BFP720F

Low Noise Silicon Germanium Bipolar RF Transistor

Data Sheet

Revision 1.1, 2012-10-25

RF & Protection Devices

Edition 2012-10-25

Published by
Infineon Technologies AG
81726 Munich, Germany

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BFP720F, Low Noise Silicon Germanium Bipolar RF Transistor

Revision History: 2012-10-25, Revision 1.1

Page	Subjects (changes since previous revision)
	This data sheet replaces the revision from 2009-03-13. The product itself has not been changed and the device characteristics remain unchanged. Only the product description and information available in the data sheet have been expanded and updated.

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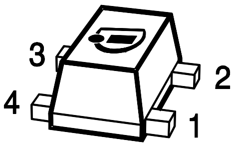
1 Product Brief

The BFP720F is a very low noise wideband NPN bipolar RF transistor. The device is based on Infineon's reliable high volume silicon germanium carbon (SiGe:C) heterojunction bipolar technology. The collector design supports voltages up to V_{CEO} = 4.0 V and currents up to I_{C} = 25 mA. The device is especially suited for mobile applications in which low power consumption is a key requirement. The typical transition frequency is approximately 45 GHz, hence the device offers high power gain at frequencies up to 12 GHz in amplifier applications. The device is housed in a thin small flat plastic package with visible leads.

2 Features

- High performance general purpose wideband LNA transistor
- Operation voltage: 1.0 V to 4.0 V
- Transistor geometry optimized for low current applications
- 26.5 dB maximum stable gain at 1.9 GHz and only 13 mA
- 15 dB maximum available gain at 10 GHz and only 13 mA
- 0.7 dB minimum noise figure at 5.5 GHz and 1.0 dB at 10 GHz
- High linearity OP_{1dB} = 7 dBm and OIP_3 = 21 dBm at 5.5 GHz and low current consumption of 13 mA
- Thin small flat Pb-free (RoHS compliant) and halogen-free package with visible leads
- Qualification report according to AEC-Q101 available



Applications

FM Radio, Mobile TV, RKE, AMR, Cellular, ZigBee, GPS, WiMAX, SDARs, Satellite Radio, Bluetooth, WiFi, Cordless phone, UMTS, WLAN, UWB, LNB

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

Product Name	Package	Pin Configuration				Marking
BFP720F	TSFP-4-1	1 = B	2 = E	3 = C	4 = E	R9s

3 Maximum Ratings

Table 3-1 Maximum Ratings at T_A = 25 °C (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector emitter voltage	V_{CEO}			 4.0 3.5	V	Open base T_A = 25 °C T_A = -55 °C
Collector emitter voltage	V_{CES}	–	–	13	V	E-B short circuited
Collector base voltage	V_{CBO}	–	–	13	V	Open emitter
Emitter base voltage	V_{EBO}	–	–	1.2	V	Open collector
Collector current	I_C	–	–	25	mA	
Base current	I_B	–	–	2	mA	
Total power dissipation[1]	P_{tot}	–	–	100	mW	$T_S \leq$ 109 °C
Junction temperature	T_J	–	–	150	°C	
Storage temperature	T_{Stg}	-55	–	150	°C	

[1] T_S is the soldering point temperature. T_S is measured on the emitter lead at the soldering point to 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.*

4 Thermal Characteristics

Table 4-1 Thermal Resistance

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - soldering point[1]	R_{thJS}	–	410	–	K/W	–

[1] For the definition of R_{thJS} please refer to Application Note AN077 (Thermal Resistance Calculation)

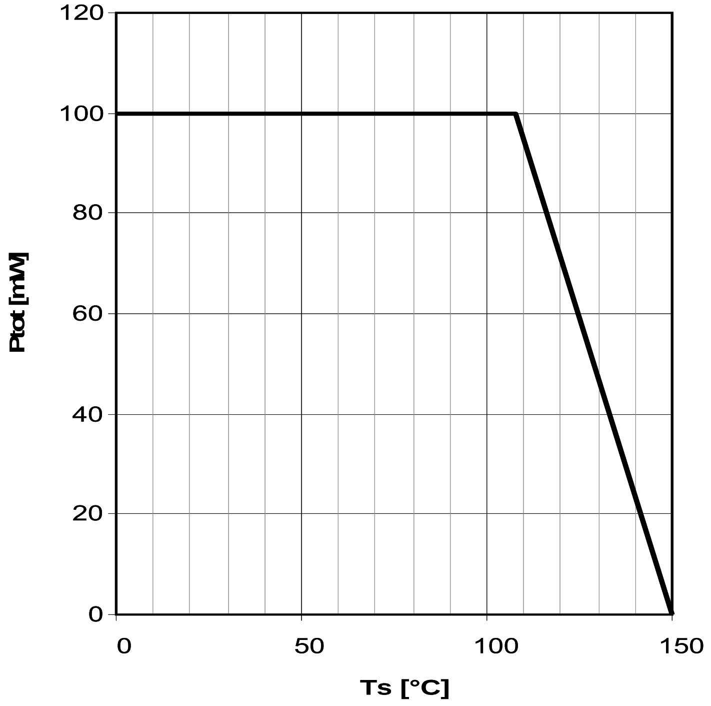


Figure 4-1 Total Power Dissipation $P_{tot} = f(T_s)$

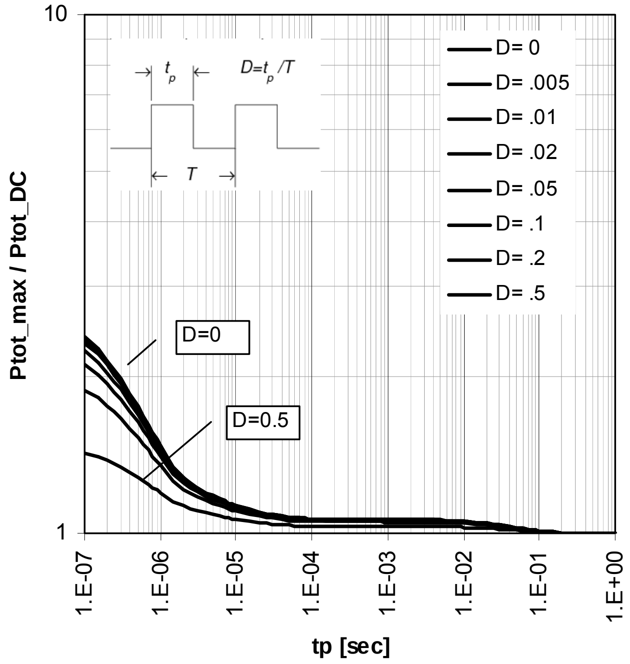


Figure 4-2 Permissible Pulse Load $P_{\text{tot\_max}} / P_{\text{tot\_DC}} = f(t_p)$

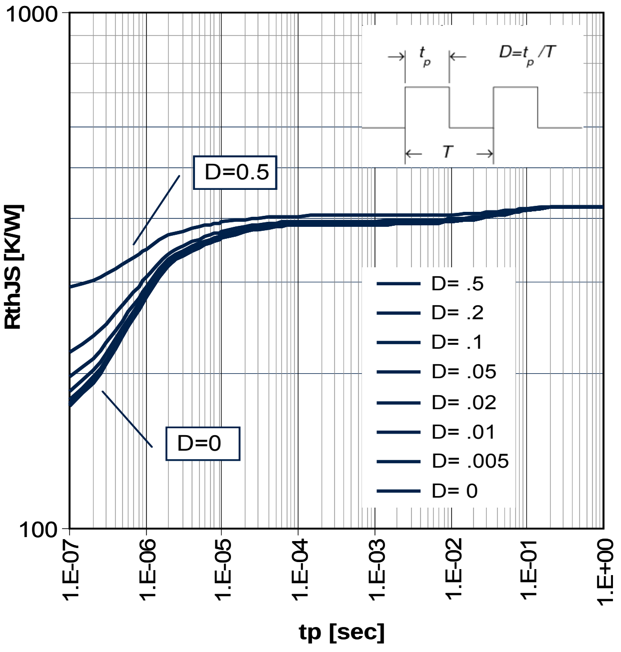


Figure 4-3 Permissible Pulse Load $R_{\text{thJS}} = f(t_p)$

5 Electrical Characteristics

5.1 DC Characteristics

Table 5-1 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	4.7	–	V	I_C = 1 mA, I_B = 0 mA
Collector emitter cutoff current	I_{CES}	–	–	30	µA	V_{CE} = 13 V, V_{BE} = 0 V
Collector base cutoff current	I_{CBO}	–	–	100	nA	V_{CB} = 5 V, I_E = 0 mA
Emitter base cutoff current	I_{EBO}	–	–	2	µA	V_{EB} = 0.5 V, I_C = 0 mA
DC current gain	h_{FE}	160	250	400		I_C = 13 mA, V_{CE} = 3 V pulse measured

5.2 General AC Characteristics

Table 5-2 AC Characteristics at T_A = 25 °C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Transition frequency	f_T	–	45	–	GHz	I_C = 13 mA, V_{CE} = 3 V f = 1 GHz
Collector base capacitance	C_{CB}	–	0.06	–	pF	V_{CB} = 3 V, V_{BE} = 0 V f = 1 MHz emitter grounded
Collector emitter capacitance	C_{CE}	–	0.3	–	pF	V_{CE} = 3 V, V_{BE} = 0 V f = 1 MHz base grounded
Emitter base capacitance	C_{EB}	–	0.3	–	pF	V_{EB} = 0.5 V, V_{CB} = 0 V f = 1 MHz collector grounded

5.3 Frequency Dependent AC Characteristics

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

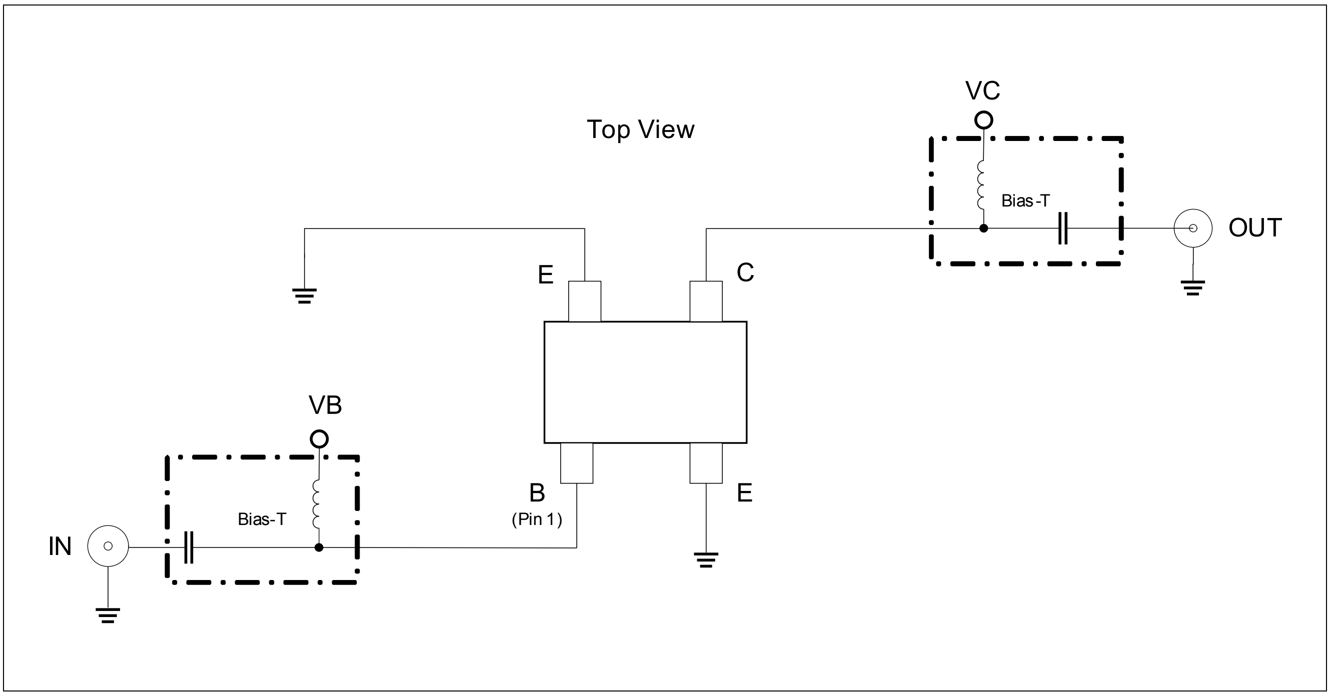


Figure 5-1 BFP720F Testing Circuit

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	34	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	37.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	23	–		I_C = 5 mA
High linearity operation point	S_{21}	–	29	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.4	–		I_C = 5 mA
Associated gain	G_{ass}	–	28	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	6	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	22.5	–		I_C = 13 mA

Table 5-4 AC Characteristics, V_{CE} = 3 V, f = 450 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	29	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	32.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	22.5	–		I_C = 5 mA
High linearity operation point	S_{21}	–	28.5	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.4	–		I_C = 5 mA
Associated gain	G_{ass}	–	27.5	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	5.5	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	21.5	–		I_C = 13 mA

Table 5-5 AC Characteristics, V_{CE} = 3 V, f = 900 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	26.5	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	29.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	22.5	–		I_C = 5 mA
High linearity operation point	S_{21}	–	27.5	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.45	–		I_C = 5 mA
Associated gain	G_{ass}	–	25.5	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	5.5	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	20.5	–		I_C = 13 mA

Table 5-6 AC Characteristics, V_{CE} = 3 V, f = 1.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	24	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	27.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	21.5	–		I_C = 5 mA
High linearity operation point	S_{21}	–	26	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.45	–		I_C = 5 mA
Associated gain	G_{ass}	–	24	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	6	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	21	–		I_C = 13 mA

Table 5-7 AC Characteristics, V_{CE} = 3 V, f = 1.9 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	23	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	26.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	21	–		I_C = 5 mA
High linearity operation point	S_{21}	–	24.5	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.5	–		I_C = 5 mA
Associated gain	G_{ass}	–	23	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	6.5	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	21	–		I_C = 13 mA

Table 5-8 AC Characteristics, V_{CE} = 3 V, f = 2.4 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	22	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	25.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	20.5	–		I_C = 5 mA
High linearity operation point	S_{21}	–	23	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.55	–		I_C = 5 mA
Associated gain	G_{ass}	–	22	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	6	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	21	–		I_C = 13 mA

Table 5-9 AC Characteristics, V_{CE} = 3 V, f = 3.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ms}	–	20.5	–		I_C = 5 mA
High linearity operation point	G_{ms}	–	23.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	18	–		I_C = 5 mA
High linearity operation point	S_{21}	–	20.5	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.6	–		I_C = 5 mA
Associated gain	G_{ass}	–	19.5	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	6.5	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	21.5	–		I_C = 13 mA

Table 5-10 AC Characteristics, V_{CE} = 3 V, f = 5.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain	G_{ms}				dB	
Low noise operation point	G_{ms}	–	19	–		I_C = 5 mA
High linearity operation point		–	21.5	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	15	–		I_C = 5 mA
High linearity operation point	S_{21}	–	16.5	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.7	–		I_C = 5 mA
Associated gain	G_{ass}	–	15	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	7	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	21	–		I_C = 13 mA

Table 5-11 AC Characteristics, V_{CE} = 3 V, f = 10 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain					dB	
Low noise operation point	G_{ma}	–	14	–		I_C = 5 mA
High linearity operation point	G_{ma}	–	15	–		I_C = 13 mA
Transducer Gain					dB	$Z_S = Z_L = 50\ \Omega$
Low noise operation point	S_{21}	–	9.5	–		I_C = 5 mA
High linearity operation point	S_{21}	–	10.5	–		I_C = 13 mA
Minimum Noise Figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.0	–		I_C = 5 mA
Associated gain	G_{ass}	–	10.5	–		I_C = 5 mA
Linearity					dBm	$Z_S = Z_L = 50\ \Omega$
1 dB gain compression point	OP_{1dB}	–	8	–		I_C = 13 mA
3rd order intercept point	OIP_3	–	19.5	–		I_C = 13 mA

Notes

1. *$G_{ms} = |S_{21} / S_{12}|$ for $k < 1$; $G_{ma} = |S_{21} / S_{12}|(k-(k^2-1)^{1/2})$ for $k > 1$*
2. *In order to get the NF_{min} values stated in this chapter the test fixture losses have been subtracted from all measured results*

5.4 Characteristic Curves

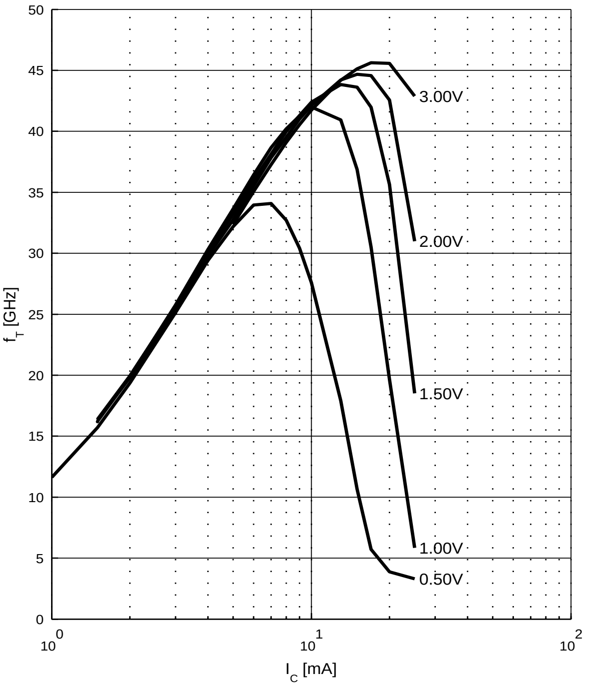


Figure 5-2 Transition Frequency $f_T = f(I_C, V_{CE})$, f = 1 GHz, V_{CE} Parameter in V

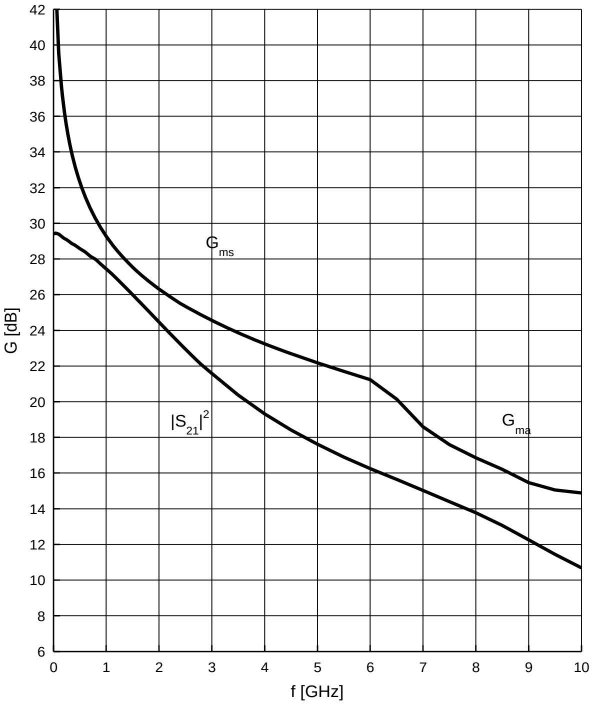


Figure 5-3 Power Gain G_{ma}, G_{ms}, $|S_{21}|^2 = f(f)$, V_{CE} = 3 V, I_C = 13 mA

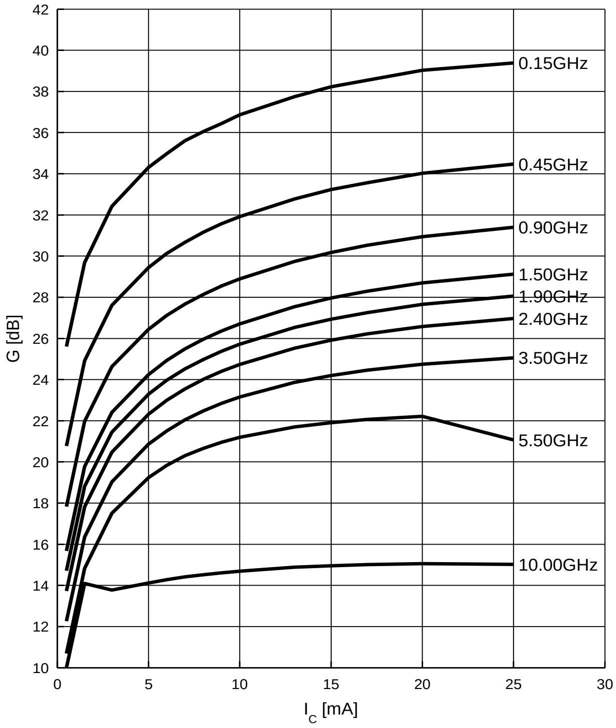


Figure 5-4 Power Gain G_{ma}, G_{ms} = f (I_C), V_{CE} = 3 V, f = Parameter in GHz

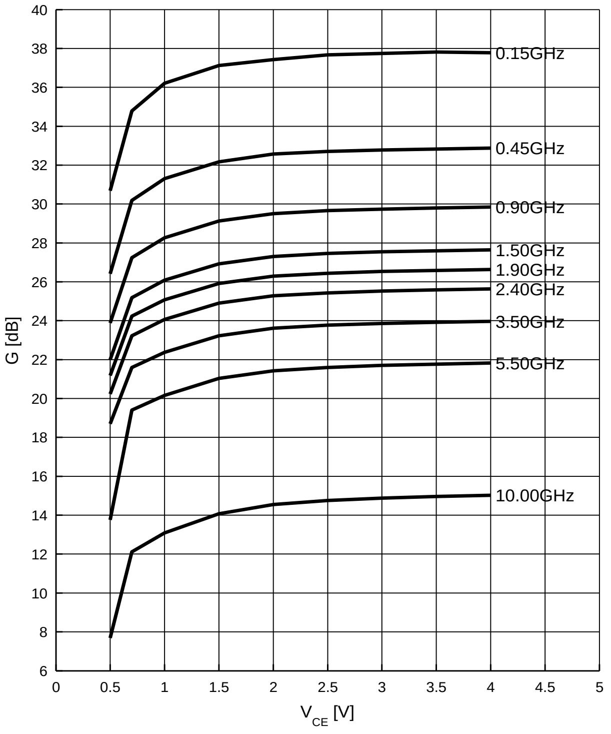


Figure 5-5 Power Gain G_{ma}, G_{ms} = f (V_{CE}), I_C = 13 mA, f = Parameter in GHz

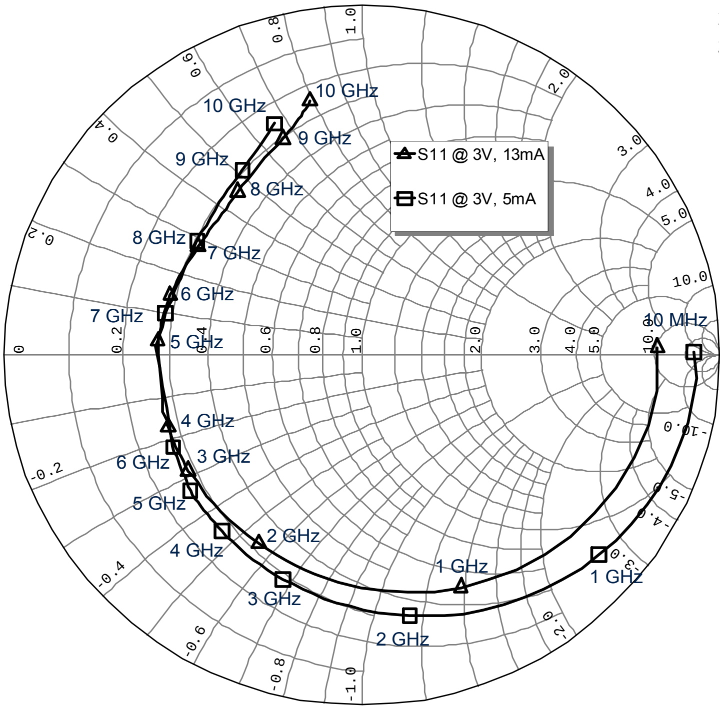


Figure 5-6 Input Matching $S_{11} = f(f)$, V_{CE} = 3 V, I_C = 5 mA / 13 mA

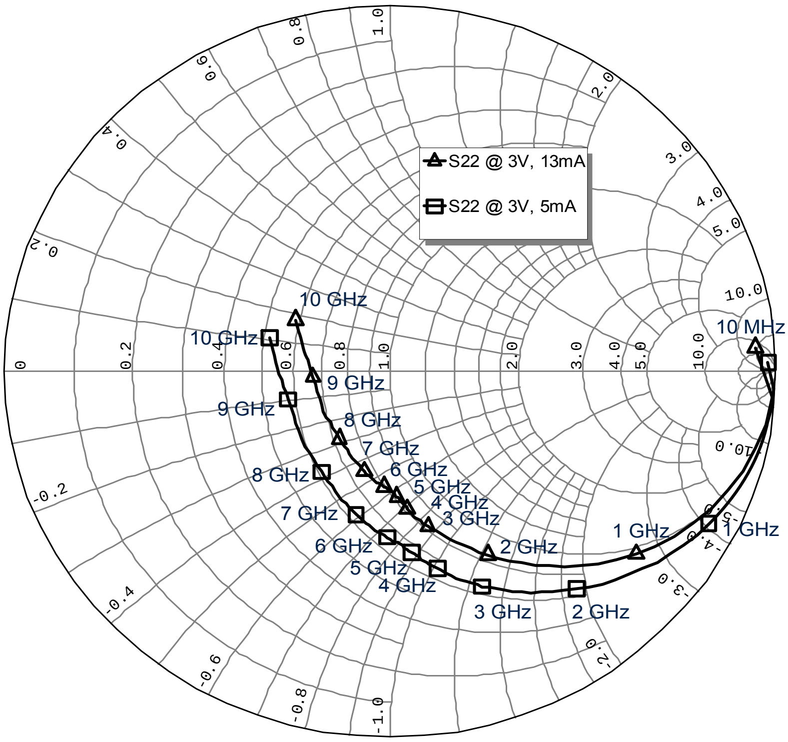


Figure 5-7 Output Matching $S_{22} = f(f)$, V_{CE} = 3 V, I_C = 5 mA / 13 mA

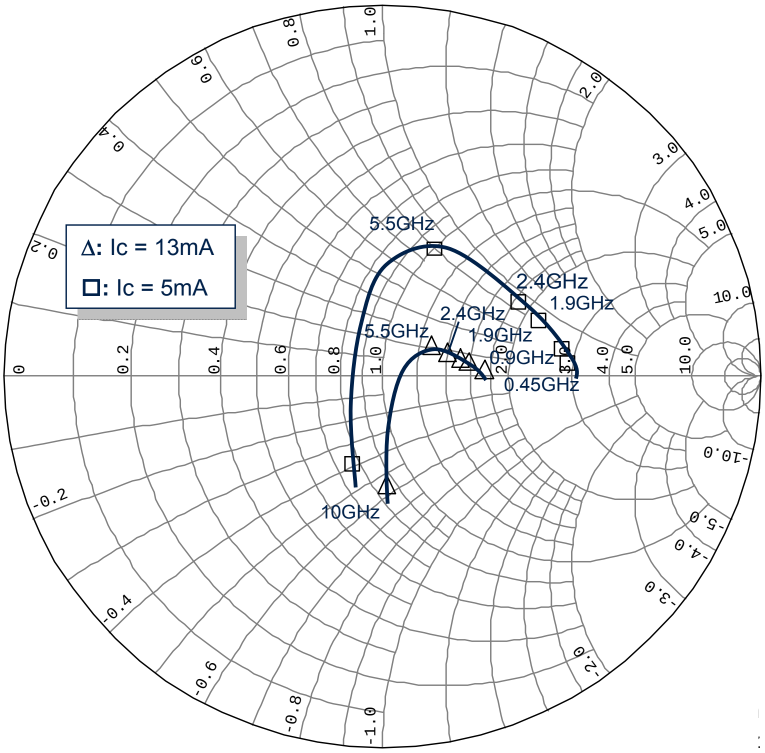


Figure 5-8 Source Impedance Z_{opt} for $NF_{min} = f(f)$, $V_{CE} = 3$ V, $I_C = 5$ mA / 13 mA

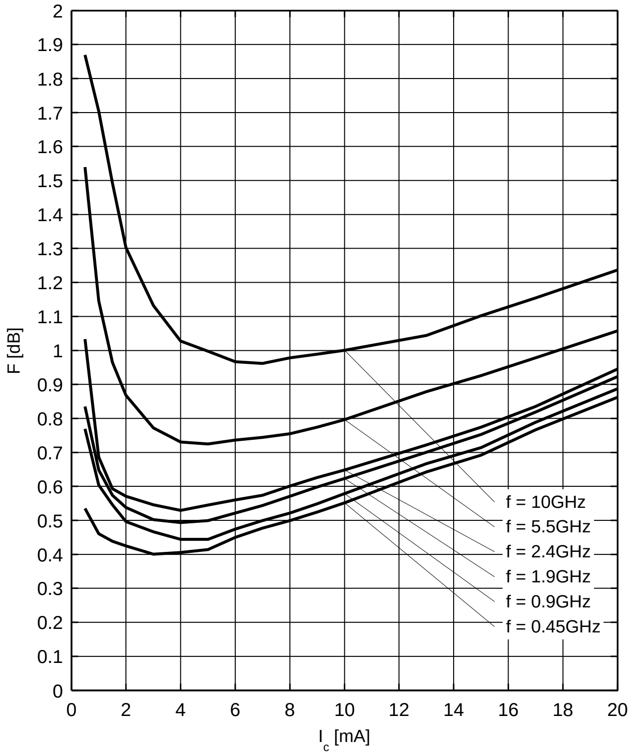


Figure 5-9 Noise Figure $NF_{min} = f(I_C)$, $V_{CE} = 3$ V, $Z_S = Z_{opt}$

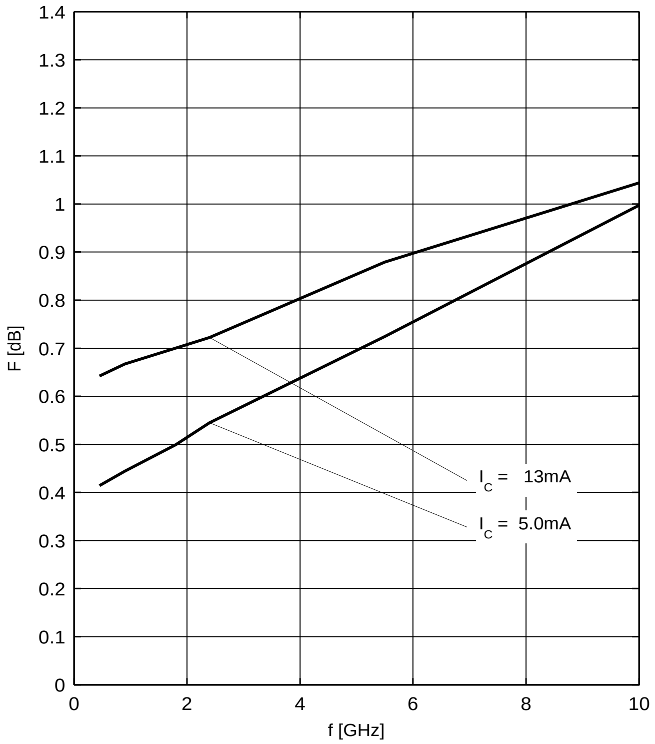


Figure 5-10 Noise Figure $NF_{min} = f(f)$, $V_{CE} = 3$ V, $Z_S = Z_{opt}$

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.

6 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 BFP720F 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 parasitic 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 15 GHz using typical devices. The BFP720F SPICE GP model reflects the typical DC- and RF-performance within the limitations which are given by the SPICE GP model itself.

7 Package Information TSFP-4-1

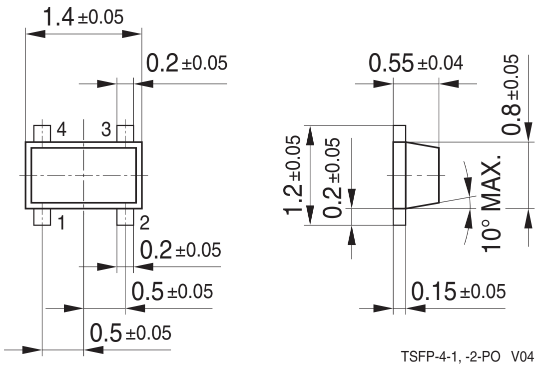


Figure 7-1 Package Outline

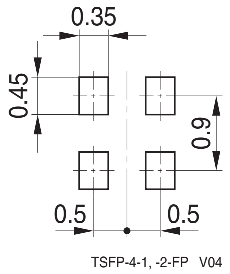


Figure 7-2 Footprint

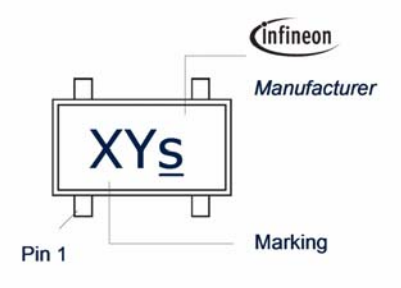


Figure 7-3 Marking Description (Marking BFP720F: R9s)

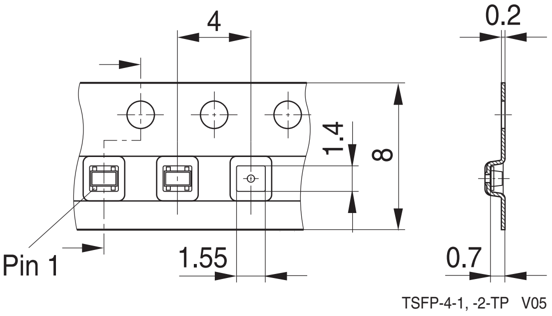


Figure 7-4 Tape Dimensions

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