BFP740ESD

Robust Low Noise Silicon Germanium Bipolar RF Transistor

Data Sheet

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Page	Subjects (changes since previous revision)
	This data sheet replaces the revision from 2010-06-29. 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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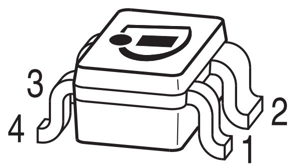
1 Product Brief

The BFP740ESD 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} = 4.2 V and currents up to I_C = 45 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 10 GHz in amplifier applications. The transistor is fitted with internal protection circuits, which enhance the robustness against electrostatic discharge (ESD) and high levels of RF input power. The device is housed in an easy to use plastic package with visible leads.

2 Features

- Robust very low noise amplifier based on Infineon´s reliable, high volume SiGe:C wafer technology
- 2 kV ESD robustness (HBM) due to integrated protection circuits
- High maximum RF input power of 21 dBm
- 0.65 dB minimum noise figure typical at 2.4 GHz, 0.9 dB at 5.5 GHz, 6 mA
- 25.5 dB maximum gain G_{ms} typical at 2.4 GHz, 18.5 dB G_{ma} at 5.5 GHz, 25 mA
- 24 dBm OIP_3 typical at 5.5 GHz, 25 mA
- Easy to use Pb-free (RoHS compliant) and halogen-free standard package with visible leads
- Qualification report according to AEC-Q101 available



RoHS

Applications

As Low Noise Amplifier (LNA) in

- Mobile, portable and fixed connectivity applications: WLAN 802.11a/b/g/n, WiMax 2.5/3.5/5 GHz, UWB, Bluetooth
- Satellite communication systems: Navigation systems (GPS, Glonass), satellite radio (SDARs, DAB) and C-band LNB
- Multimedia applications such as mobile/portable TV, CATV, FM Radio
- 3G/4G UMTS/LTE mobile phone applications
- ISM applications like RKE, AMR and Zigbee, as well as for emerging wireless applications

As discrete active mixer, amplifier in VCOs and buffer amplifier

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

Product Name	Package	Pin Configuration				Marking
BFP740ESD	SOT343	1 = B	2 = E	3 = C	4 = E	T7s

3 Maximum Ratings

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

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Collector emitter voltage	V_{CEO}				Open base
		–	4.2	V	T_A = 25 °C
		–	3.7	V	T_A = -55 °C
Collector emitter voltage[1)]	V_{CBO}				Open emitter
		–	4.9	V	T_A = 25 °C
		–	4.4	V	T_A = -55 °C
Collector emitter voltage[2)]	V_{CES}				E-B short circuited
		–	4.2	V	T_A = 25 °C
		–	3.7	V	T_A = -55 °C
Base current[3)]	I_B	-10	5	mA	–
Collector current	I_C	–	45	mA	–
RF input power[4)]	P_{RFin}	–	21	dBm	–
ESD stress pulse[5)]	V_{ESD}	-2	2	kV	HBM, all pins, acc. to JESD22-A114
Total power dissipation[6)]	P_{tot}	–	160	mW	$T_S \leq 98$ °C
Junction temperature	T_J	–	150	°C	–
Storage temperature	T_{Stg}	-55	150	°C	–

1) Low V_{CBO} due to integrated protection circuits
2) V_{CES} is identical to V_{CEO} due to integrated protection circuits.
3) Sustainable reverse bias current is high due to integrated protection circuits.
4) RF input power is high due to integrated protection circuits.
5) ESD robustness is high due to integrated protection circuits.
6) T_S is the soldering point temperature. T_S is 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.

4 Thermal Characteristics

Table 4-1 Thermal Resistance

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - soldering point[1)]	R_{thJS}	–	325	–	K/W	–

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

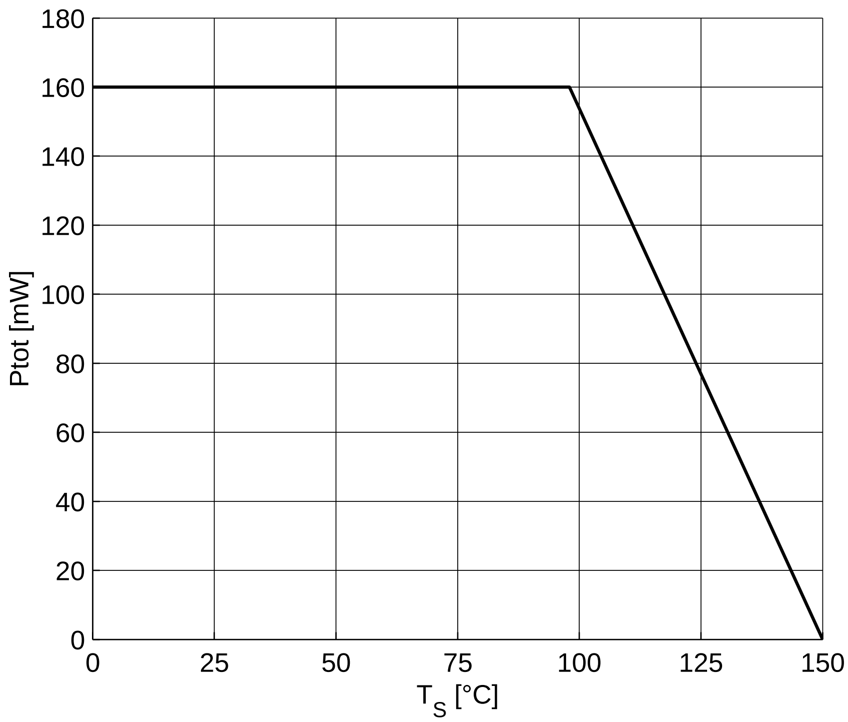


Figure 4-1 Total Power Dissipation $P_{tot} = f(T_s)$

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	$V_{(BR)CEO}$	4.2	4.7	–	V	I_C = 1 mA, I_B = 0 Open base
Collector emitter leakage current	I_{CES}	–	–	400	nA	V_{CE} = 2 V, V_{BE} = 0 E-B short circuited
Collector base leakage current	I_{CBO}	–	–	400	nA	V_{CB} = 2 V, I_E = 0 Open emitter
Emitter base leakage current	I_{EBO}	–	–	10	µA	V_{EB} = 0.5 V, I_C = 0 Open collector
DC current gain	h_{FE}	160	250	400		V_{CE} = 3 V, I_C = 25 mA Pulse measured

5.2 General AC Characteristics

Table 5-2 General 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 = 25 mA f = 2 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}	–	0.45	–	pF	V_{CE} = 3 V, V_{BE} = 0 f = 1 MHz Base grounded
Emitter base capacitance	C_{EB}	–	0.55	–	pF	V_{EB} = 0.4 V, V_{CB} = 0 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

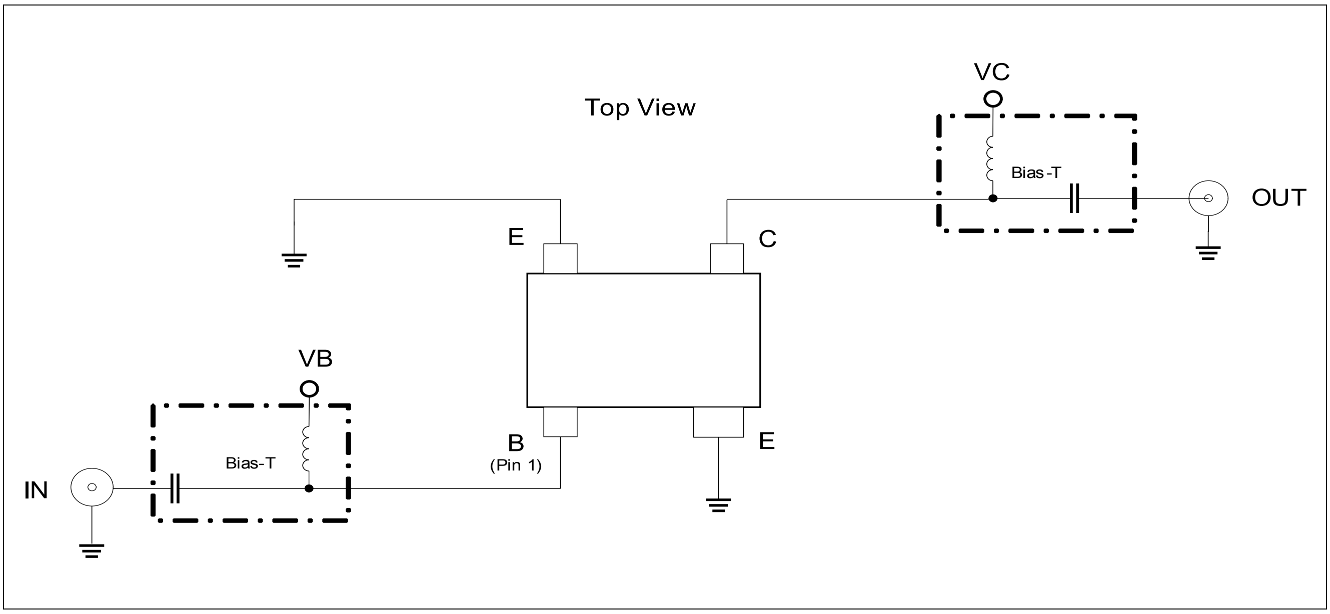


Figure 5-1 BFP740ESD Testing Circuit

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 = 6 mA
High linearity operation point	G_{ms}	–	38.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	25	–		I_C = 6 mA
High linearity operation point	S_{21}	–	34	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.55	–		I_C = 6 mA
Associated gain	G_{ass}	–	30.5	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	9	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	23.5	–		I_C = 25 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 = 6 mA
High linearity operation point	G_{ms}	–	33.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	24.5	–		I_C = 6 mA
High linearity operation point	S_{21}	–	32	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.55	–		I_C = 6 mA
Associated gain	G_{ass}	–	28.5	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	9.5	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	23.5	–		I_C = 25 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	–		I_C = 6 mA
High linearity operation point	G_{ms}	–	30.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	23.5	–		I_C = 6 mA
High linearity operation point	S_{21}	–	29	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.55	–		I_C = 6 mA
Associated gain	G_{ass}	–	25.5	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	9.5	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	24	–		I_C = 25 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}	–	23.5	–		I_C = 6 mA
High linearity operation point	G_{ms}	–	28	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	22	–		I_C = 6 mA
High linearity operation point	S_{21}	–	25.5	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.6	–		I_C = 6 mA
Associated gain	G_{ass}	–	23	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	10	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	24.5	–		I_C = 25 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}	–	22.5	–		I_C = 6 mA
High linearity operation point	G_{ms}	–	26.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	21	–		I_C = 6 mA
High linearity operation point	S_{21}	–	24	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.6	–		I_C = 6 mA
Associated gain	G_{ass}	–	21	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	10	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	25	–		I_C = 25 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 = 6 mA
High linearity operation point	G_{ms}	–	25.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	19.5	–		I_C = 6 mA
High linearity operation point	S_{21}	–	22	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.65	–		I_C = 6 mA
Associated gain	G_{ass}	–	20	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	10.5	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	25	–		I_C = 25 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 = 6 mA
High linearity operation point	G_{ms}	–	23	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	17	–		I_C = 6 mA
High linearity operation point	S_{21}	–	19	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.7	–		I_C = 6 mA
Associated gain	G_{ass}	–	16.5	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	10.5	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	24.5	–		I_C = 25 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					dB	
Low noise operation point	G_{ms}	–	19	–		I_C = 6 mA
High linearity operation point	G_{ma}	–	18.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	13	–		I_C = 6 mA
High linearity operation point	S_{21}	–	14.5	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	0.9	–		I_C = 6 mA
Associated gain	G_{ass}	–	13.5	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	10	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	24	–		I_C = 25 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_{ms}	–	14.5	–		I_C = 6 mA
High linearity operation point	G_{ms}	–	14.5	–		I_C = 25 mA
Transducer gain					dB	$Z_S = Z_L$ = 50 Ω
Low noise operation point	S_{21}	–	5.5	–		I_C = 6 mA
High linearity operation point	S_{21}	–	7.5	–		I_C = 25 mA
Minimum noise figure					dB	$Z_S = Z_{opt}$
Minimum noise figure	NF_{min}	–	1.8	–		I_C = 6 mA
Associated gain	G_{ass}	–	8.5	–		I_C = 6 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB gain compression point	OP_{1dB}	–	7.5	–		I_C = 25 mA
3rd order intercept point	OIP_3	–	21	–		I_C = 25 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.*
3. *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.*

5.4 Characteristic DC Diagrams

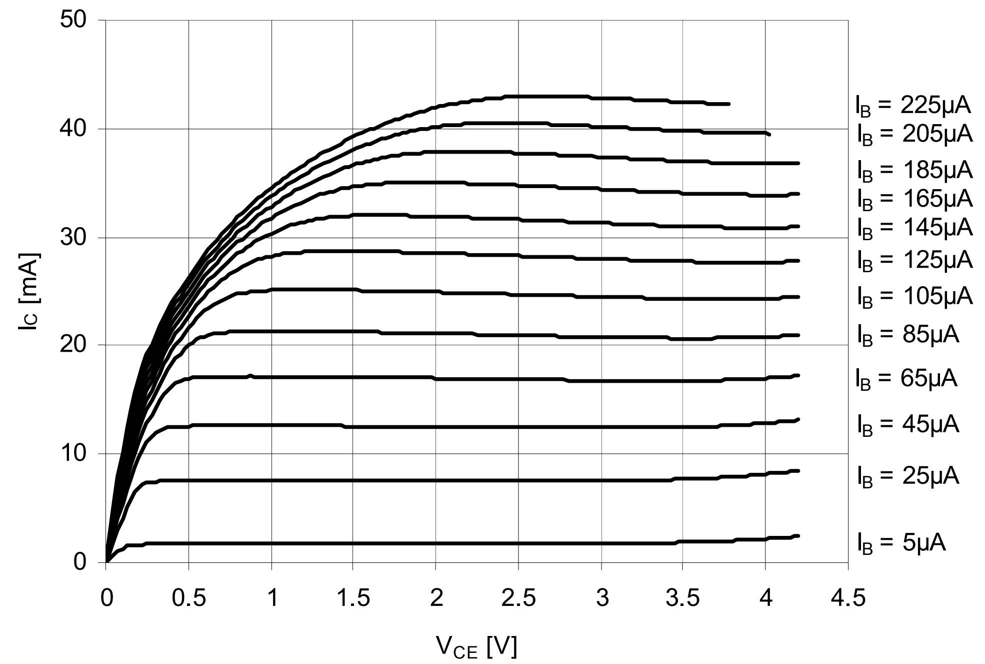


Figure 5-2 Collector Current vs. Collector Emitter Voltage $I_C = f(V_{CE})$, I_B = Parameter in µA

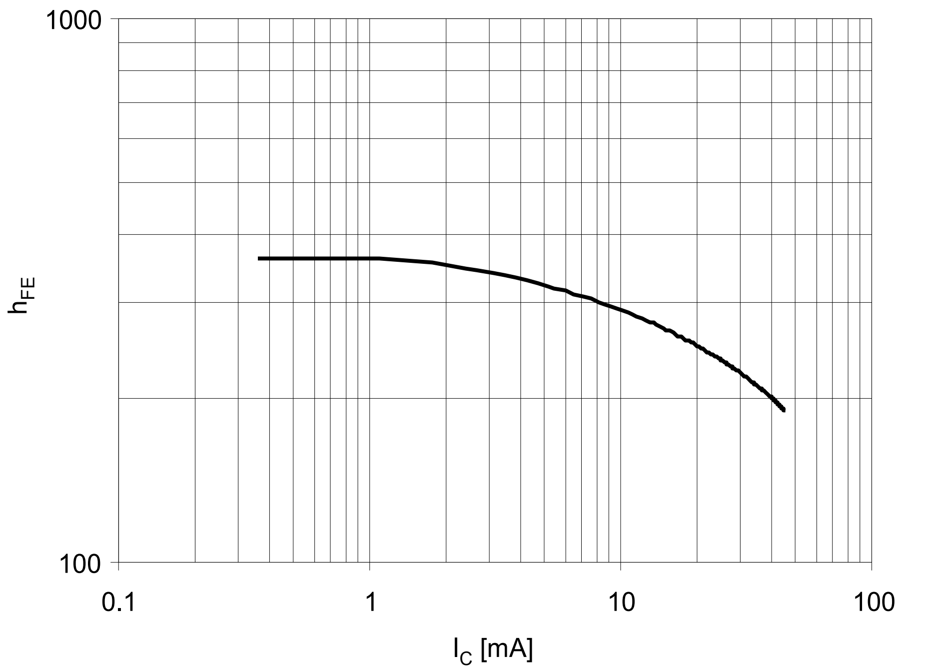


Figure 5-3 DC Current Gain $h_{FE} = f(I_C)$, V_{CE} = 3 V

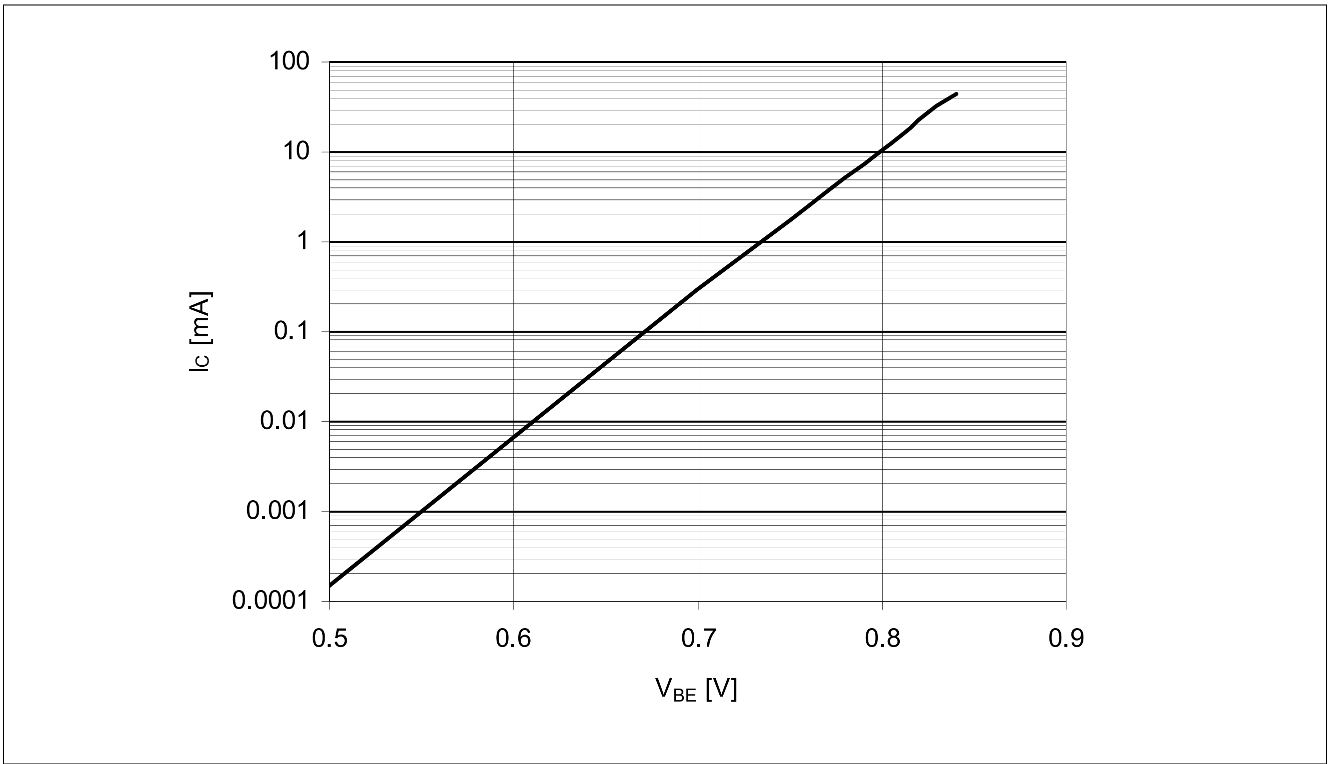


Figure 5-4 Collector Current vs. Base Emitter Voltage $I_C = f(V_{BE})$, V_{CE} = 2 V

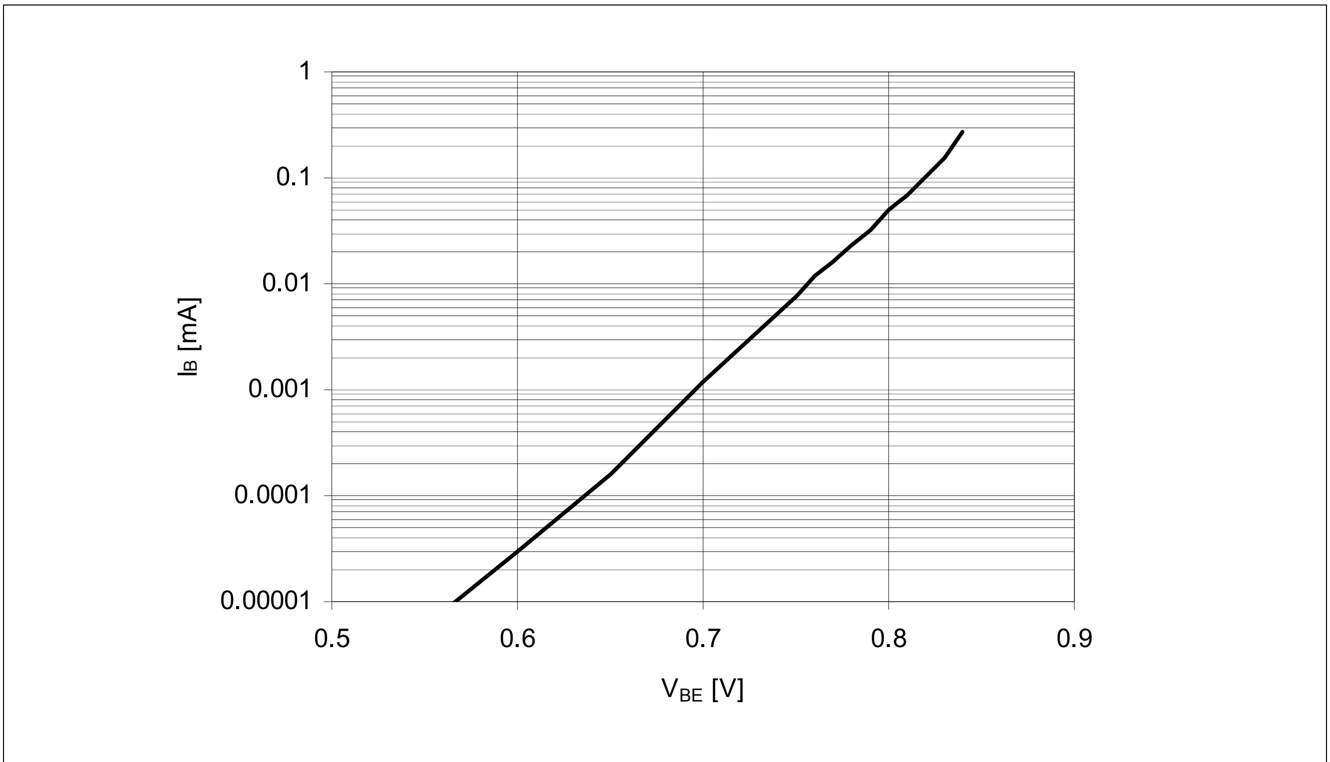


Figure 5-5 Base Current vs. Base Emitter Forward Voltage $I_B = f(V_{BE})$, V_{CE} = 2 V

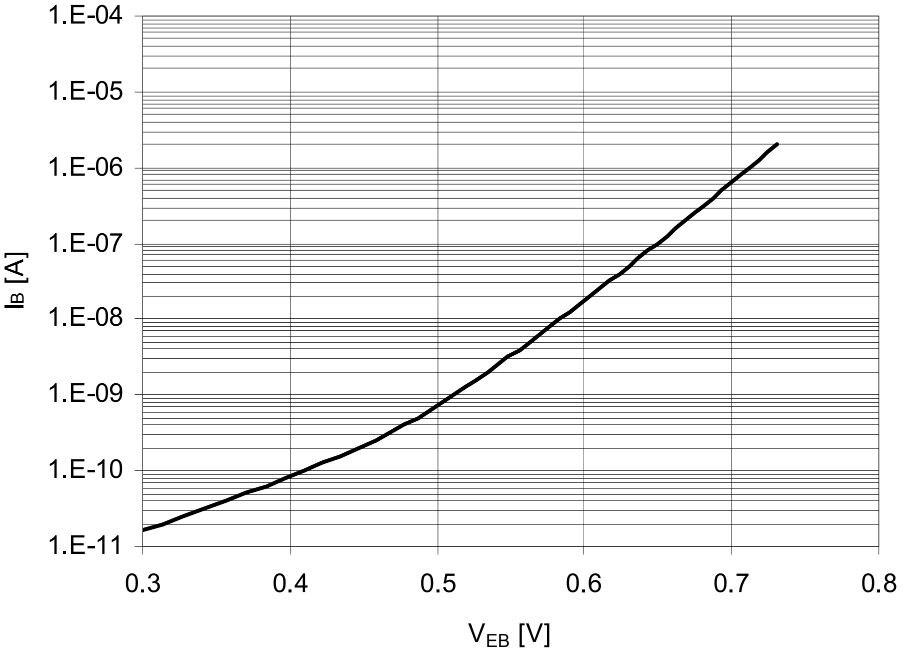


Figure 5-6 Base Current vs. Base Emitter Reverse Voltage $I_B = f(V_{EB})$, V_{CE} = 2 V

5.5 Characteristic AC Diagrams

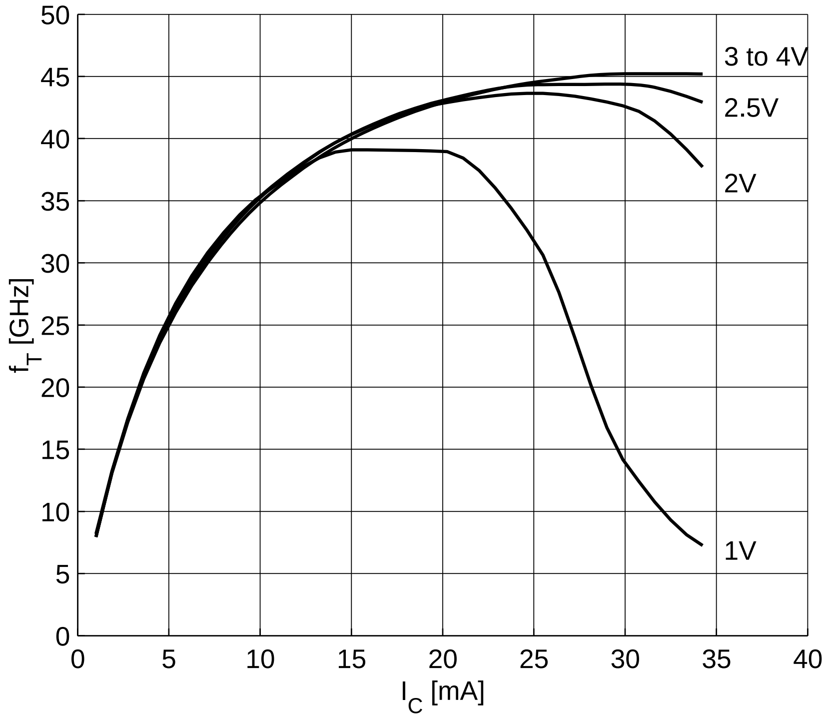


Figure 5-7 Transition Frequency $f_T = f\,(I_C)$, f = 2 GHz, V_{CE} = Parameter in V

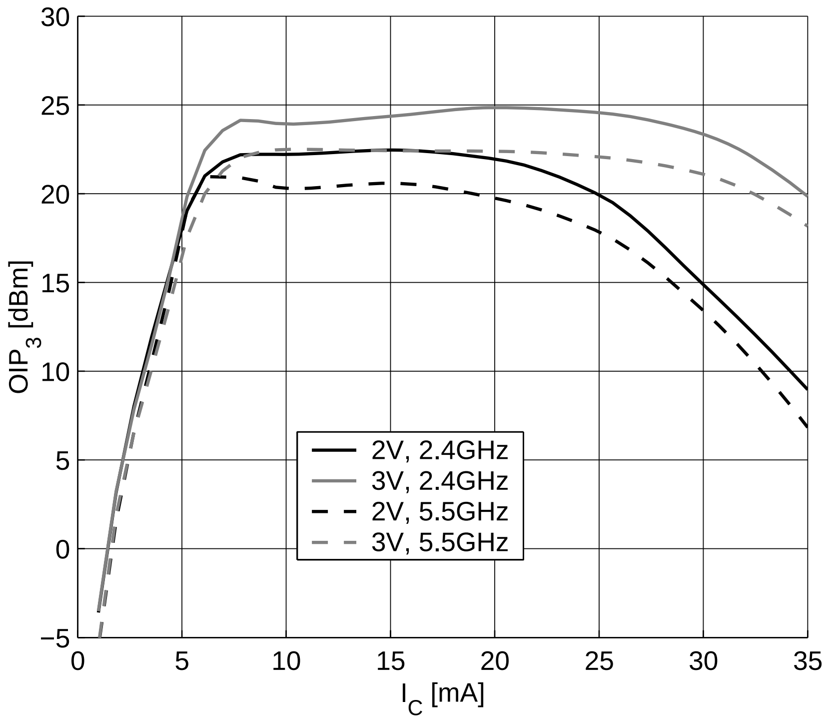


Figure 5-8 3rd Order Intercept Point $OIP_3 = f\,(I_C)$, $Z_S = Z_L$= 50 Ω, V_{CE}, f = Parameters

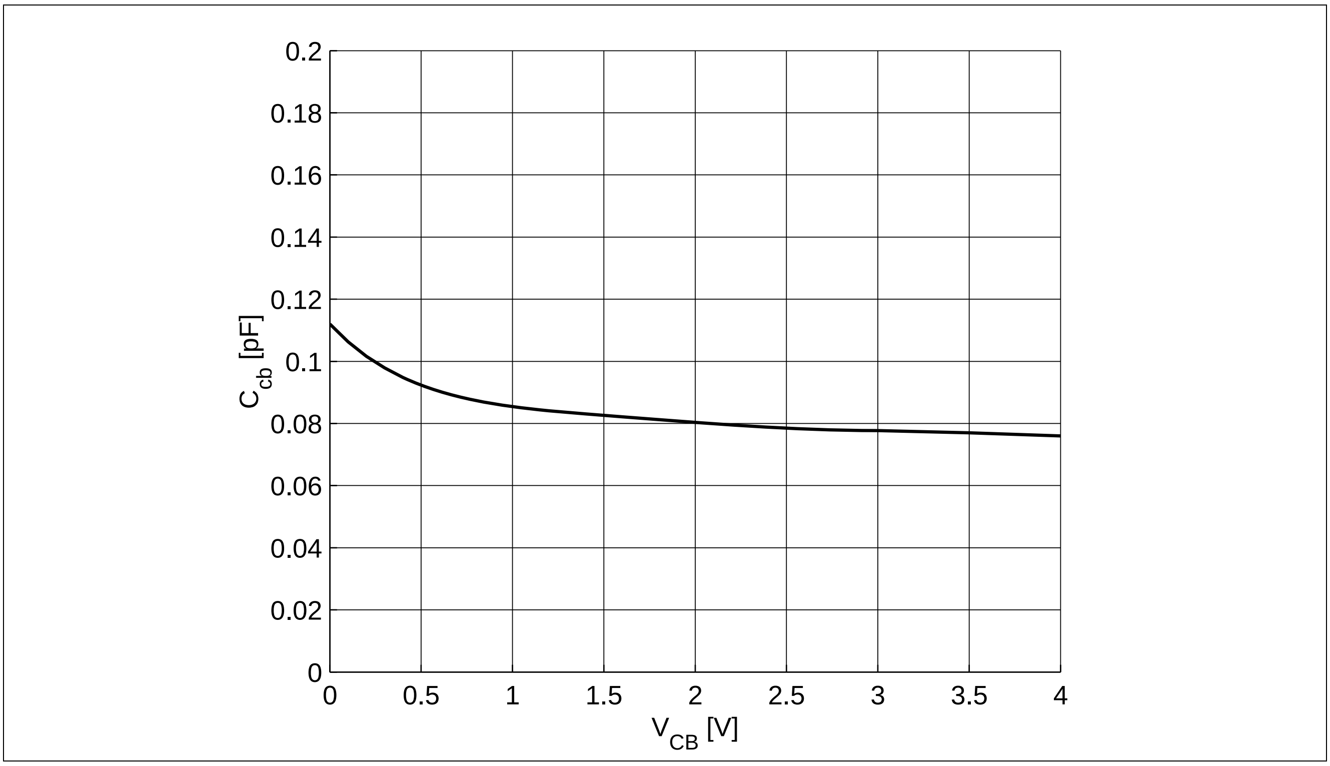


Figure 5-9 Collector Base Capacitance $C_{CB} = f(V_{CB})$, f = 1 MHz

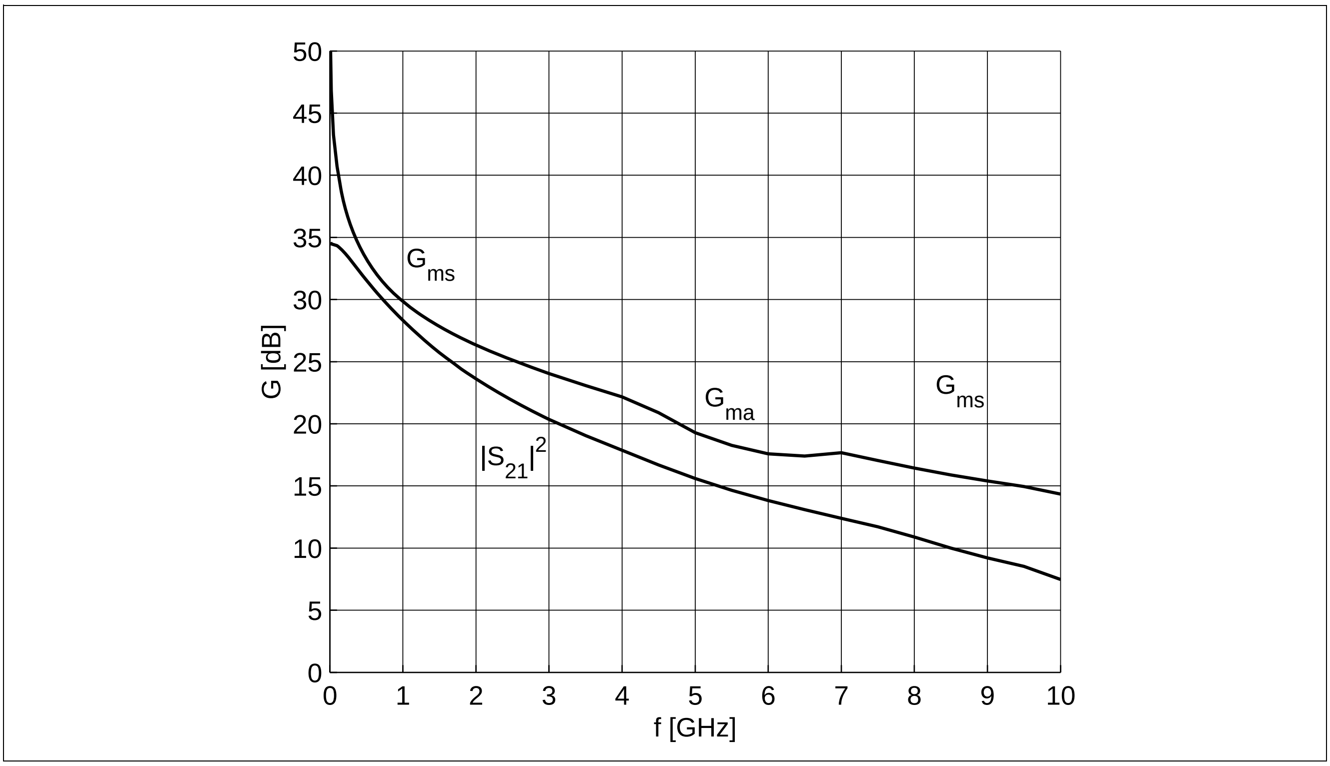


Figure 5-10 Gain G_{ma}, G_{ms}, $|S_{21}|^2 = f(f)$, V_{CE} = 3 V, I_C = 25 mA

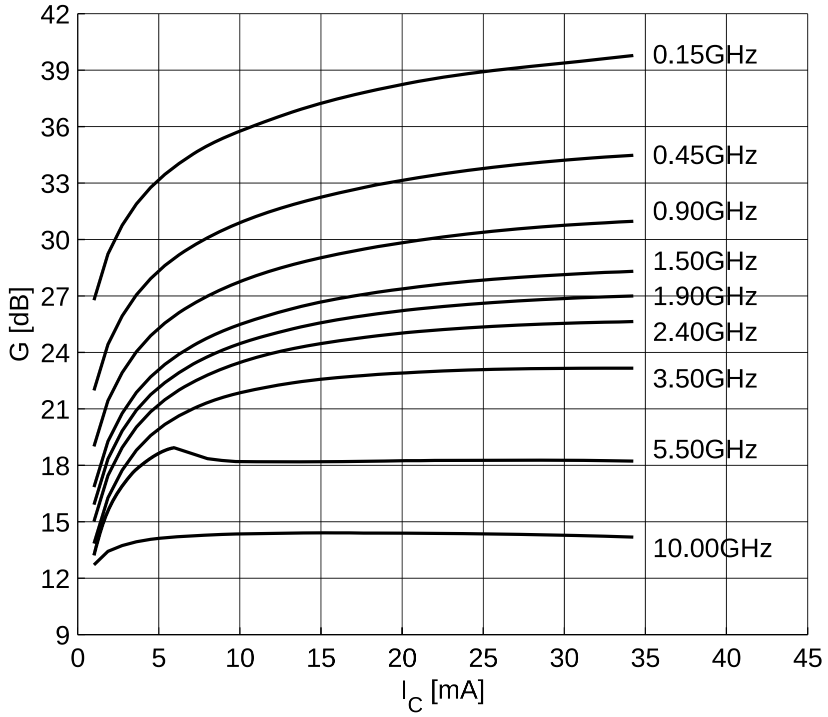


Figure 5-11 Maximum Power Gain $G_{max} = f\,(I_C)$, V_{CE} = 3 V, f = Parameter in GHz

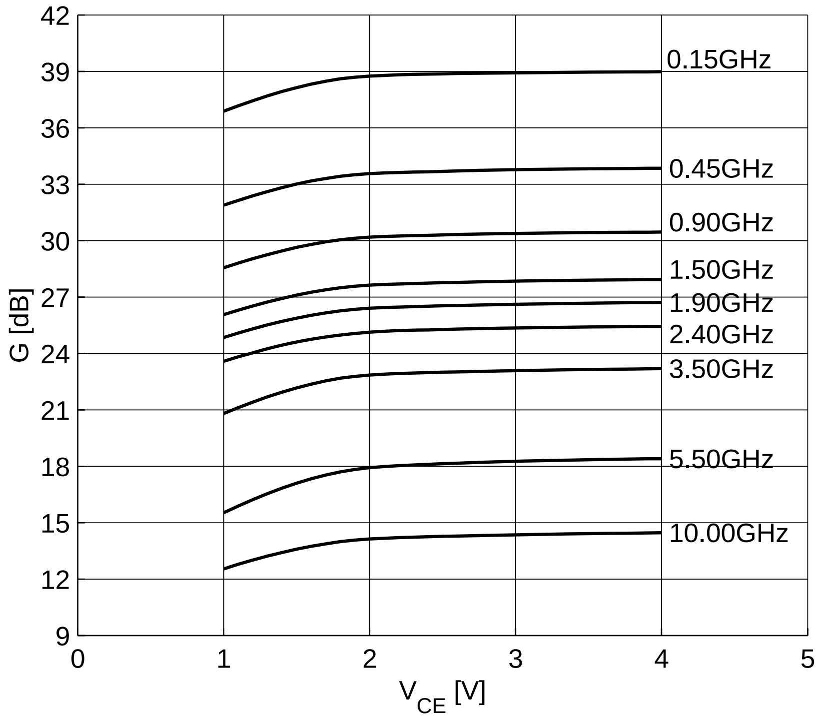


Figure 5-12 Maximum Power Gain $G_{max} = f\,(V_{CE})$, I_C = 25 mA, f = Parameter in GHz

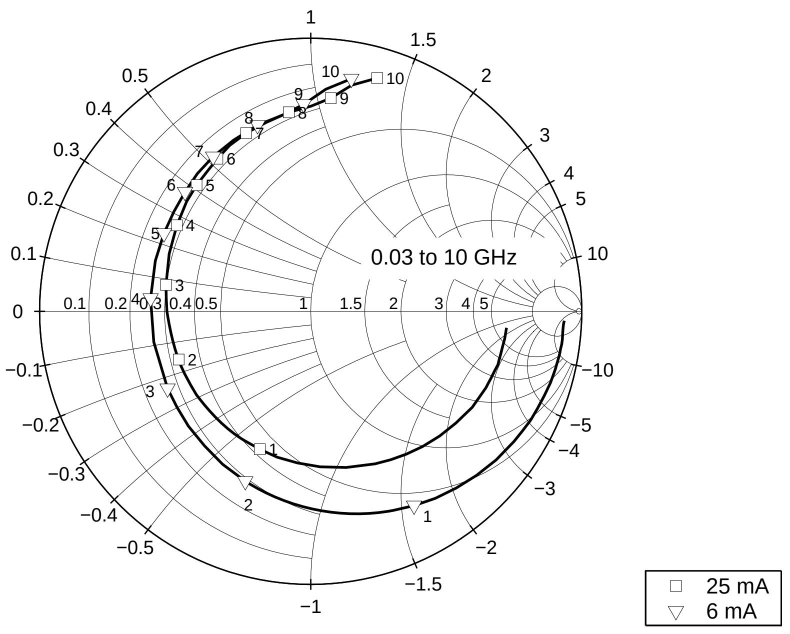


Figure 5-13 Input Matching $S_{11} = f(f)$, V_{CE} = 3 V, I_C = 6 / 25 mA

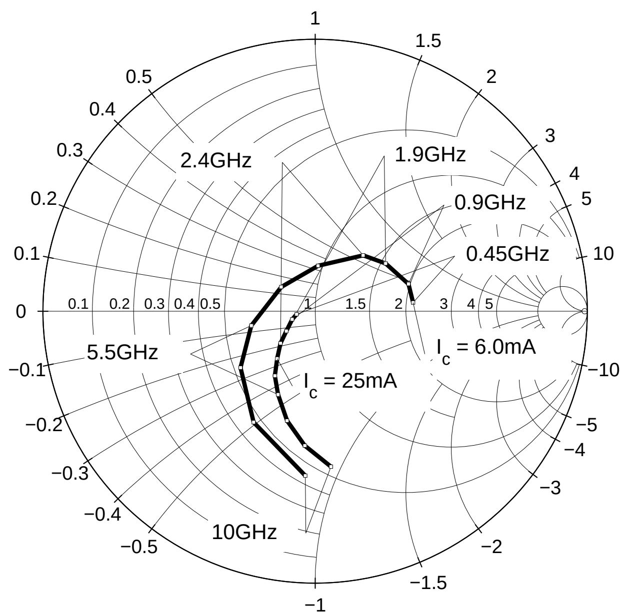


Figure 5-14 Source Impedance for Minimum Noise Figure $Z_{opt} = f(f)$, V_{CE} = 3 V, I_C = 6 / 25 mA

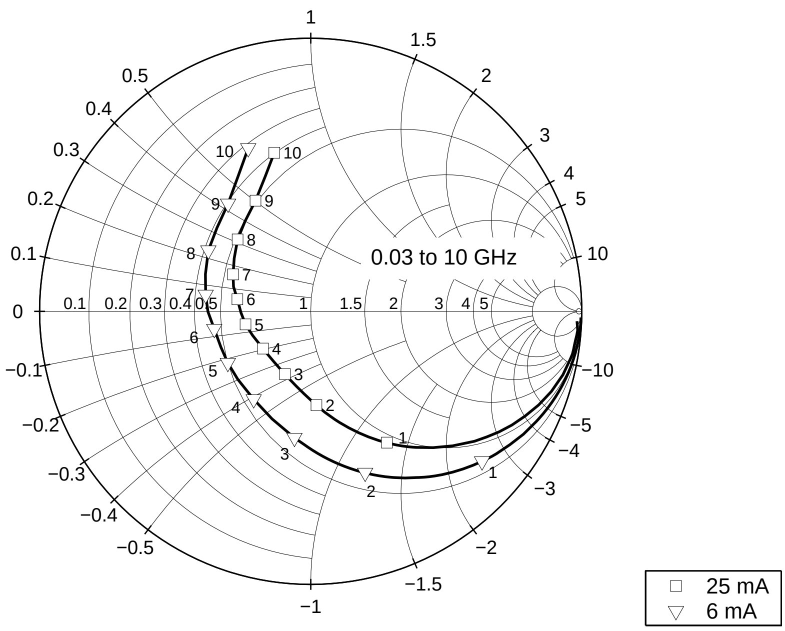


Figure 5-15 Output Matching $S_{22} = f(f)$, V_{CE} = 3 V, I_C = 6 / 25 mA

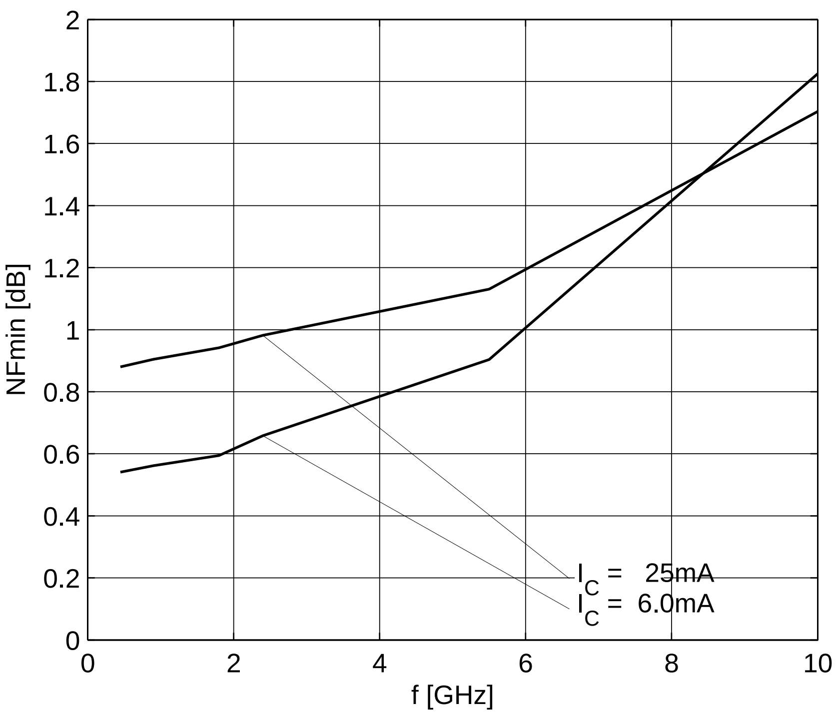


Figure 5-16 Noise Figure $NF_{min} = f(f)$, V_{CE} = 3 V, I_C = 6 / 25 mA, $Z_S = Z_{opt}$

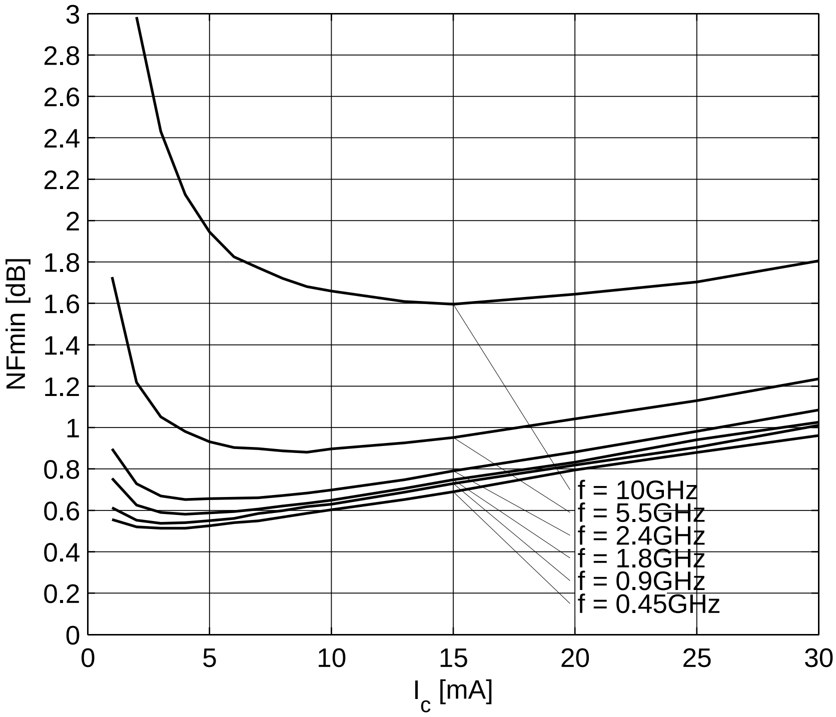


Figure 5-17 Noise Figure $NF_{min} = f(I_C)$, V_{CE} = 3 V, $Z_S = Z_{opt}$, f = Parameter in GHz

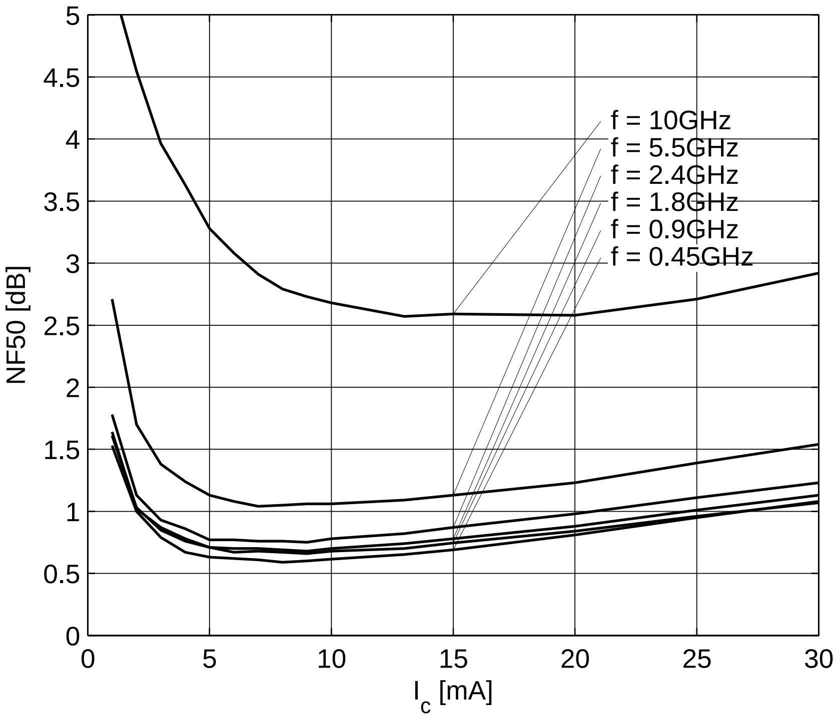


Figure 5-18 Noise Figure $NF_{50} = f(I_C)$, V_{CE} = 3 V, Z_S = 50 Ω, f = Parameter in GHz

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

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 BFP740ESD 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 BFP740ESD SPICE GP model reflects the typical DC- and RF-performance within the limitations which are given by the SPICE GP model itself. Besides the DC characteristics all S-parameters in magnitude and phase, as well as noise figure (including optimum source impedance, equivalent noise resistance and flicker noise) and intermodulation have been extracted.

7 Package Information SOT343

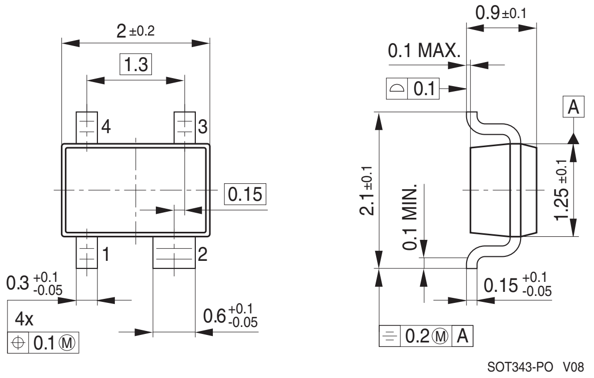


Figure 7-1 Package Outline

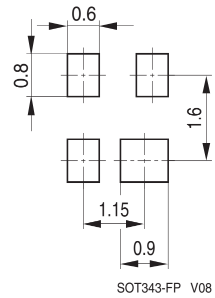


Figure 7-2 Package Footprint

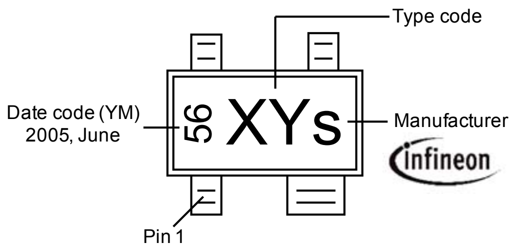


Figure 7-3 Marking Example (Marking BFP740ESD**: T7s)**

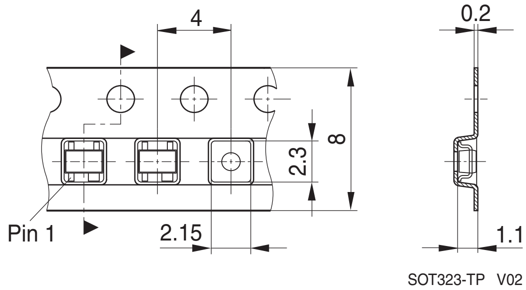


Figure 7-4 Tape Dimensions

w w w . i n f i n e o n . c o m

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