BFP450

High Linearity Low Noise Si NPN RF Transistor

Data Sheet

Revision 1.0, 2010-10-22

RF & Protection Devices

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Revision History	
Page or Item	**Subjects (changes since previous revision)**
Revision 1.0, 2010-10-22	
	This datasheet replaces the revision from 20 April 2007. The product itself has not been changed and the device characteristics remain unchanged. Only the product description and information available in the datasheet have been expanded and updated. The old datasheet revision remains fully valid for those customers who have got the revision from 20 April 2007.
1	Maximum collector current ICmax increased from 100 mA to 170 mA and maximum DC power dissipation Ptot from 450 mW to 500 mW .
2	Typical values for leakage currents included.
3	Description of electrical parameters updated.
4, 5	Spice GP model parameters removed from datasheet, updated model parameters shifted to the internet simulation data section.
6	Pulse load curves removed.
7, 8	AC characteristic curves updated.

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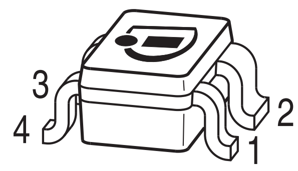
1 Features



- Highly linear low noise driver amplifier for all RF frontends up to 2.5 GHz
- Output compression point OP_{1dB} = 18.5 dBm at 90 mA, 3 V, 1.9 GHz, 50 Ω system
- Output 3rd order intermodulation point OIP_3 = 31 dBm at 90 mA, 3 V, 1.9 GHz, 50 Ω system
- Maximum available gain G_{ma} = 15.5 dB at 50 mA, 3 V, 1.9 GHz
- Minimum noise figure NF_{min} = 1.7 dB at 50 mA, 3 V, 1.9 GHz
- Based on Infineon´s reliable, high volume 25 GHz SIEGET™ line
- Easy to use Pb-free (RoHS compliant) standard package with visible leads
- Qualified according AEC Q101

RoHS

AEC Qualified

Application Examples

Driver amplifier

- ISM bands 434 and 868 MHz
- 1.9 GHz cordless phones
- CATV LNA

Transmitter driver amplifier

- 2.4 GHz WLAN and Bluetooth

Output stage LNA for active antennas

- TV, GPS, SDARS, 2.4 GHz WLAN, etc

Suitable for 3 - 5.5 GHz oscillators

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

Product Name	Package	Pin Configuration				Marking
BFP450	SOT343	1 = B	2 = E	3 = C	4 = E	ANs

2 Maximum Ratings

Table 1 Maximum Ratings

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Collector emitter voltage	V_{CEO}				Open base
		–	4.5	V	T_A = 25 °C
		–	4.1	V	T_A = -55 °C
Collector emitter voltage	V_{CES}	–	15	V	Emitter / base shortened
Collector base voltage	V_{CBO}	–	15	V	Open emitter
Emitter base voltage	V_{EBO}	–	1.5	V	Open collector
Collector current	I_C	–	170	mA	–
Base current	I_B	–	10	mA	–
Total power dissipation[1)]	P_{tot}	–	500	mW	$T_S \leq 90$ °C
Junction temperature	T_J	–	150	°C	–
Storage temperature	T_{Stg}	-65	150	°C	–

1)T_S is the soldering point temperature. T_S measured on the emitter lead at the soldering point of the pcb.

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. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

3 Thermal Characteristics

Table 2 Thermal Resistance

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - soldering point[1)]	R_{thJS}	–	–	120	K/W	–

1)For calculation of R_{thJA} please refer to Application Note Thermal Resistance AN077

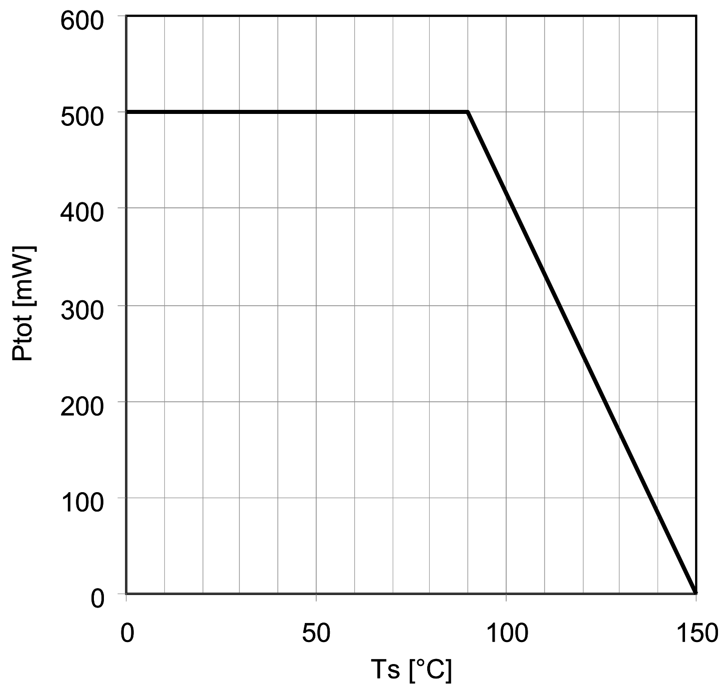


Figure 1 Total Power Dissipation $P_{tot} = f(T_s)$

4 Electrical Characteristics

4.1 DC Characteristics

Table 3 DC Characteristics at T_A = 25 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector emitter breakdown voltage	$V_{(BR)CEO}$	4.5	5	–	V	I_C = 1 mA, I_B = 0 Open base
Collector emitter leakage current	I_{CES}	– –	– 1	10 30	µA nA	V_{CE} = 15 V, V_{BE} = 0 V_{CE} = 3 V, V_{BE} = 0 Emitter/base shortened
Collector base leakage current	I_{CBO}	–	1	30	nA	V_{CB} = 3 V, I_E = 0 Open emitter
Emitter base leakage current	I_{EBO}	–	0.1	3	µA	V_{EB} = 0.5 V, I_C = 0 Open collector
DC current gain	h_{FE}	60 50	95 85	130 120		V_{CE} = 4 V, I_C = 50 mA V_{CE} = 3 V, I_C = 90 mA Pulse measured

4.2 General AC Characteristics

Table 4 General AC Characteristics at T_A = 25 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Transition frequency	f_T	18	24	–	GHz	V_{CE} = 3 V, I_C = 90 mA, f = 1 GHz
Collector base capacitance	C_{CB}	–	0.48	0.8	pF	V_{CB} = 3 V, V_{BE} = 0 V f = 1 MHz Emitter grounded
Collector emitter capacitance	C_{CE}	–	1.2	–	pF	V_{CE} = 3 V, V_{BE} = 0 V f = 1 MHz Base grounded
Emitter base capacitance	C_{EB}	–	1.7	–	pF	V_{EB} = 0.5 V, V_{CB} = 0 V f = 1 MHz Collector grounded

4.3 Frequency Dependent AC Characteristics

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

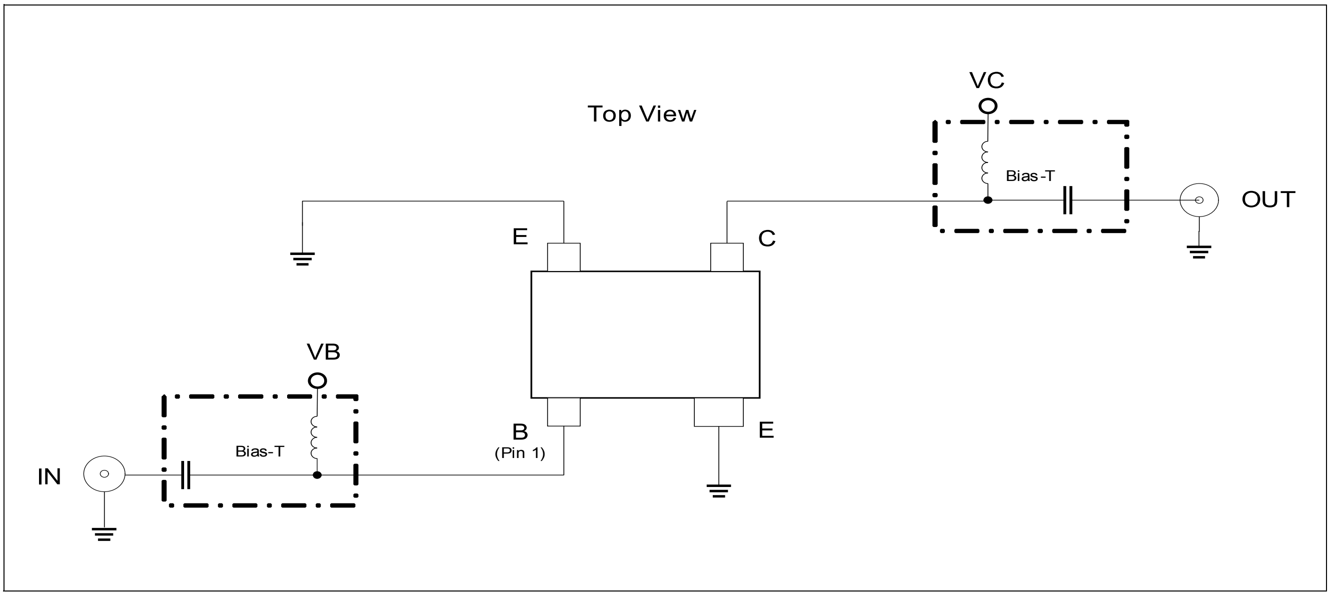


Figure 2 BFP450 Testing Circuit

Table 5 AC Characteristics, V_{CE} = 3 V, f = 150 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ms}	–	34.5	–		I_C = 50 mA
Class A operation point	G_{ms}	–	35.5	–		I_C = 90 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
High linearity operation point	S_{21}	–	33	–		I_C = 50 mA
Class A operation point	S_{21}	–	33.5	–		I_C = 90 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.55	–		I_C = 50 mA
Associated gain	G_{ass}	–	32	–		I_C = 50 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	19	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	30.5	–		I_C = 90 mA

Table 6 AC Characteristics, V_{CE} = 3 V, f = 450 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ms}	–	28.5	–		I_C = 50 mA
Class A operation point	G_{ms}	–	29	–		I_C = 90 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
High linearity operation point	S_{21}	–	25	–		I_C = 50 mA
Class A operation point	S_{21}	–	25	–		I_C = 90 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.55	–		I_C = 50 mA
Associated gain	G_{ass}	–	27.5	–		I_C = 50 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	19	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	30	–		I_C = 90 mA

Table 7 AC Characteristics, V_{CE} = 3 V, f = 900 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ms}	–	23	–		I_C = 50 mA
Class A operation point	G_{ms}	–	23.5	–		I_C = 90 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
High linearity operation point	S_{21}	–	18.5	–		I_C = 50 mA
Class A operation point	S_{21}	–	19	–		I_C = 90 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.6	–		I_C = 50 mA
Associated gain	G_{ass}	–	23	–		I_C = 50 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	19	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	30.5	–		I_C = 90 mA

Table 8 AC Characteristics, V_{CE} = 3 V, f = 1.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ma}	–	18	–		I_C = 50 mA
Class A operation point	G_{ma}	–	18	–		I_C = 90 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
High linearity operation point	S_{21}	–	14	–		I_C = 50 mA
Class A operation point	S_{21}	–	14	–		I_C = 90 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.65	–		I_C = 50 mA
Associated gain	G_{ass}	–	17	–		I_C = 50 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	19	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	31	–		I_C = 90 mA

Table 9 AC Characteristics, V_{CE} = 3 V, f = 1.9 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ma}	–	15.5	–		I_C = 50 mA
Class A operation point	G_{ma}	–	15.5	–		I_C = 90 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
High linearity operation point	S_{21}	9.5	11.5	–		I_C = 50 mA
Class A operation point	S_{21}	–	11.5	–		I_C = 90 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.7	–		I_C = 50 mA
Associated gain	G_{ass}	–	14	–		I_C = 50 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	19	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	31	–		I_C = 90 mA

Table 10 AC Characteristics, V_{CE} = 3 V, f = 2.4 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ma}	–	13.5	–		I_C = 50 mA
Class A operation point	G_{ma}	–	13.5	–		I_C = 90 mA
Transducer gain					dB	Z_S = Z_L = 50 Ω
High linearity operation point	S_{21}	–	9.5	–		I_C = 50 mA
Class A operation point	S_{21}	–	9.5	–		I_C = 90 mA
Minimum noise figure					dB	Z_S = Z_{opt}
Minimum noise figure	NF_{min}	–	1.8	–		I_C = 50 mA
Associated gain	G_{ass}	–	12	–		I_C = 50 mA
Linearity					dBm	Z_S = Z_L = 50 Ω
1 dB gain compression point	OP_{1dB}	–	19	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	30	–		I_C = 90 mA

Table 11 AC Characteristics, V_{CE} = 3 V, f = 3.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum power gain					dB	
High linearity operation point	G_{ma}	–	10	–		I_C = 50 mA
Class A operation point	G_{ma}	–	10	–		I_C = 90 mA
Transducer gain					dB	Z_S = Z_L = 50 Ω
High linearity operation point	S_{21}	–	5.5	–		I_C = 50 mA
Class A operation point	S_{21}	–	6	–		I_C = 90 mA
Minimum noise figure					dB	Z_S = Z_{opt}
Minimum noise figure	NF_{min}	–	2.05	–		I_C = 50 mA
Associated gain	G_{ass}	–	9	–		I_C = 50 mA
Linearity					dBm	Z_S = Z_L = 50 Ω
1 dB gain compression point	OP_{1dB}	–	18.5	–		I_C = 90 mA
3rd order intercept point	OIP_3	–	29.5	–		I_C = 90 mA

Note:

1. *AC paramter limits verified by random sampling*
2. *In order to get the NF_{min} values stated in this chapter the test fixture losses have been subtracted from all measured result*
3. *$OIP3_3$ value depends on termination of all intermodulation frequency components. Termination used for this measurement is 50 Ω from 0.2 MHz to 12 GHz.*

4.4 Characteristic DC Diagrams

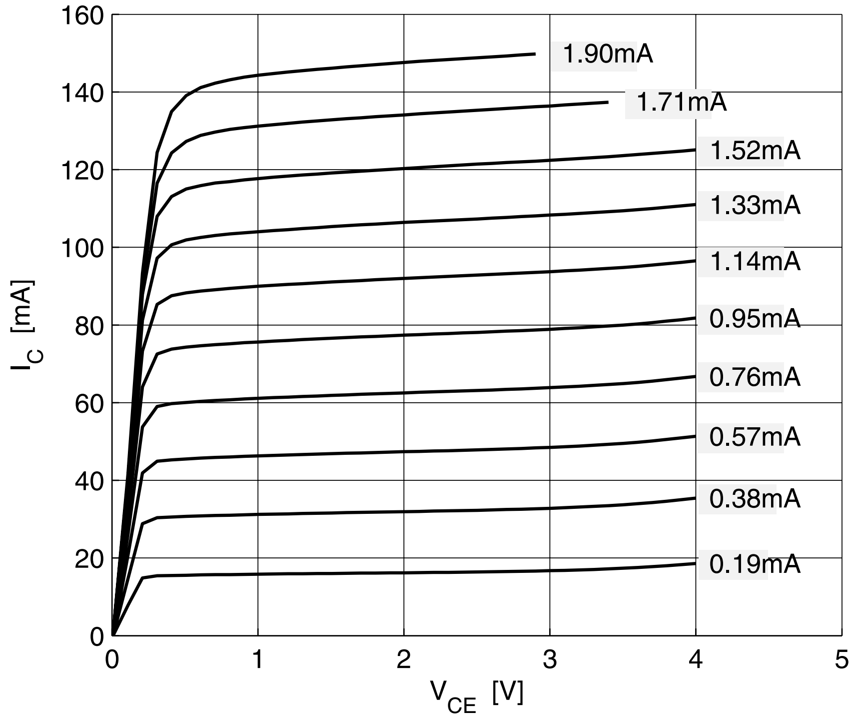


Figure 3 Collector Current vs. Collector Emitter Voltage $I_C = f(V_{CE})$, I_B = Parameter

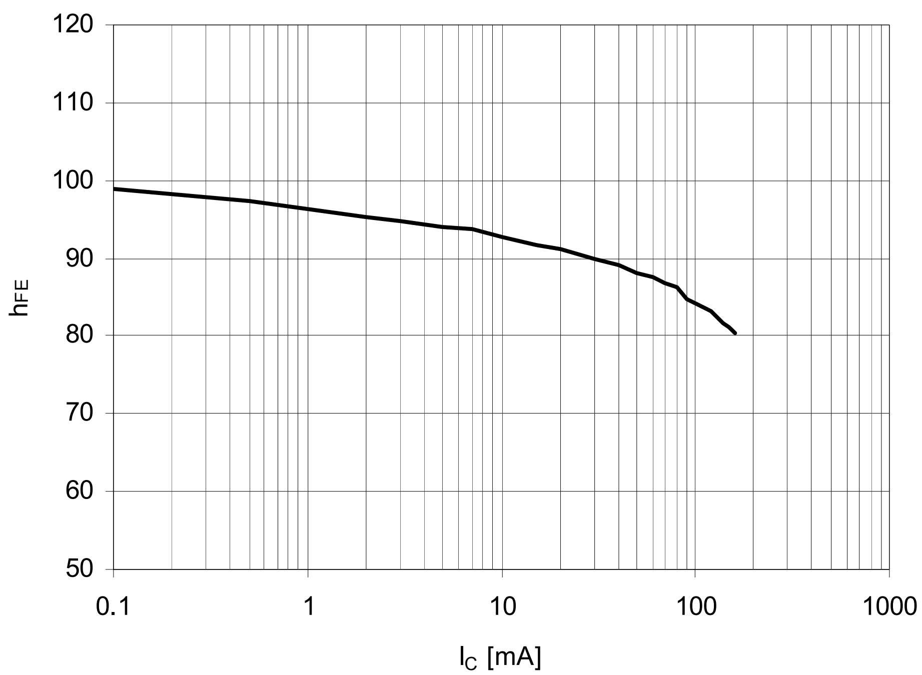


Figure 4 DC Current Gain $h_{FE} = f(I_C)$, V_{CE} = 3 V

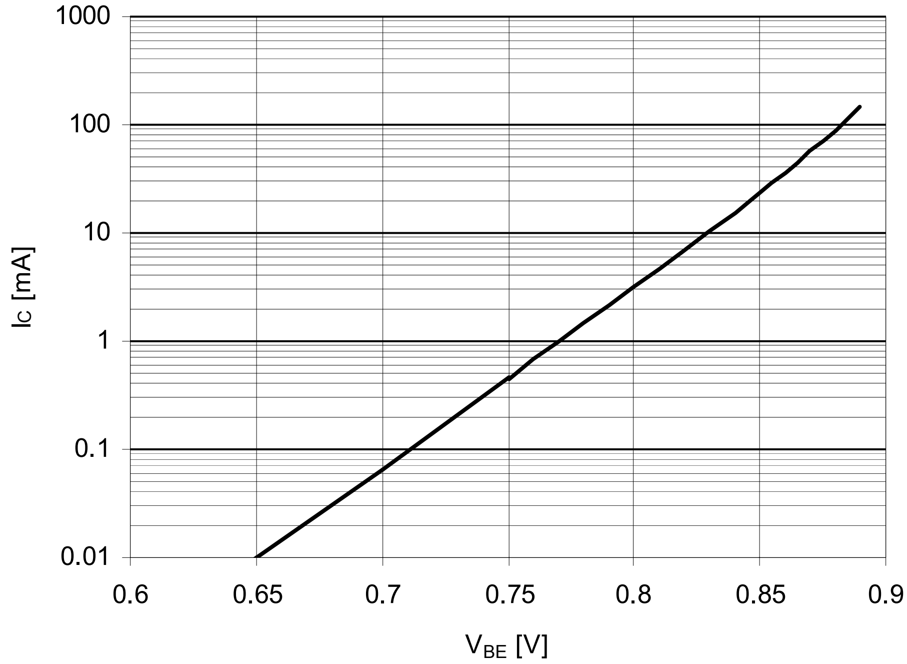


Figure 5 Collector Current vs. Base Emitter Voltage $I_C = f(V_{BE})$, V_{CE} = 2 V

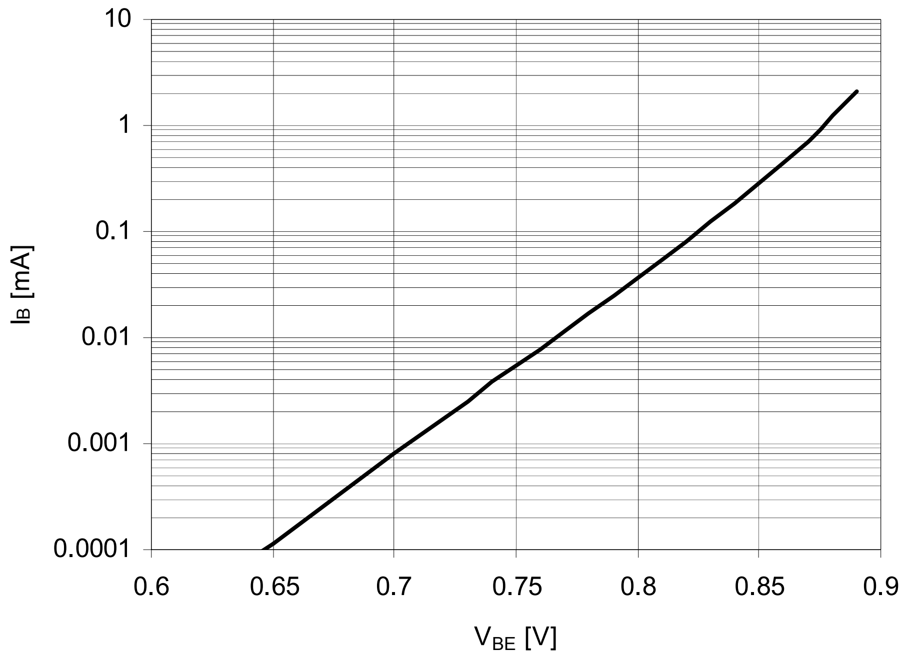


Figure 6 Base Current vs. Base Emitter Forward Voltage $I_B = f(V_{BE})$, V_{CE} = 2 V

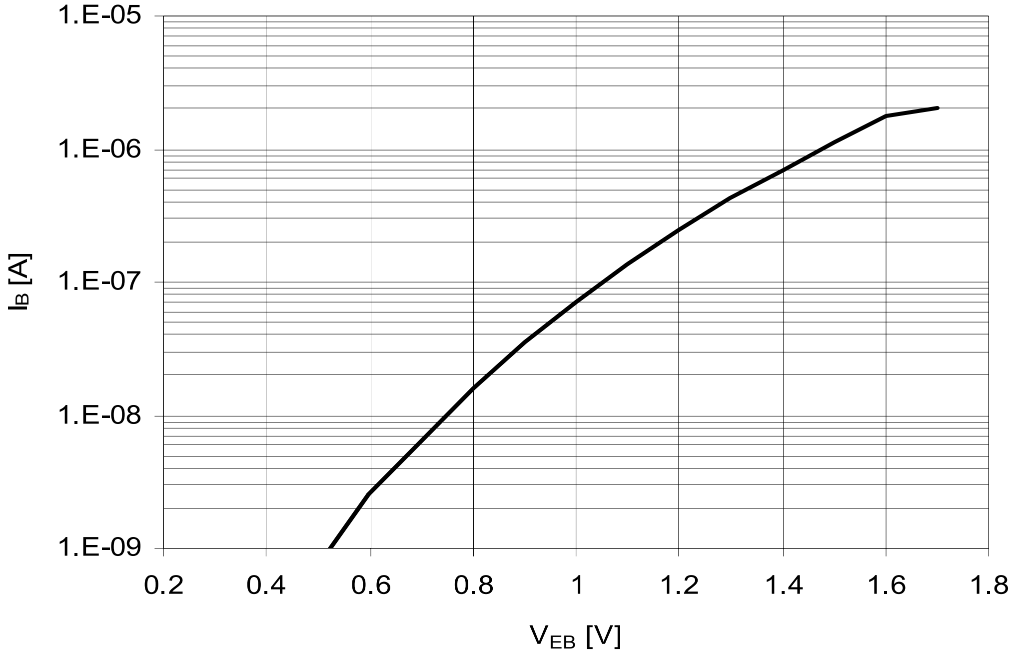


Figure 7 Base Current vs. Base Emitter Reverse Voltage $I_B = f(V_{EB})$, V_{CE} = 2 V

4.5 Characteristic AC Diagrams

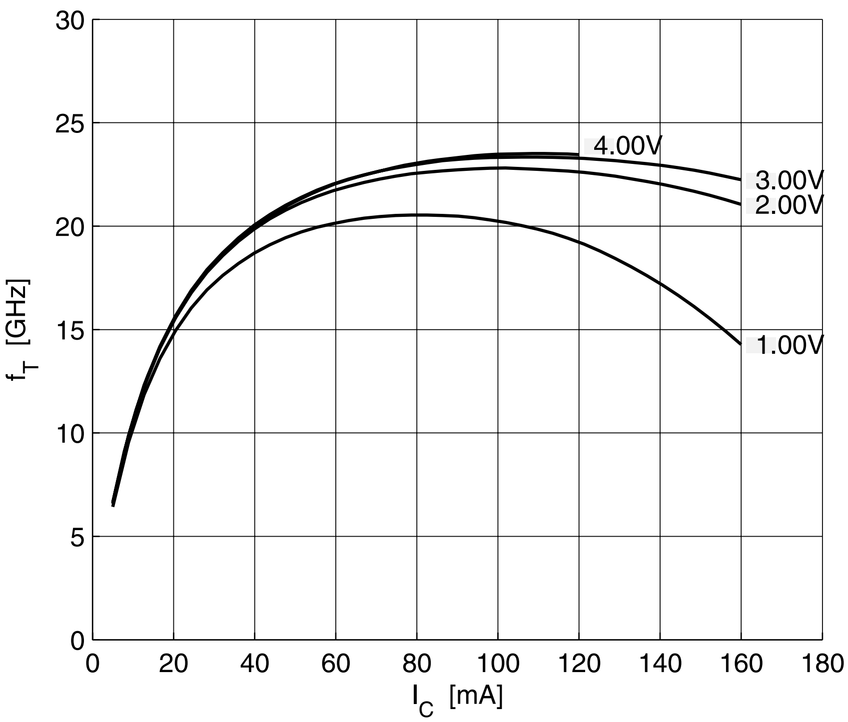


Figure 8 Transition Frequency $f_T = f(I_C)$, f = 1 GHz, V_{CE} = Parameter

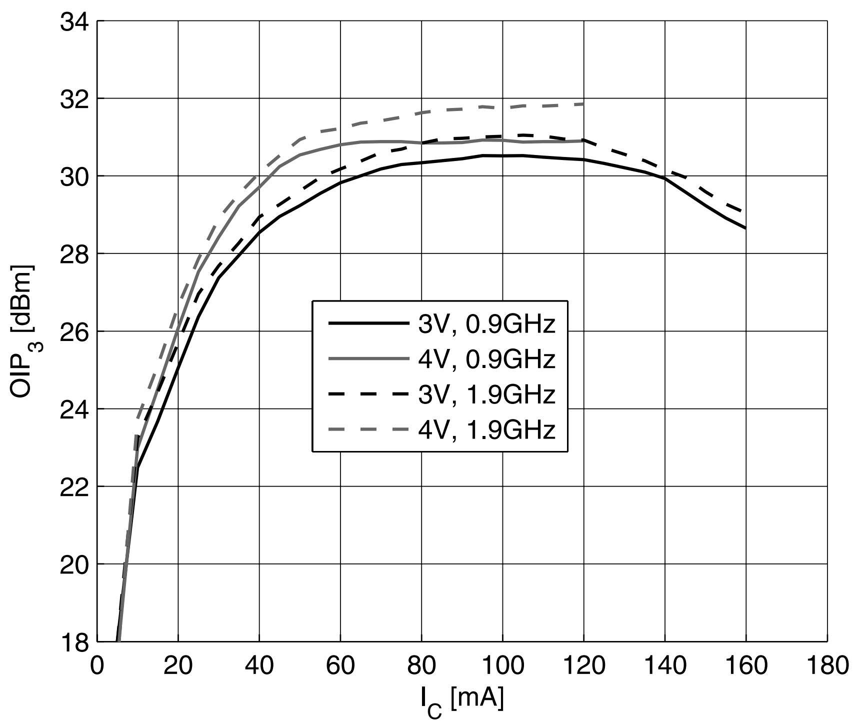


Figure 9 3rd Order Intercept Point $OIP_3 = f(I_C)$, $Z_S = Z_L$ = 50 Ω, V_{CE}, f = Parameters

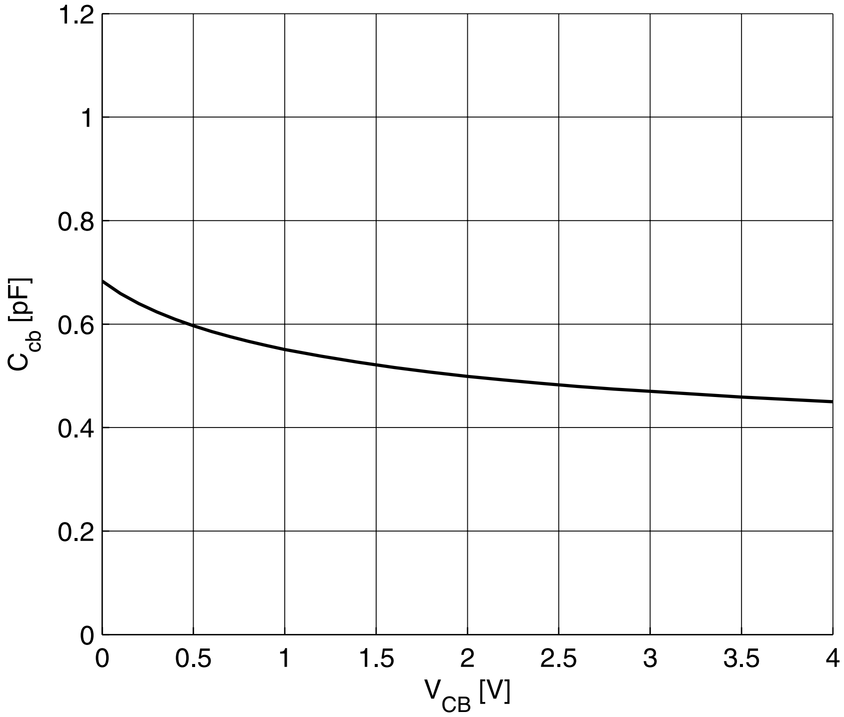


Figure 10 Collector Base Capacitance $C_{CB} = f(V_{CB})$, f = 1 MHz

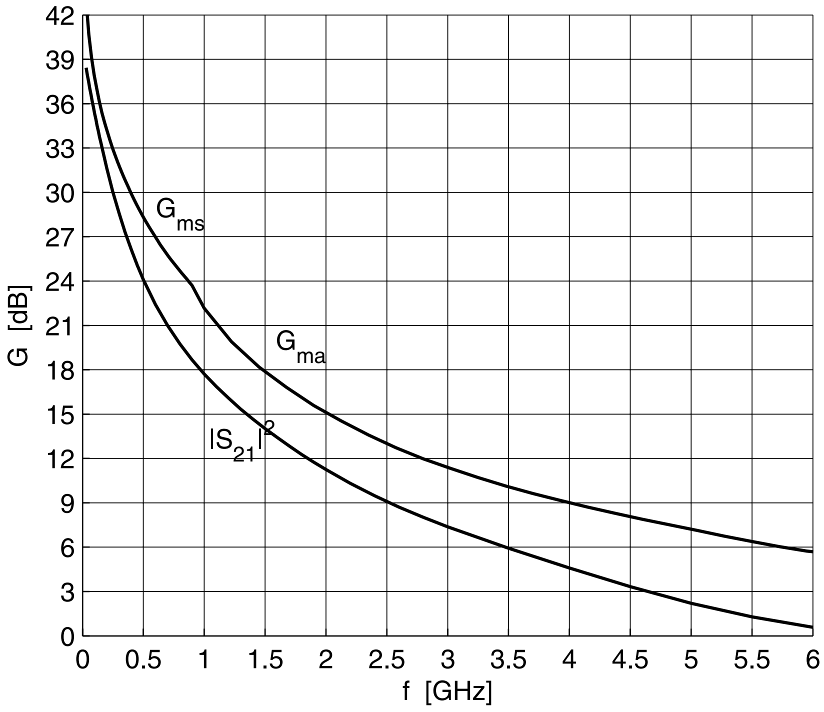


Figure 11 Gain G_{ma}, G_{ms}, $|S_{21}|^2 = f(f)$, V_{CE} = 3 V, I_C = 90 mA

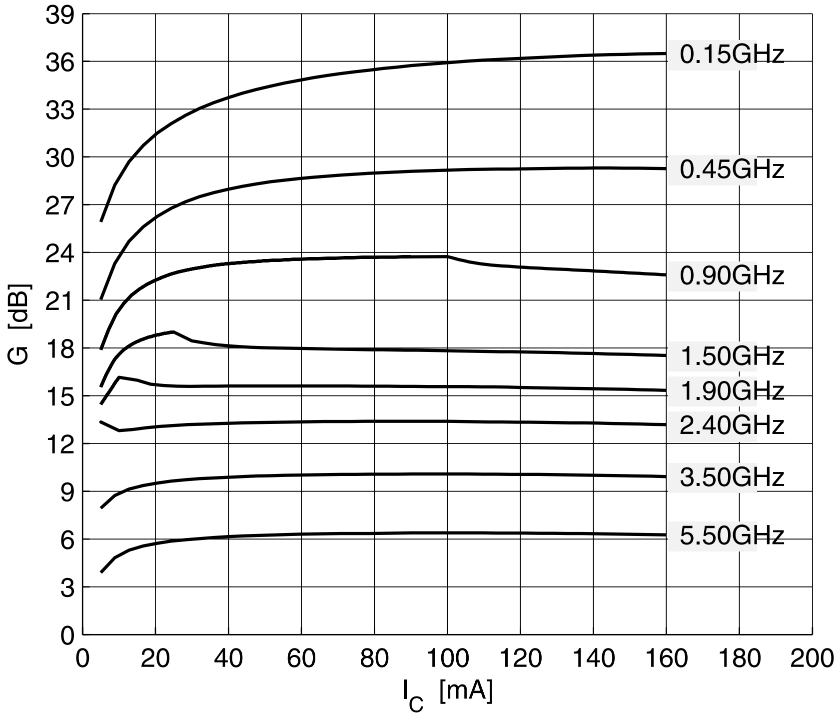


Figure 12 Maximum Power Gain $G_{max} = f(I_C)$, V_{CE} = 3 V, f = Parameter in GHz

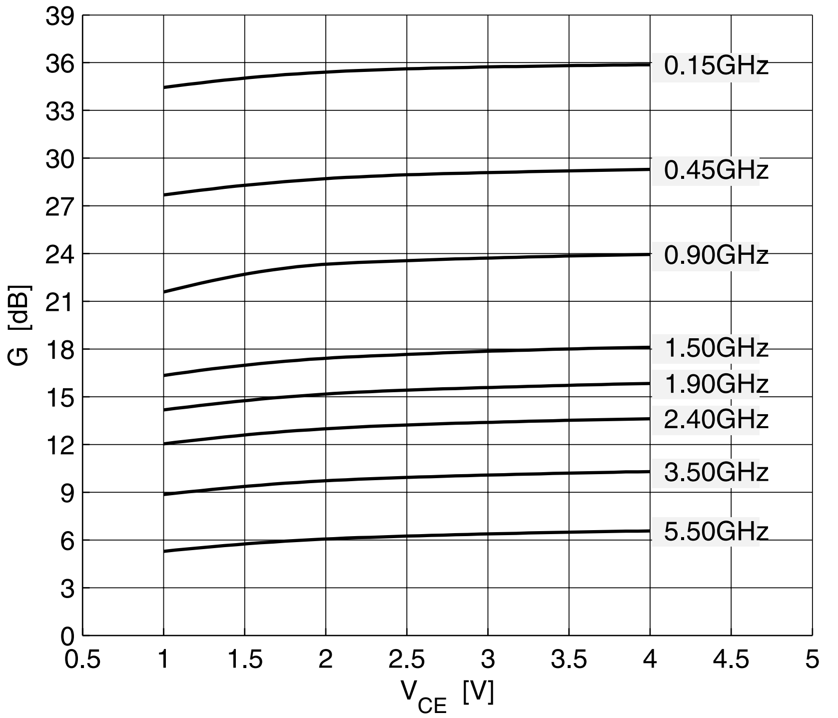


Figure 13 Maximum Power Gain $G_{max} = f(V_{CE})$, I_C = 90 mA, f = Parameter in GHz

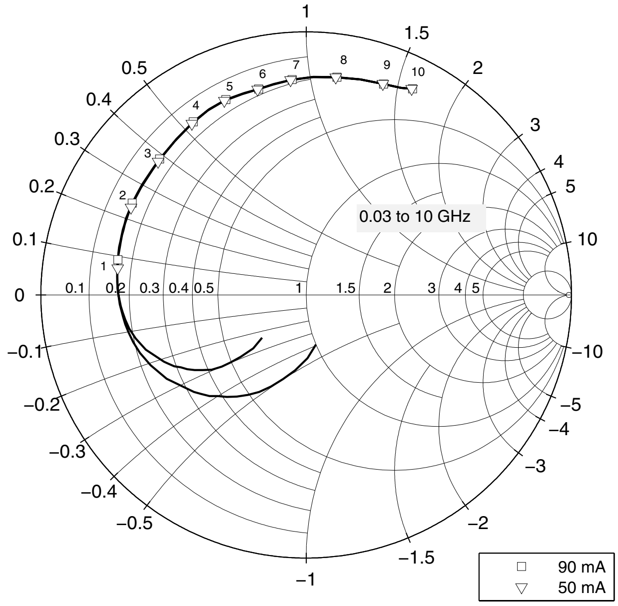


Figure 14 Input Matching $S_{11} = f(f)$, V_{CE} = 3 V, I_C = 50 / 90 mA

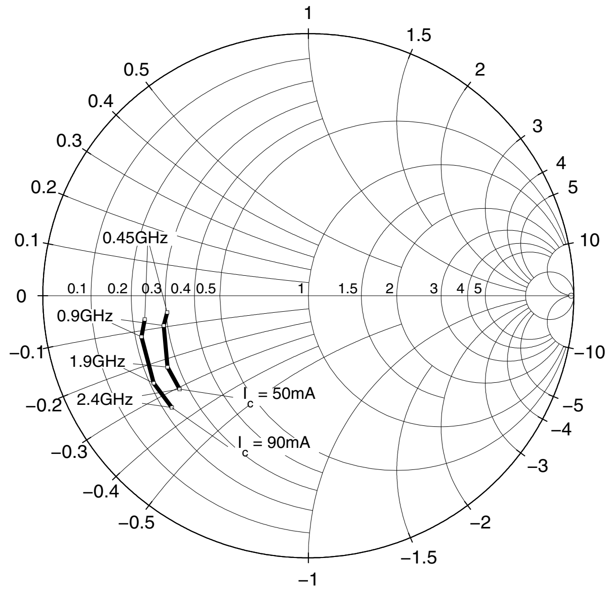


Figure 15 Source Impedance for Minimum Noise Figure $Z_{opt} = f(f)$, V_{CE} = 3 V, I_C = 50 / 90 mA

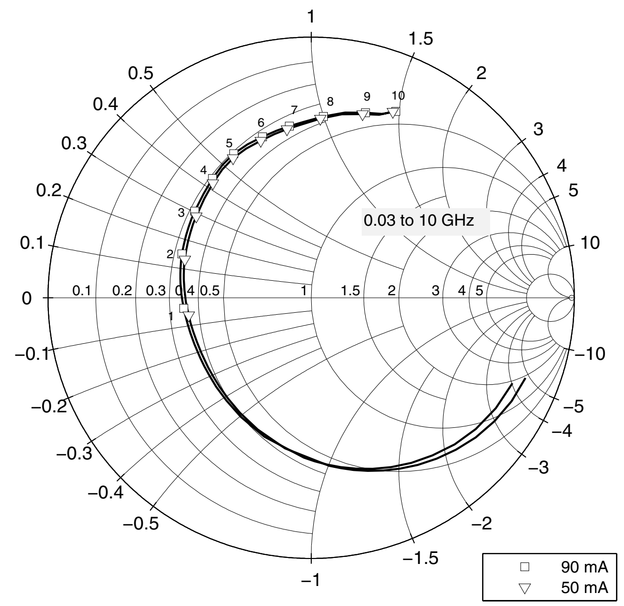


Figure 16 Output Matching $S_{22} = f\,(f)$, V_{CE} = 3 V, I_C = 50 / 90 mA

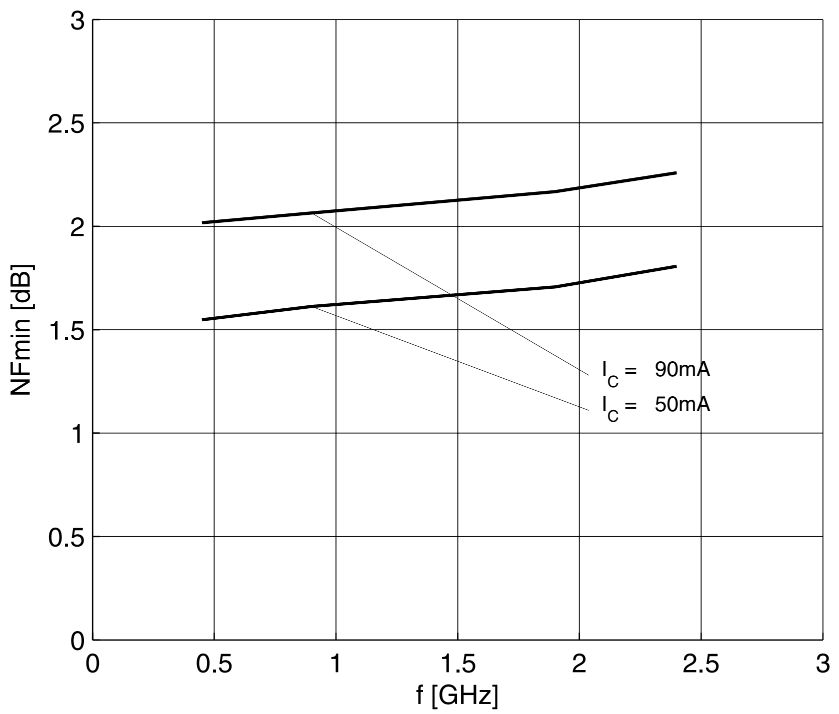


Figure 17 Noise Figure $NF_{min} = f\,(f)$, V_{CE} = 3 V, I_C = 50 / 90 mA, $Z_S = Z_{opt}$

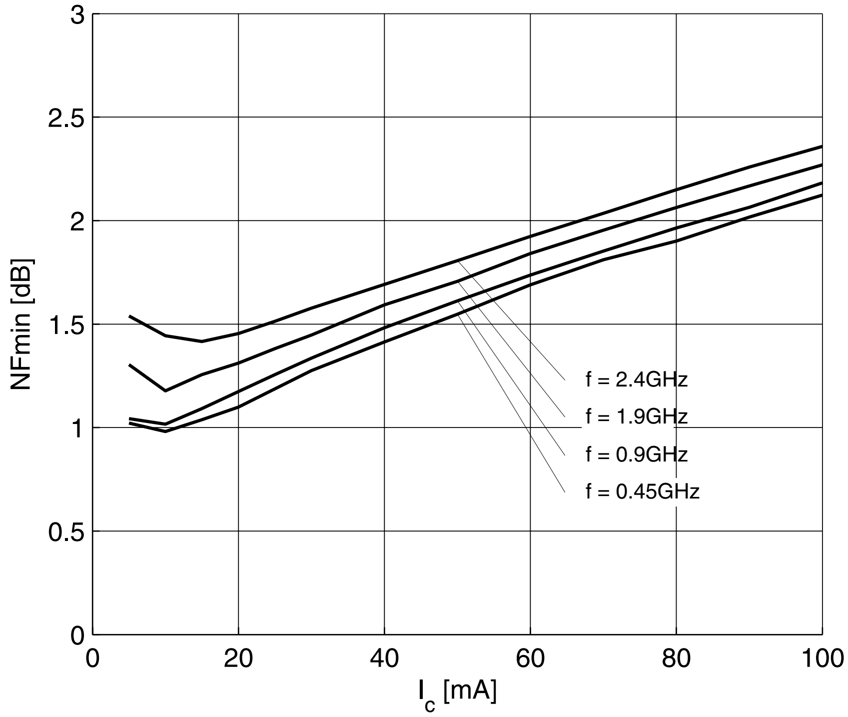


Figure 18 **Noise Figure** $NF_{min} = f(I_C)$, V_{CE} **= 3 V,** $Z_S = Z_{opt}$, f **= Parameter in GHz**

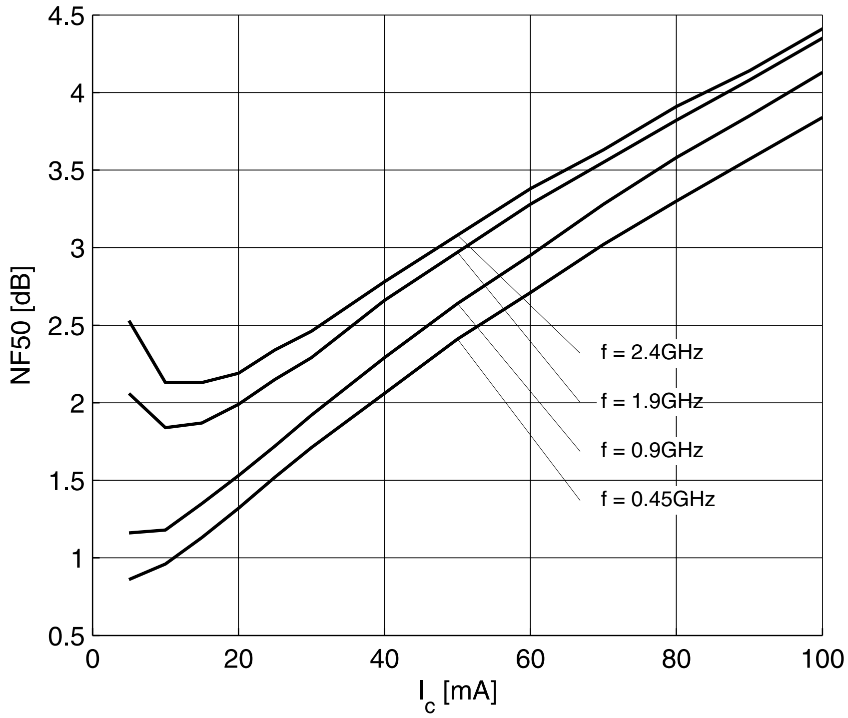


Figure 19 **Noise Figure** $NF_{50} = f(I_C)$, V_{CE} **= 3 V,** Z_S **= 50 Ω,** f **= Parameter in GHz**

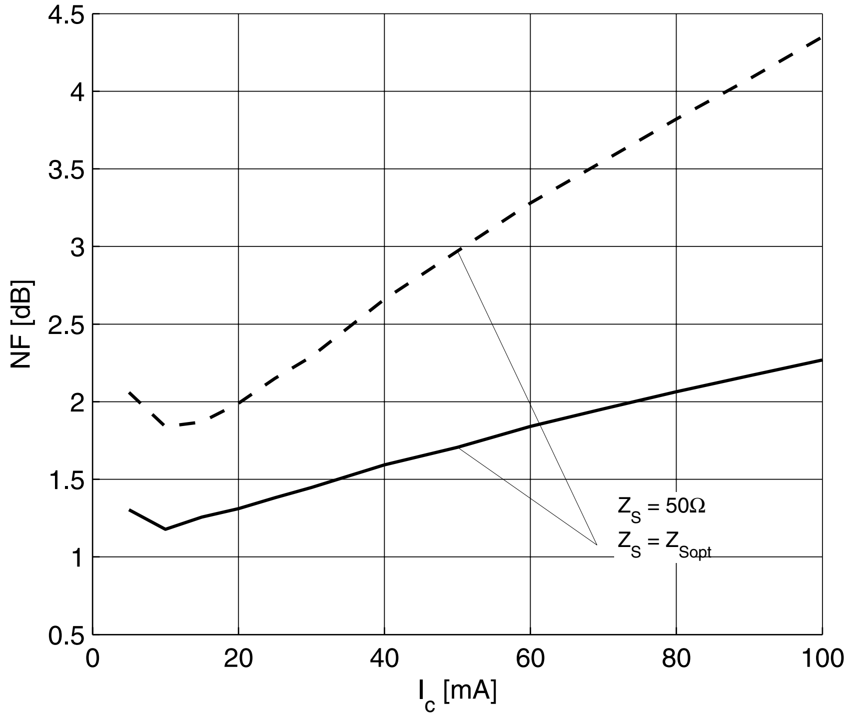


Figure 20 Comparison Noise Figure NF_{50} / NF_{min}= f (I_C), V_{CE} = 3 V, f = 1.9 GHz

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.*

5 Simulation Data

For the SPICE Gummel Poon (GP) model as well as for the S-parameters (including noise parameters) please refer to our internet website: **www.infineon.com/rf.models**. Please consult our website and download the latest versions before actually starting your design.

You find the BFP450 SPICE GP model in the internet in MWO- and ADS-format, which you can import into these circuit simulation tools very quickly and conveniently. The model already contains the package parasitics and is ready to use for DC- and high frequency simulations. The terminals of the model circuit correspond to the pin configuration of the device.

The model parameters have been extracted and verified up to 10 GHz using typical devices. The BFP450 SPICE GP model reflects the typical DC- and RF-performance within the limitations which are given by the SPICE GP model itself.

6 Package Information SOT343

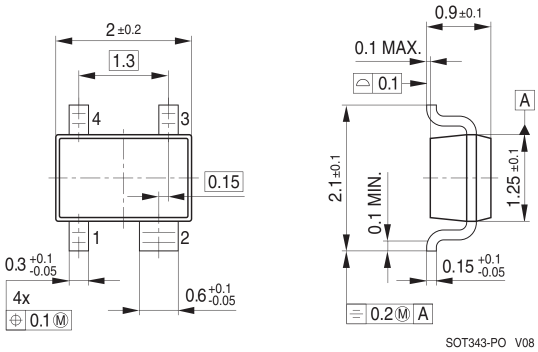


Figure 21 Package Outline

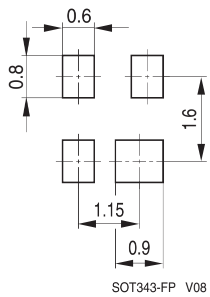


Figure 22 Package Foot Print

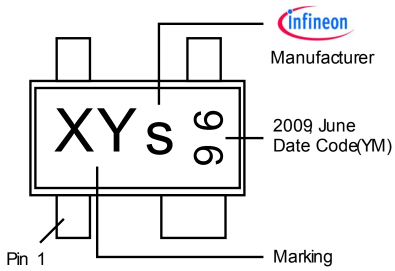


Figure 23 Marking Description (Marking BFP450: ANs)

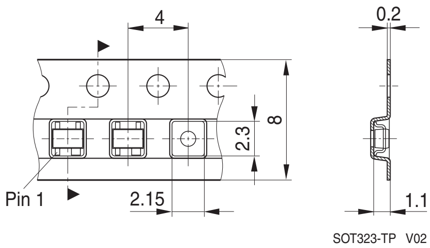


Figure 24 Tape Dimensions

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