BFP720

SiGe:C Heterojunction Wideband RF Bipolar Transistor

Data Sheet

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BFP720 SiGe:C Heterojunction Wideband RF Bipolar Transistor

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Previous Revision:

Page	Subjects (major changes since last revision)
	Converted to the new IFX Template.
	Business Unit, Infineon Logo and the Trademarks were changed.

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Last Trademarks Update 2009-10-19

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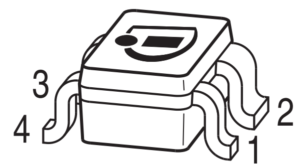
1 Features



Main features:

- High performance general purpose wideband LNA transistor
- 150 GHz f_T-Silicon Germanium Carbon technology
- Enables Best-In-Class performance for wireless applications due to high dynamic range
- Transistor geometry optimized for low-current applications
- Operation voltage: 1.0 V to 4.0 V
- Very high gain at high frequencies and low current consumption
- 26 dB maximum stable gain at 1.9 GHz and only 13 mA
- 15 dB maximum available gain at 10 GHz and only 13 mA
- Ultra low noise figure from latest SiGe:C technology
- 0.7 dB minimum noise figure at 5.5 GHz and 0.95 dB at 10 GHz
- High linearity OP1dB = +8.5 dBm and OIP3 = +23 dBm at 5.5 GHz and low current consumption of 13 mA
- Pb-free (RoHS compliant) package

RoHS

Application

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

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

Product Name	Package	Pin Configuration				Marking
BFP720	SOT343	1 = B	2 = E	3 = C	4 = E	R9s

2 Product Brief

The BFP720 is a wideband Silicon Germanium Carbon (SiGe:C) NPN Heterojunction Bipolar Transistor (HBT) in a plastic 4-pin dual emitter SOT343 package. The device combines very high gain with lowest noise figure at low operating current for use in a wide range of wireless applications. The BFP720 is especially well-suited for portable battery-powered applications in which reduced power consumption is a key requirement. Collector design supports operation voltages from 1.0 V to 4.0 V.

Table 1 Quick Reference 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-base breakdown voltage	$V_{(BR)CBO}$	13	15	–	V	I_E = 0 mA
Collector current	I_C	–	–	25	mA	
Total power dissipation	P_{tot}	–	–	100	mW	$T_S \leq$ 108 °C
DC current gain	h_{FE}	160	250	400		V_{CE} = 3 V, I_C = 13 mA

Table 2 Quick Reference AC Characteristics at T_A = 25°C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Transition frequency	f_T	–	45	–	GHz	V_{CE} = 3 V, I_C = 13 mA
***f* = 2.4 GHz**						
Maximum Power Gain		–		–	dB	
Low Noise Operation Point	G_{ms}		22			I_C = 5 mA
High Linearity Operation Point	G_{ms}		25			I_C = 13 mA
Transducer Gain		–		–	dB	$Z_S = Z_L$ = 50 Ω
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}		0.5			I_C = 5 mA
Associated Gain	G_{ass}		21.5			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			I_C = 13 mA
***f* = 5.5 GHz**						
Maximum Power Gain		–		–	dB	
Low Noise Operation Point	G_{ms}		19			I_C = 5 mA
High Linearity Operation Point	G_{ma}		19.5			I_C = 13 mA
Transducer Gain		–		–	dB	$Z_S = Z_L$ = 50 Ω
Low Noise Operation Point	S_{21}		15			I_C = 5 mA
High Linearity Operation Point	S_{21}		16			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 Ω
1 dB Gain Compression Point	OP_{1dB}		8.5			I_C = 13 mA
3rd Order Intercept Point	OIP_3		23			I_C = 13 mA

3 Maximum Ratings

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector-emitter voltage T_A = -55 °C	V_{CEO}	–	–	4.0 3.5	V	–
Collector-emitter voltage	V_{CES}	–	–	13	V	–
Collector-base voltage	V_{CBO}	–	–	13	V	–
Emitter-base voltage	V_{EBO}	–	–	1.2	V	–
Collector current	I_C	–	–	25	mA	–
Base current	I_B	–	–	2	mA	–
Total power dissipation[1)] $T_S \leq$ 108 °C	P_{tot}	–	–	100	mW	–
Operation junction temperature	T_{JOp}	-55	–	150	°C	–
Storage temperature	T_{Stg}	-55	–	150	°C	–

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

Note: Exceeding only one of the above maximum rating limits even for a short moment may cause permanent damage to the device. Even if the device continues to operate, its lifetime may be considerably shortened. Maximum ratings are stress ratings only and do not mean unaffected functional operation and lifetime at others than standard operation conditions.

4 Thermal Characteristics

Table 4 Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point[1)]	R_{thJS}	420	K/W

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

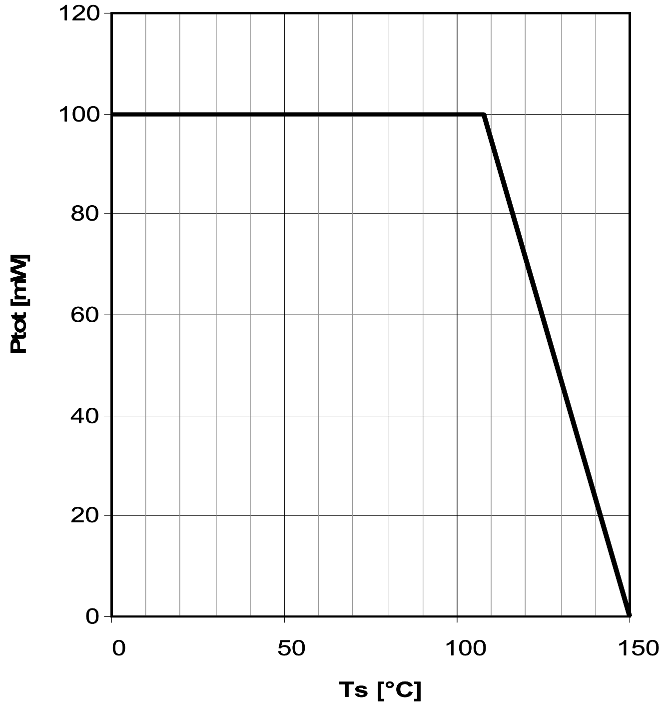


Figure 1 Total Power Dissipation $P_{tot} = f(T_s)$

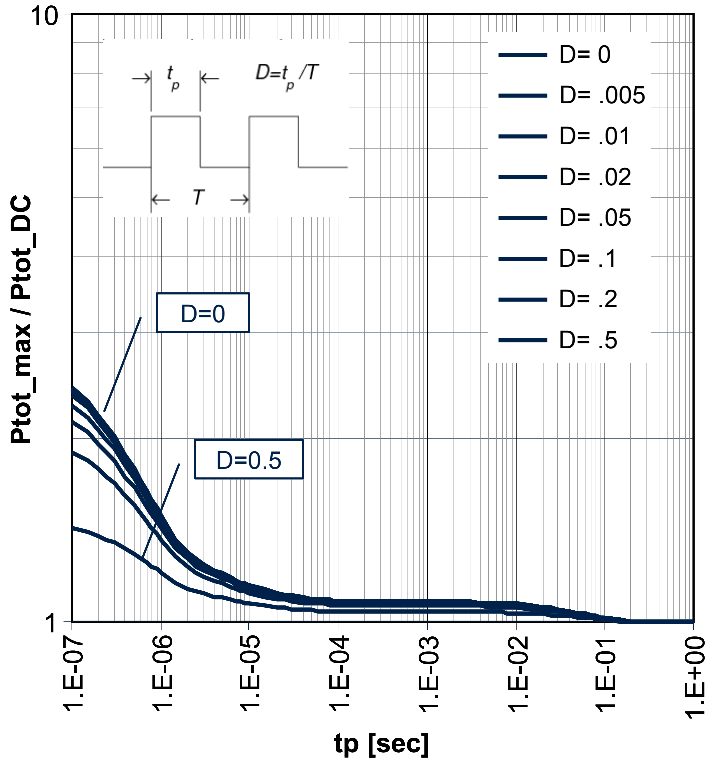


Figure 2 Permissible Pulse Load P_{tot_max} / P_{tot_DC} = f (tp)

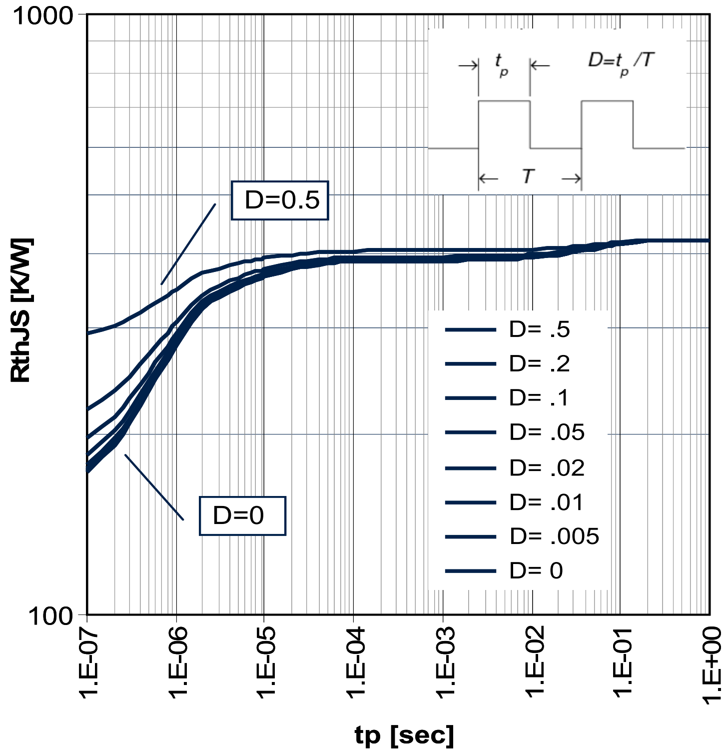


Figure 3 Permissible Pulse Load R_{thJS} = f (tp)

5 Electrical Characteristics

5.1 DC Characteristics

Table 5 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 6 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}	–	0.35	–	pF	V_{CE} = 3 V, V_{BE} = 0 V f = 1 MHz base grounded
Emitter-base capacitance	C_{eb}	–	0.35	–	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 testfixture with Bias T's in a 50 Ω system, T_A = 25 °C

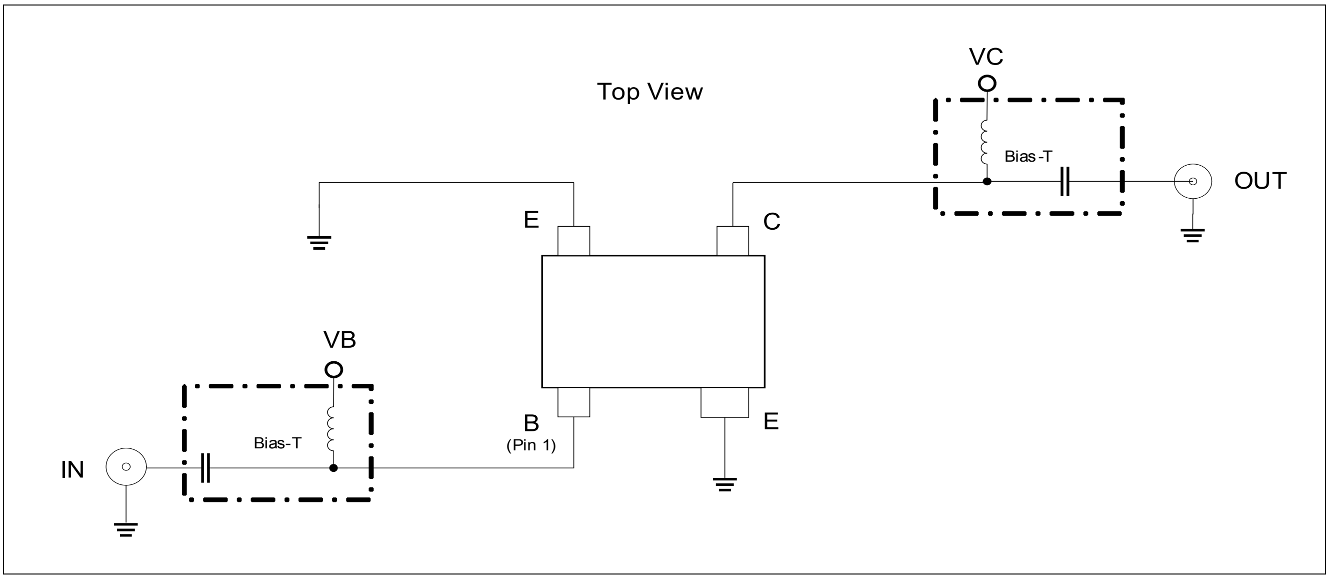


Figure 4 BFP720 Testing Circuit

Table 7 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}		29.5			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}		28.5			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			I_C = 13 mA

Table 8 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 Ω
Low Noise Operation Point	S_{21}		23			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}		28			I_C = 5 mA
Linearity		–		–	dBm	$Z_S = Z_L$ = 50 Ω
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 9 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 Ω
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}		0.4			I_C = 5 mA
Associated Gain	G_{ass}		26			I_C = 5 mA
Linearity		–		–	dBm	$Z_S = Z_L$ = 50 Ω
1 dB Gain Compression Point	OP_{1dB}		5.5			I_C = 13 mA
3rd Order Intercept Point	OIP_3		21			I_C = 13 mA

Table 10 AC Characteristics, V_{CE} = 3 V, f = 1500 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain Low Noise Operation Point High Linearity Operation Point	 G_{ms} G_{ms}	–	 24 27.5	–	dB	 I_C = 5 mA I_C = 13 mA
Transducer Gain Low Noise Operation Point High Linearity Operation Point	 S_{21} S_{21}	–	 22 25.5	–	dB	$Z_S = Z_L$ = 50 Ω I_C = 5 mA I_C = 13 mA
Minimum Noise Figure Minimum Noise Figure Associated Gain	 NF_{min} G_{ass}	–	 0.45 24	–	dB	$Z_S = Z_{opt}$ I_C = 5 mA I_C = 5 mA
Linearity 1 dB Gain Compression Point 3rd Order Intercept Point	 OP_{1dB} OIP_3	–	 6 21.5	–	dBm	$Z_S = Z_L$ = 50 Ω I_C = 13 mA I_C = 13 mA

Table 11 AC Characteristics, V_{CE} = 3 V, f = 1.9 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain Low Noise Operation Point High Linearity Operation Point	 G_{ms} G_{ms}	–	 23 26	–	dB	 I_C = 5 mA I_C = 13 mA
Transducer Gain Low Noise Operation Point High Linearity Operation Point	 S_{21} S_{21}	–	 21.5 24.5	–	dB	$Z_S = Z_L$ = 50 Ω I_C = 5 mA I_C = 13 mA
Minimum Noise Figure Minimum Noise Figure Associated Gain	 NF_{min} G_{ass}	–	 0.45 23	–	dB	$Z_S = Z_{opt}$ I_C = 5 mA I_C = 5 mA
Linearity 1 dB Gain Compression Point 3rd Order Intercept Point	 OP_{1dB} OIP_3	–	 7 22	–	dBm	$Z_S = Z_L$ = 50 Ω I_C = 13 mA I_C = 13 mA

Table 12 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			I_C = 13 mA
Transducer Gain		–		–	dB	$Z_S = Z_L$ = 50 Ω
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}		0.5			I_C = 5 mA
Associated Gain	G_{ass}		21.5			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			I_C = 13 mA

Table 13 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 Ω
Low Noise Operation Point	S_{21}		18.5			I_C = 5 mA
High Linearity Operation Point	S_{21}		20			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}		19			I_C = 5 mA
Linearity		–		–	dBm	$Z_S = Z_L$ = 50 Ω
1 dB Gain Compression Point	OP_{1dB}		7.5			I_C = 13 mA
3rd Order Intercept Point	OIP_3		22.5			I_C = 13 mA

Table 14 AC Characteristics, V_{CE} = 3 V, f = 5.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Maximum Power Gain		–		–	dB	
Low Noise Operation Point	G_{ms}		19			I_C = 5 mA
High Linearity Operation Point	G_{ma}		19.5			I_C = 13 mA
Transducer Gain		–		–	dB	$Z_S = Z_L$ = 50 Ω
Low Noise Operation Point	S_{21}		15			I_C = 5 mA
High Linearity Operation Point	S_{21}		16			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 Ω
1 dB Gain Compression Point	OP_{1dB}		8.5			I_C = 13 mA
3rd Order Intercept Point	OIP_3		23			I_C = 13 mA

Table 15 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}		13.5			I_C = 5 mA
High Linearity Operation Point	G_{ma}		15			I_C = 13 mA
Transducer Gain		–		–	dB	$Z_S = Z_L$ = 50 Ω
Low Noise Operation Point	S_{21}		9			I_C = 5 mA
High Linearity Operation Point	S_{21}		10			I_C = 13 mA
Minimum Noise Figure		–		–	dB	$Z_S = Z_{opt}$
Minimum Noise Figure	NF_{min}		0.95			I_C = 5 mA
Associated Gain	G_{ass}		10.5			I_C = 5 mA
Linearity		–		–	dBm	$Z_S = Z_L$ = 50 Ω
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

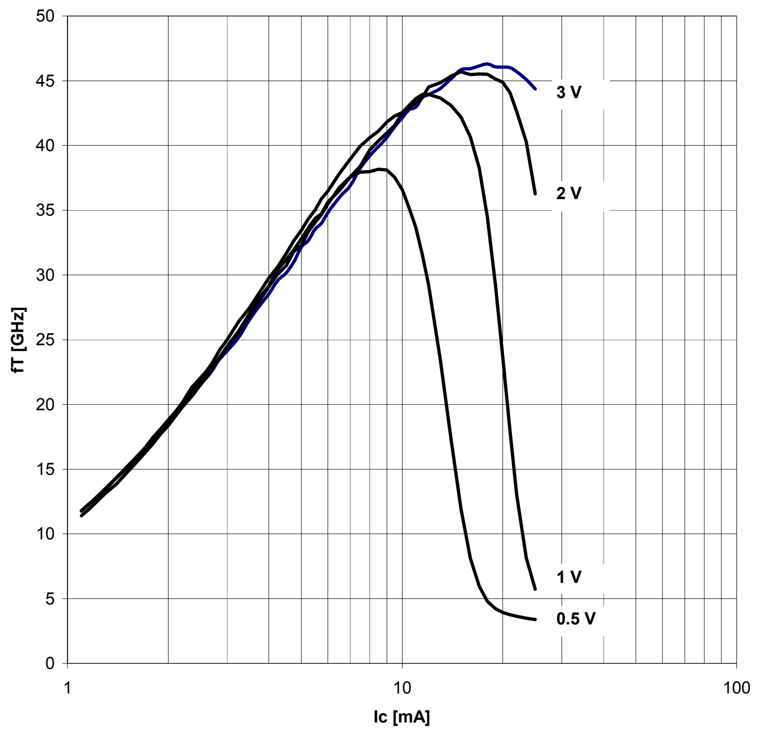


Figure 5 Transition Frequency $f_T = f(I_C, V_{CE})$ f = 1 GHz, V_{CE} Parameter in V

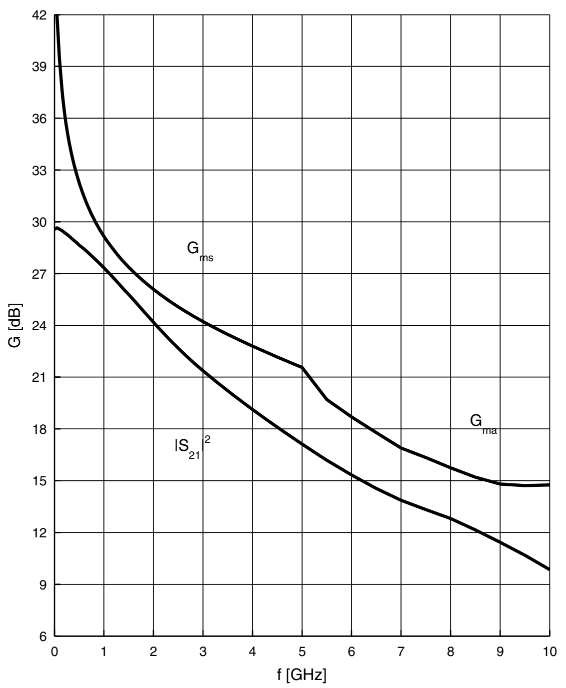


Figure 6 Power Gain G_{ma}, G_{ms}, $|S_{21}|^2 = f$(f) V_{CE} = 3 V, I_C = 13 mA

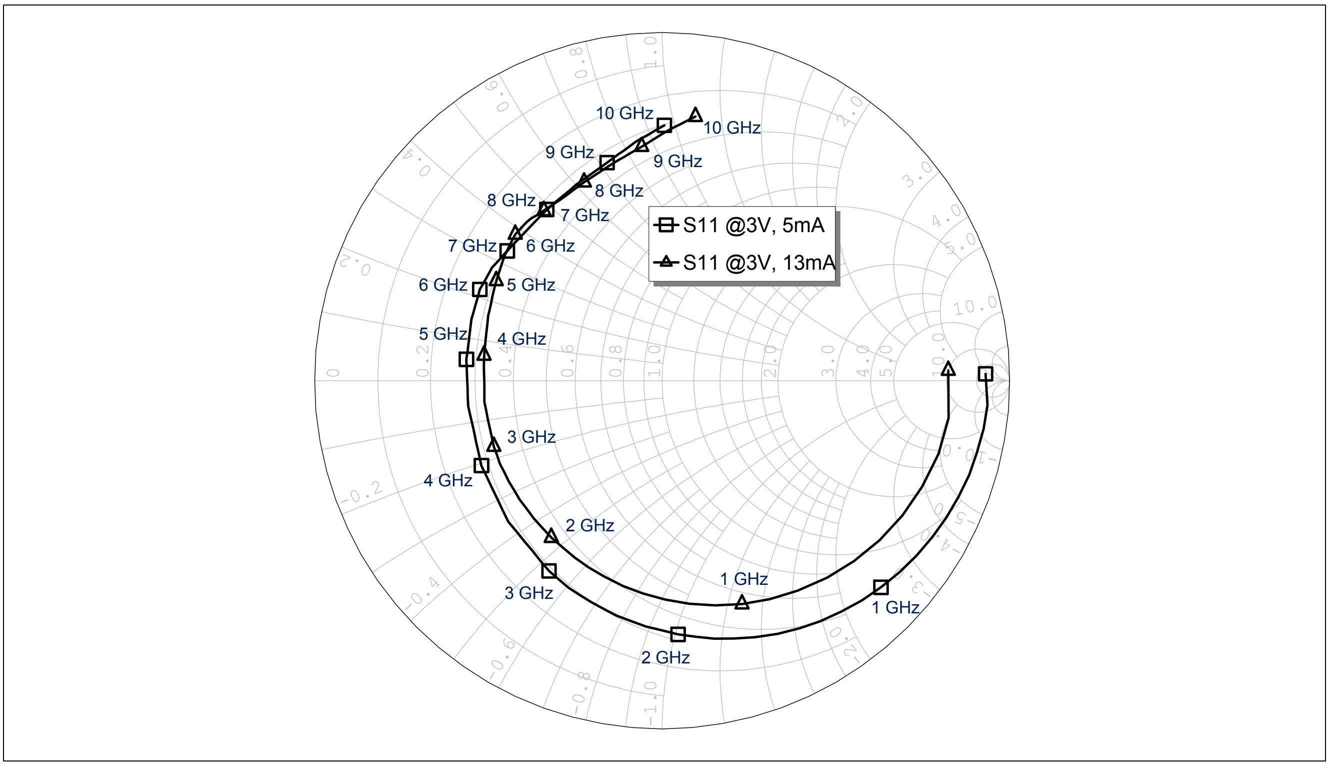


Figure 7 Input Matching S_{11} vs. Frequency V_{CE} = 3 V, I_C = 5 mA / 13 mA

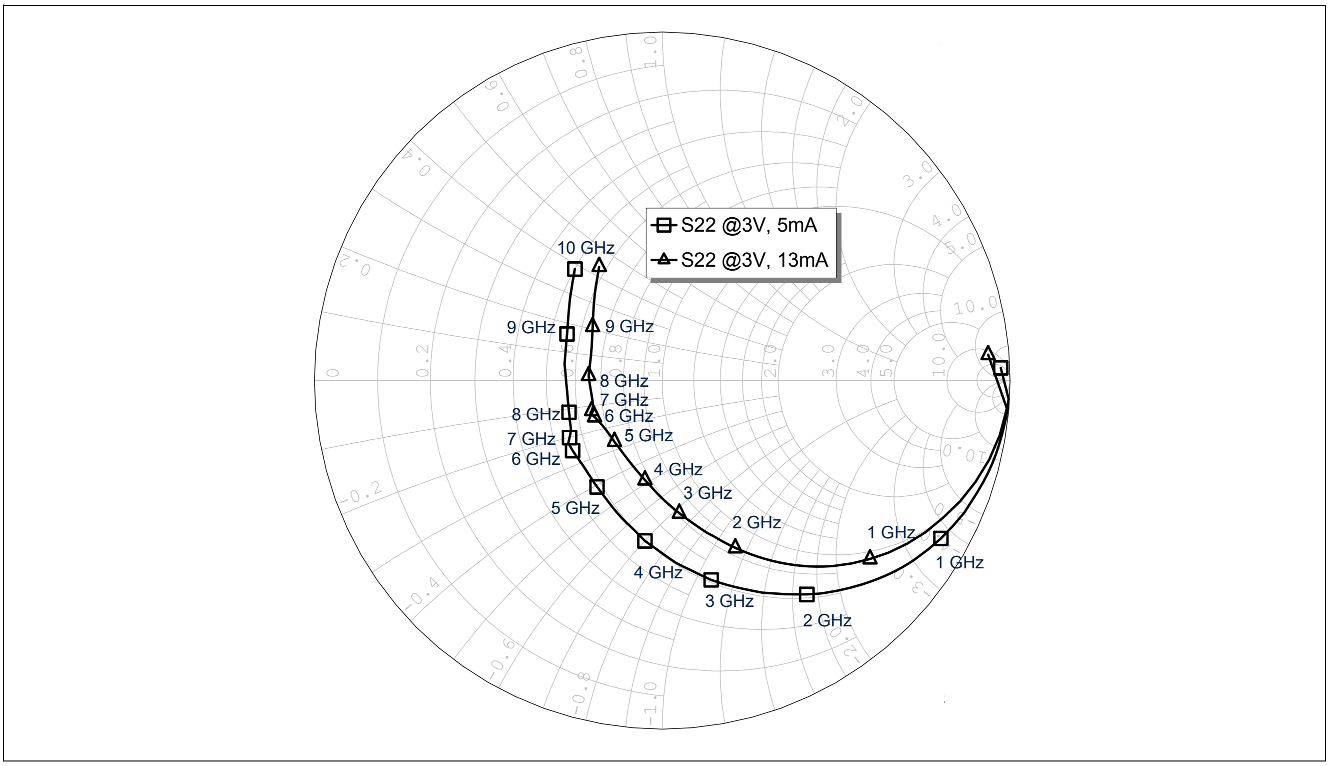


Figure 8 Output Matching S_{22} vs. Frequency V_{CE} = 3 V, I_C = 5 mA / 13 mA

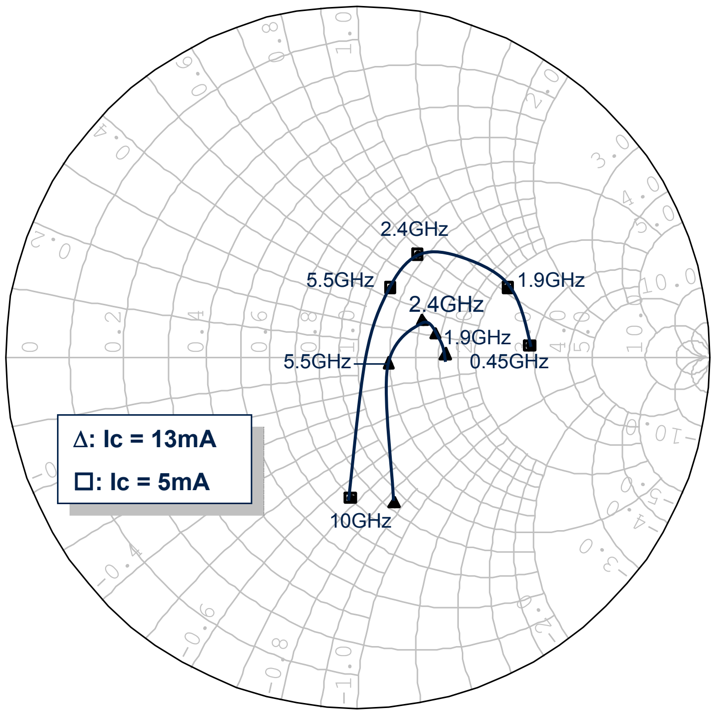


Figure 9 Source Impedance Z_{opt} for NF_{min} vs. Frequency V_{CE} = 3 V, I_C = 5 mA / 13 mA

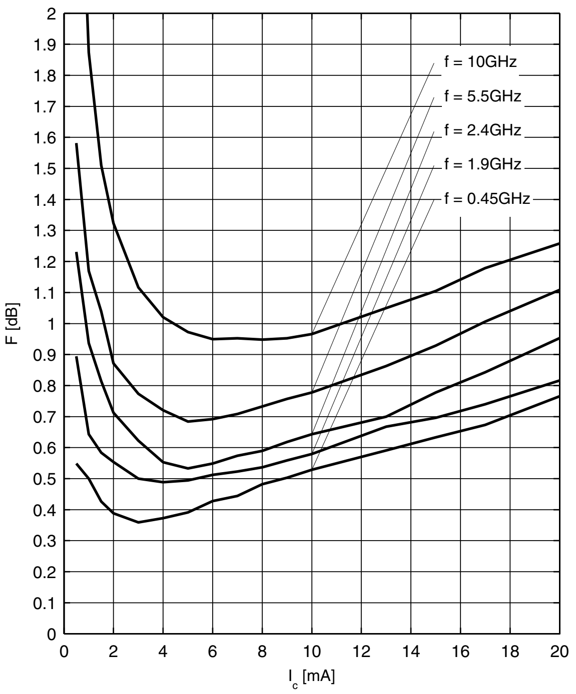


Figure 10 Noise Figure $NF_{min} = f(I_C)$ V_{CE} = 3 V, $Z_S = Z_{opt}$

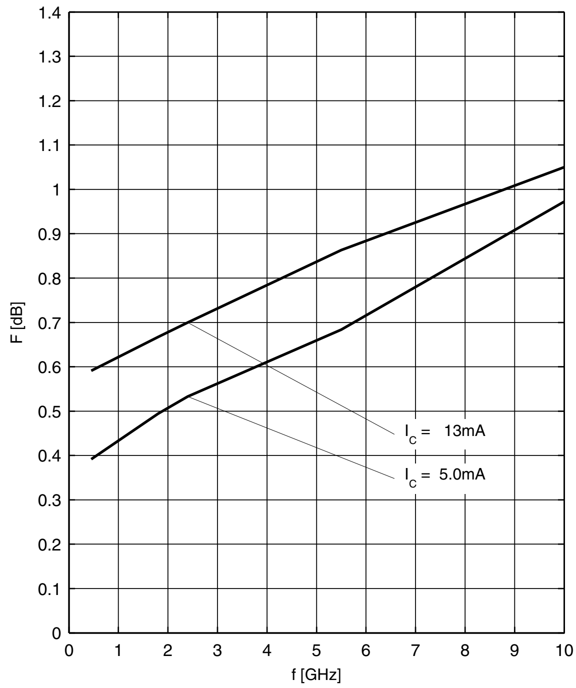


Figure 11 Noise Figure $NF_{min} = f\,(f)$ V_{CE} = 3 V, $Z_S = Z_{op}$

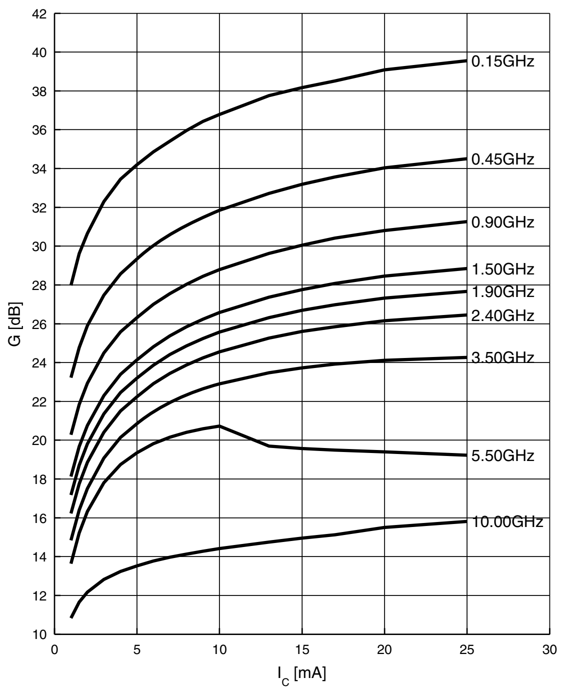


Figure 12 Power Gain G_{ma}, $G_{ms} = f\,(I_C)$ V_{CE} = 3 V, f = Parameter in GHz

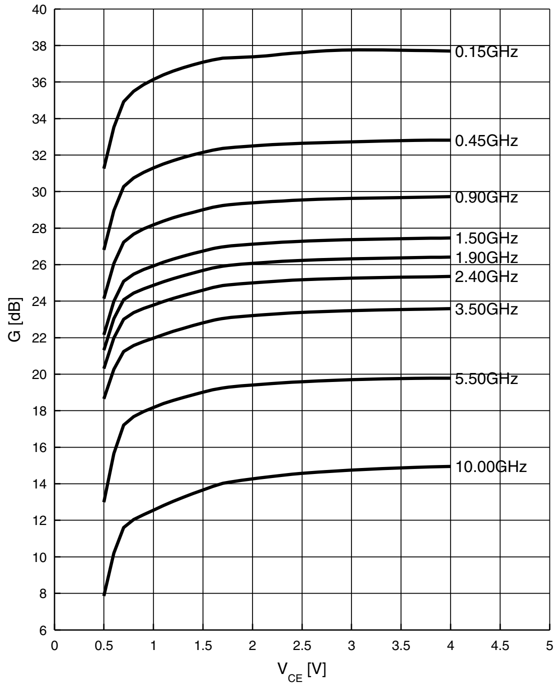


Figure 13 Power Gain G_{ma}, G_{ms} = $f(V_{CE})$ I_C = 13 mA, f = Parameter in GHz

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.

6 Simulation Data

For SPICE-model as well as for 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.

The simulation data have been generated and verified using typical devices. The BFP720 nonlinear SPICE-model reflects the typical DC- and RF-device performance with high accuracy.

7 Package Information

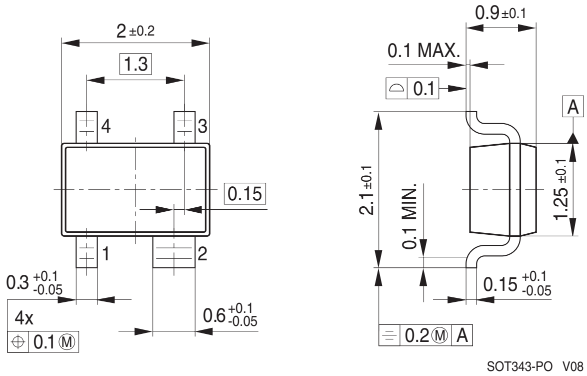


Figure 14 Package Outline SOT343 (top / side view)

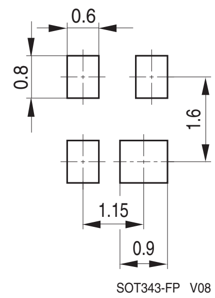


Figure 15 Footprint

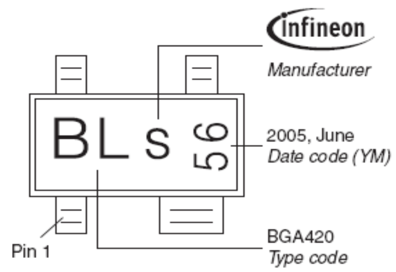


Figure 16 Marking Example (Marking BFP720: R9s)

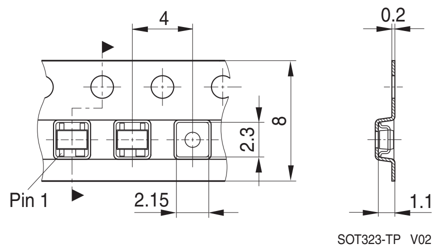


Figure 17 Tape Dimensions

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