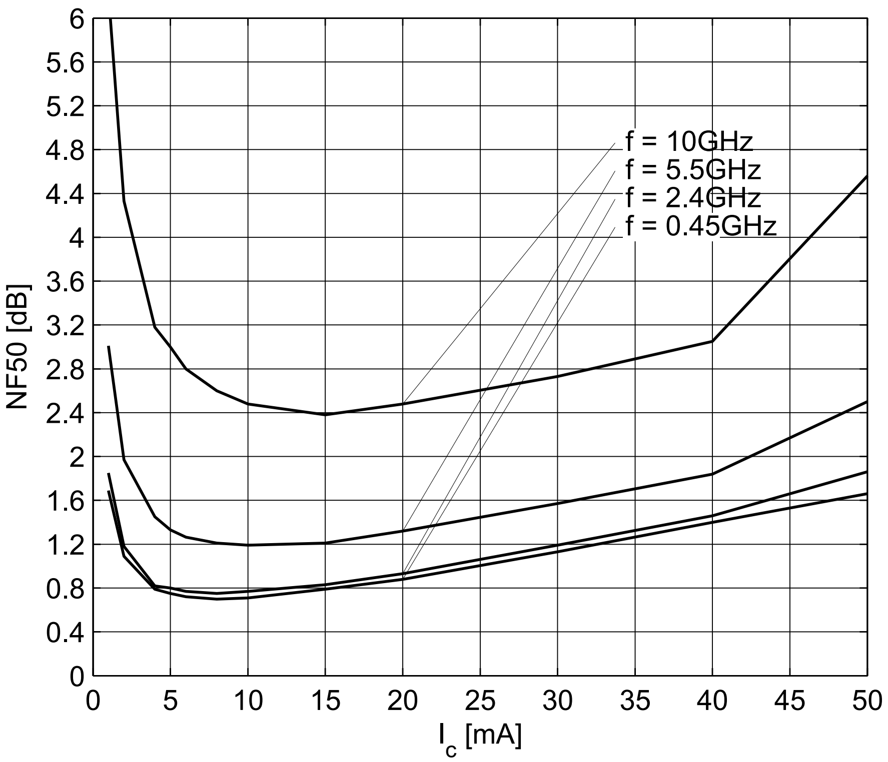


Figure 19 **Noise figure NF_{50} = f(I_C), Z_S = 50 Ω, V_{CE} = 3 V, f = parameter in GHz**

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

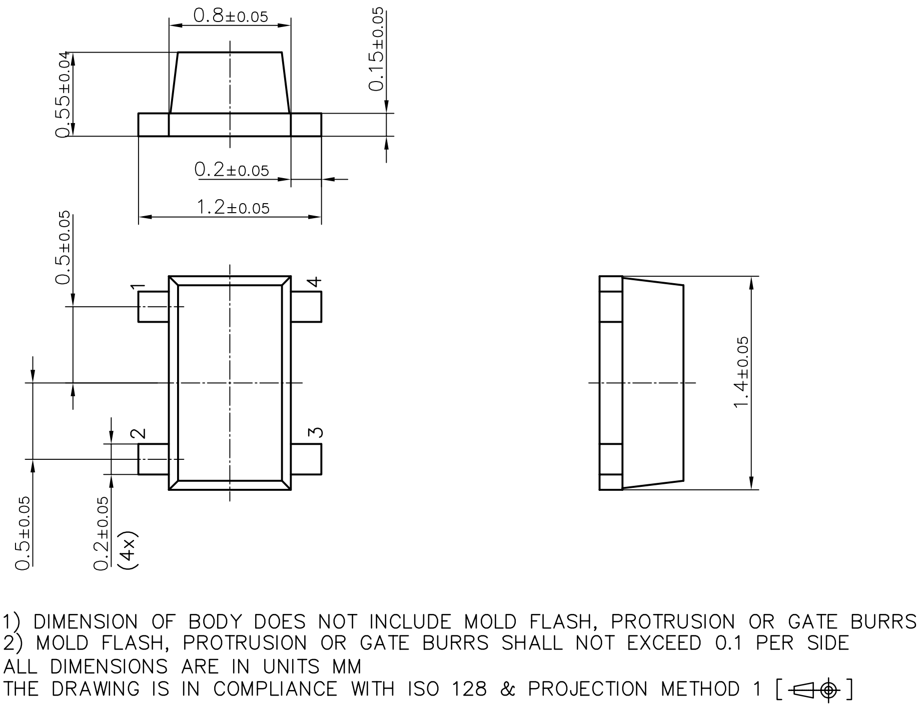


Figure 20 **TSFP-4-1 package**

Note: *For package information including footprint, packing and assembly recommendation refer to:*

https://www.infineon.com/packages/TSFP-4-1/

Revision history

Document version	Date of release	Description of changes
Revision 2.0	2019-01-25	New datasheet layout.
Revision 3.0	2024-07-01	Updated product validation

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