BFR843EL3

Robust Low Noise Broadband Pre-Matched Bipolar RF Transistor

Data Sheet

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RF & Protection Devices

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BFR843EL3, Robust Low Noise Broadband Pre-Matched Bipolar RF Transistor

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Page	Subjects (major changes since last revision)

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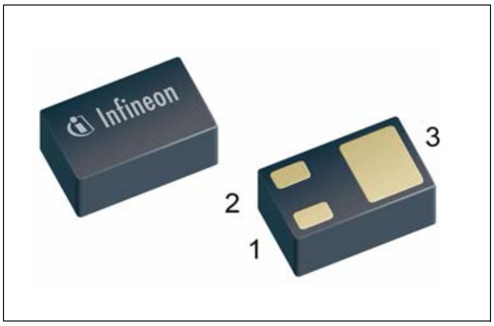
1 Product Brief

The BFR843EL3 is a low noise broadband NPN bipolar RF transistor. Its integrated feedback provides a broadband pre-match to 50 Ω at input and output and improves the stability against parasitic oscillations. These measures simplify the design of arbitrary LNA application circuits. 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} = 2.25 V and currents up to I_C = 55 mA. The device is especially suited for mobile applications in which low power consumption is a key requirement. The transistor is fitted with internal protection circuits, which enhance the robustness against electrostatic discharge (ESD) and against high levels of RF input power. The device is housed in a very small thin leadless plastic package, ideal for modules.

2 Features

- Low noise broadband NPN RF transistor based on Infineon´s reliable, high volume SiGe:C bipolar technology
- High maximum RF input power and ESD robustness
- Unique combination of high RF performance, robustness and ease of application circuit design
- Low noise figure: NF_{min} = 1 dB at 2.4 GHz and 1.15 dB at 5.5 GHz, 1.8 V, 8 mA
- High gain $|S_{21}|^2$ = 22 dB at 2.4 GHz and 16.5 dB at 5.5 GHz, 1.8 V, 15 mA
- $OIP3$ = 22 dBm at 2.4 GHz and 5.5 GHz, 1.8 V, 25 mA
- Ideal for low voltage applications e.g. V_{CC} = 1.2 V and 1.8 V (2.85 V, 3.3 V, 3.6 V requires corresponding collector resistor)
- Low power consumption, ideal for mobile applications
- Pb-free (RoHS compliant) and halogen-free very small thin leadless plastic package



RoHS

Applications

As Low Noise Amplifier (LNA) in

- Wireless Communications: WLAN IEEE802.11b,g,n,a,ac single- and dual band applications, broadband LTE or WiMAX LNA
- Satellite navigation systems (e.g. GPS, GLONASS, COMPASS...) and satellite C-band LNB (1st and 2nd stage LNA)
- Broadband amplifiers: Dualband WLAN, multiband mobile phone, UWB up to 10 GHz
- ISM bands up to 10 GHz
- Dedicated short range communication (DSRC) systems: WLAN IEEE802.11p

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

Product Name	Package	Pin Configuration			Marking
BFR843EL3	TSLP-3-10	1 = B	2 = C	3 = E	T2

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}	–	2.25 2.0	V	T_A = 25 °C T_A = -55 °C Open base
Collector emitter voltage[1)]	V_{CES}	–	2.25 2.0	V	T_A = 25 °C T_A = -55 °C E-B short circuited
Collector base voltage[2)]	V_{CBO}	–	2.9 2.6	V	T_A = 25 °C T_A = -55 °C Open emitter
Base current	I_B	-1	5	mA	
Collector current	I_C	–	55	mA	
RF input power	P_{RFin}	–	20	dBm	f = 1.9 GHz, matched to 50 Ω
ESD stress pulse	V_{ESD}	-1	+1	kV	HBM, all pins, acc. to JESD22-A114
Total power dissipation[3)]	P_{tot}	–	125	mW	$T_S \leq$ 103 °C
Junction temperature	T_J	–	150	°C	
Storage temperature	T_{Stg}	-55	150	°C	

1) V_{CES} is identical 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.

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}	–	375	–	K/W	–

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

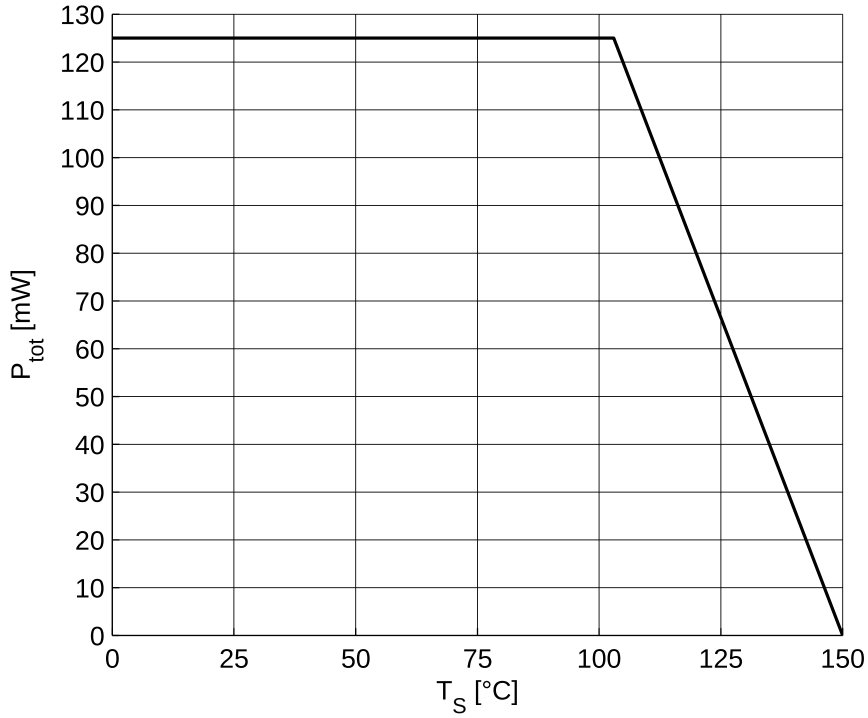


Figure 4-1 Total Power Dissipation $P_{tot} = f(T_s)$

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	$V_{(BR)CEO}$	2.25	2.6		V	I_C = 1 mA, I_B = 0 Open base
Collector emitter leakage current	I_{CES}	–	–	400	nA	V_{CE} = 1.5 V, V_{BE} = 0 E-B short circuited
Collector base leakage current	I_{CBO}	–	–	400	nA	V_{CB} = 1.5 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}	230 –	360 260	580 –		V_{CE} = 1.8 V, I_C = 1 mA V_{CE} = 1.8 V, I_C = 15 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.		
Collector base capacitance[1)]	C_{CB}	–	5.26 0.07	–	pF	f = 1 MHz f = 1 GHz V_{CB} = 1.8 V, V_{BE} = 0 Emitter grounded
Collector emitter capacitance	C_{CE}	–	0.42	–	pF	f = 1 MHz V_{CE} = 1.8 V, V_{BE}= 0 Base grounded
Emitter base capacitance	C_{EB}	–	0.66	–	pF	f = 1 MHz V_{EB} = 0.4 V,V_{CB} = 0 Collector grounded

1) Including integrated feedback capacitance

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

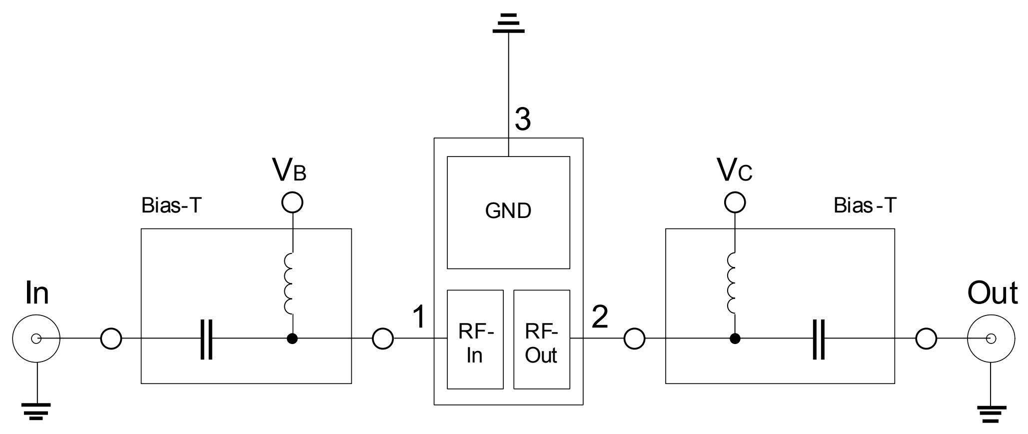


Figure 5-1 BFR843EL3 Testing Circuit

Table 5-3 AC Characteristics, V_{CE} = 1.8 V, f = 450 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	25.5	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	24.5	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	0.95	–		I_C = 8 mA
Associated gain	G_{ass}	–	22.5	–		I_C = 8 mA
Linearity					dBm	Z_S = Z_L = 50 Ω
1 dB compression point at output	OP_{1dB}	–	7.5	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	23	–		I_C = 15 mA

Table 5-4 AC Characteristics, V_{CE} = 1.8 V, f = 900 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	25	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	24	–		I_C = 15 mA

Table 5-4 AC Characteristics, V_{CE} = 1.8 V, f = 900 MHz (cont'd)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	0.95	–		I_C = 8 mA
Associated gain	G_{ass}	–	22	–		I_C = 8 mA
Linearity					dBm	Z_S = Z_L = 50 Ω
1 dB compression point at output	OP_{1dB}	–	7	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	21.5	–		I_C = 15 mA

Table 5-5 AC Characteristics, V_{CE} = 1.8 V, f = 1.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	24.5	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	23	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	0.95	–		I_C = 8 mA
Associated gain	G_{ass}	–	21.5	–		I_C = 8 mA
Linearity					dBm	Z_S = Z_L = 50 Ω
1 dB compression point at output	OP_{1dB}	–	7	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	21.5	–		I_C = 15 mA

Table 5-6 AC Characteristics, V_{CE} = 1.8 V, f = 1.9 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	24.5	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	22.5	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	1	–		I_C = 8 mA
Associated gain	G_{ass}	–	21	–		I_C = 8 mA
Linearity					dBm	Z_S = Z_L = 50 Ω
1 dB compression point at output	OP_{1dB}	–	7	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	21	–		I_C = 15 mA

Table 5-7 AC Characteristics, V_{CE} = 1.8 V, f = 2.4 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	24	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	22	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	1	–		I_C = 8 mA
Associated gain	G_{ass}	–	20	–		I_C = 8 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB compression point at output	OP_{1dB}	–	6	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	20.5	–		I_C = 15 mA

Table 5-8 AC Characteristics, V_{CE} = 1.8 V, f = 3.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	23	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	19.5	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	1.05	–		I_C = 8 mA
Associated gain	G_{ass}	–	18.5	–		I_C = 8 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB compression point at output	OP_{1dB}	–	6	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	20.5	–		I_C = 15 mA

Table 5-9 AC Characteristics, V_{CE} = 1.8 V, f = 5.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	21.5	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	16.5	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	1.15	–		I_C = 8 mA
Associated gain	G_{ass}	–	15.5	–		I_C = 8 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB compression point at output	OP_{1dB}	–	4.5	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	20.5	–		I_C = 15 mA

Table 5-10 AC Characteristics, V_{CE} = 1.8 V, f = 10 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power Gain					dB	
Maximum power gain	G_{ms}	–	14.5	–		I_C = 15 mA
Transducer gain	$\|S_{21}\|^2$	–	10.5	–		I_C = 15 mA
Minimum Noise Figure					dB	
Minimum noise figure	NF_{min}	–	1.35	–		I_C = 8 mA
Associated gain	G_{ass}	–	10.5	–		I_C = 8 mA
Linearity					dBm	$Z_S = Z_L$ = 50 Ω
1 dB compression point at output	OP_{1dB}	–	1.5	–		I_C = 15 mA
3rd order intercept point at output	$OIP3$	–	17	–		I_C = 15 mA

Note: $OIP3$ value depends on termination of all intermodulation frequency components. Termination used for this measurement is 50 Ω from 0.2 MHz to 12 GHz.

6 Characteristic DC Diagrams

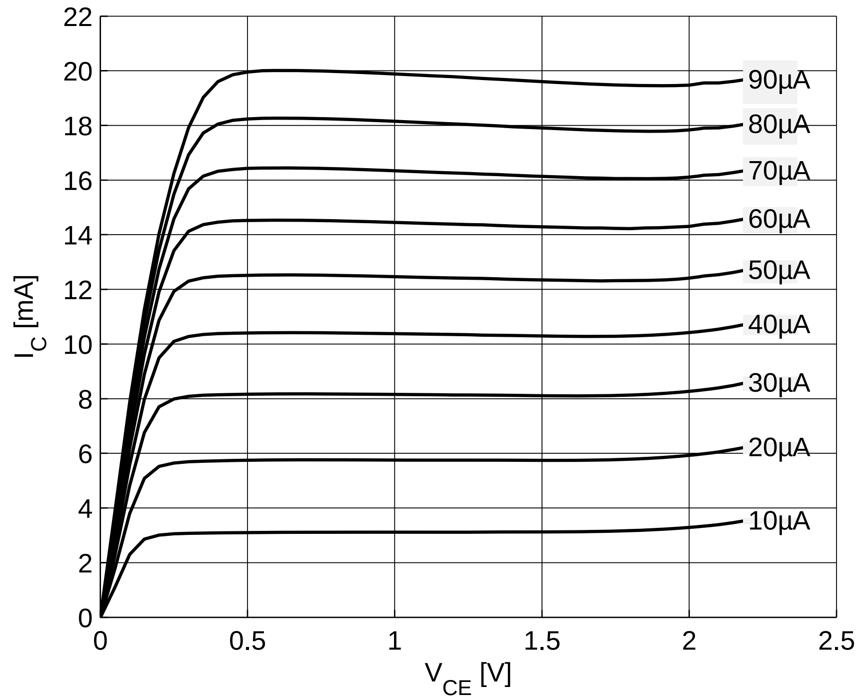


Figure 6-1 Collector Current vs. Collector Emitter Voltage $I_C = f(V_{CE})$, I_B = Parameter

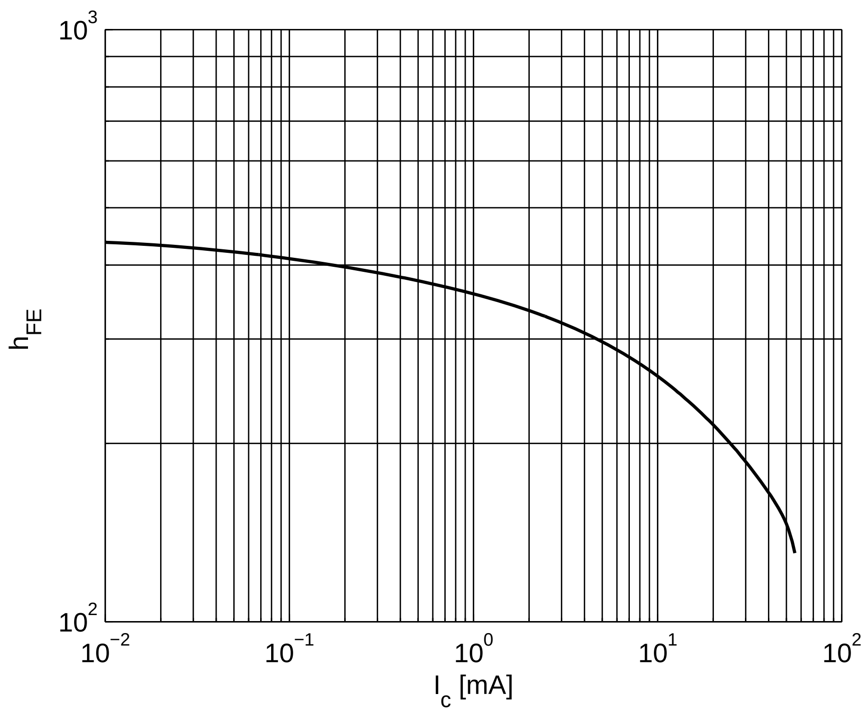


Figure 6-2 DC Current Gain $h_{FE} = f(I_C)$, V_{CE} = 1.8 V

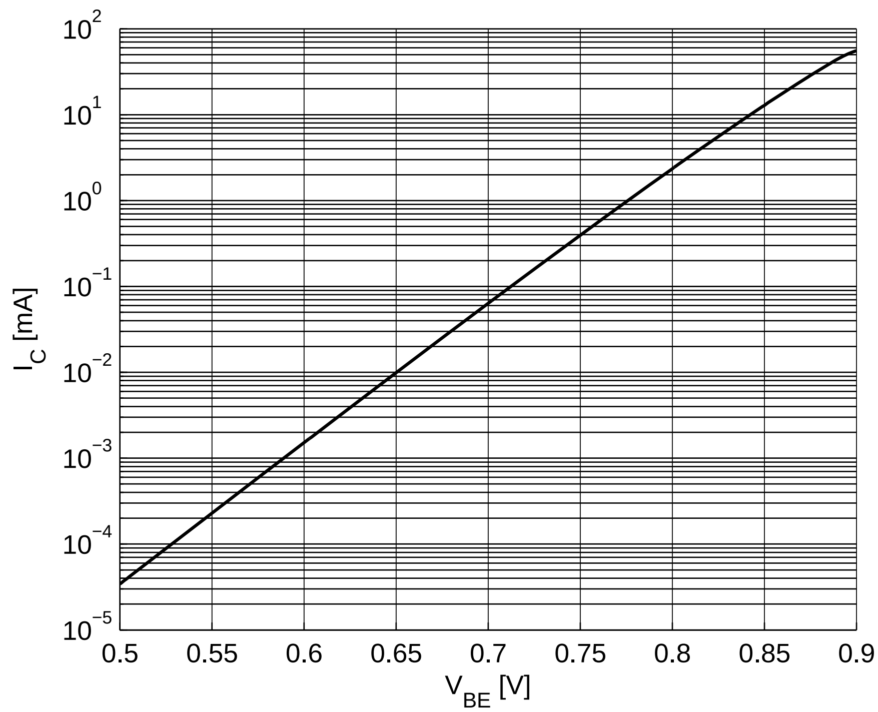


Figure 6-3 Collector Current vs. Base Emitter Forward Voltage $I_C = f(V_{BE})$, V_{CE} = 1.8 V

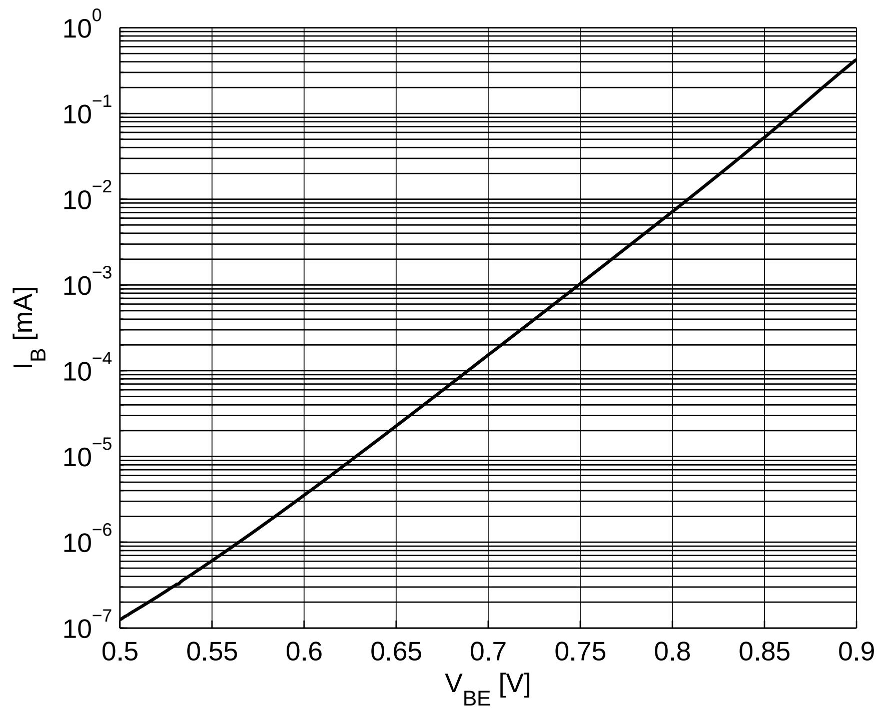


Figure 6-4 Base Current vs. Base Emitter Forward Voltage $I_B = f(V_{BE})$, V_{CE} = 1.8 V

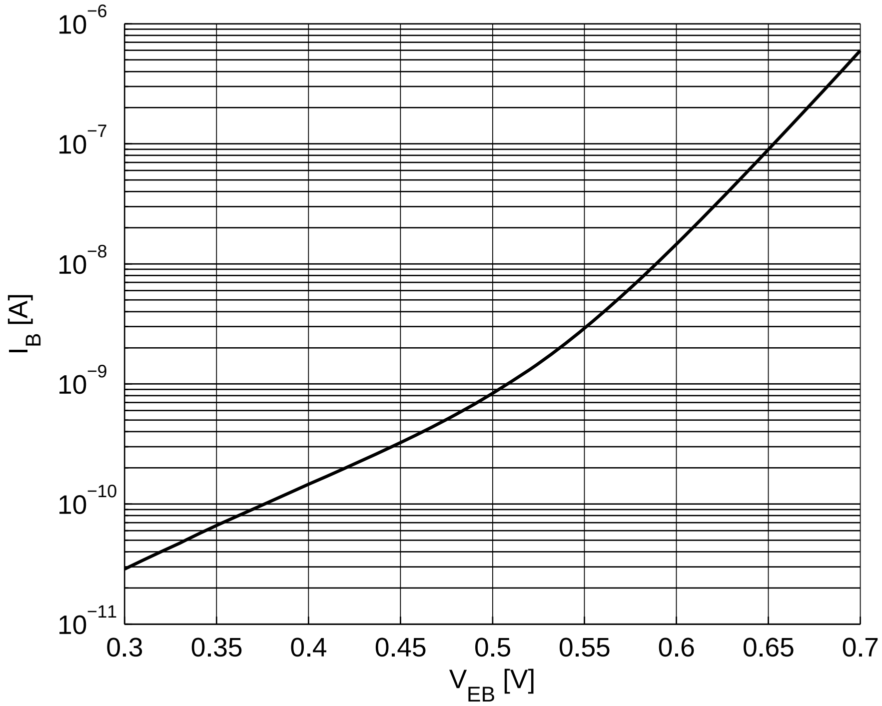


Figure 6-5 Base Current vs. Base Emitter Reverse Voltage $I_B = f(V_{EB})$, V_{CE} = 1.8 V

7 Characteristic AC Diagrams

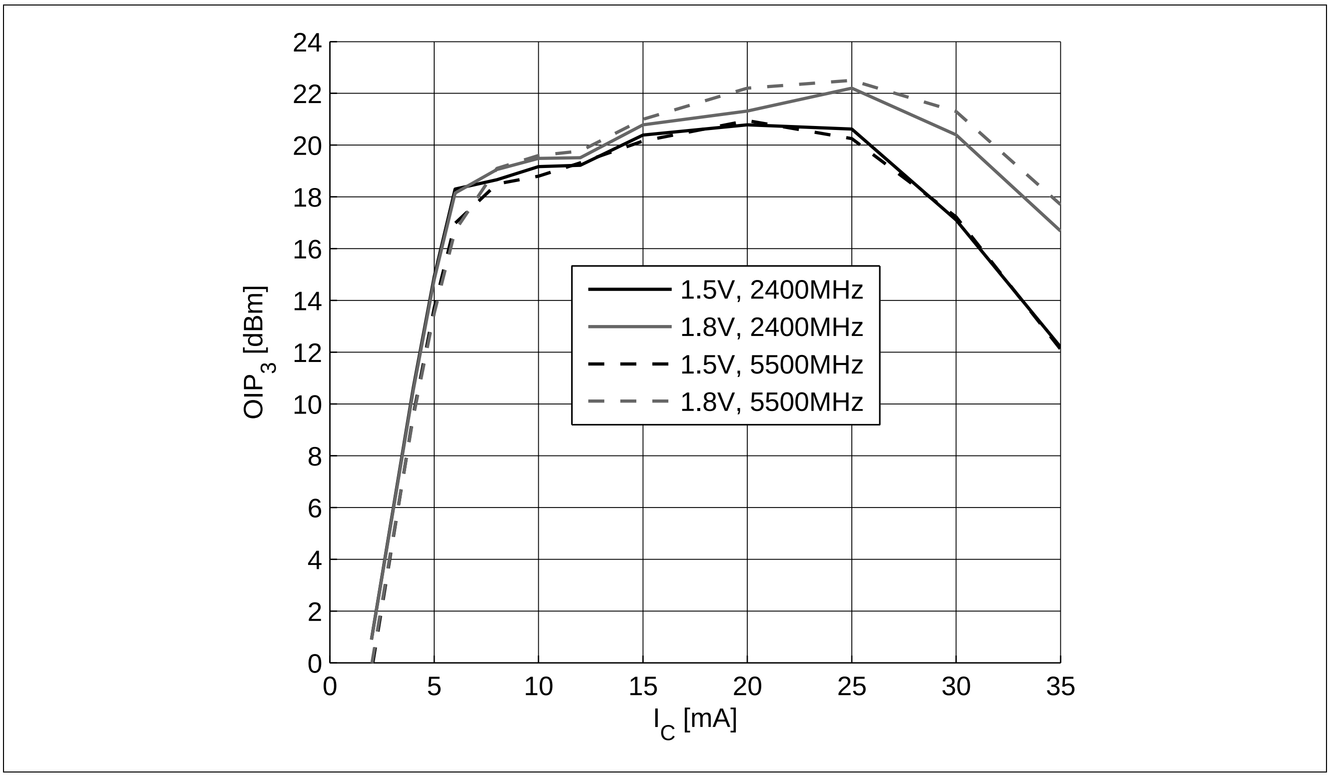


Figure 7-1 3rd Order Intercept Point at Output $OIP3 = f(I_C)$, $Z_S = Z_L = 50\ \Omega$, V_{CE}, f = **Parameters**

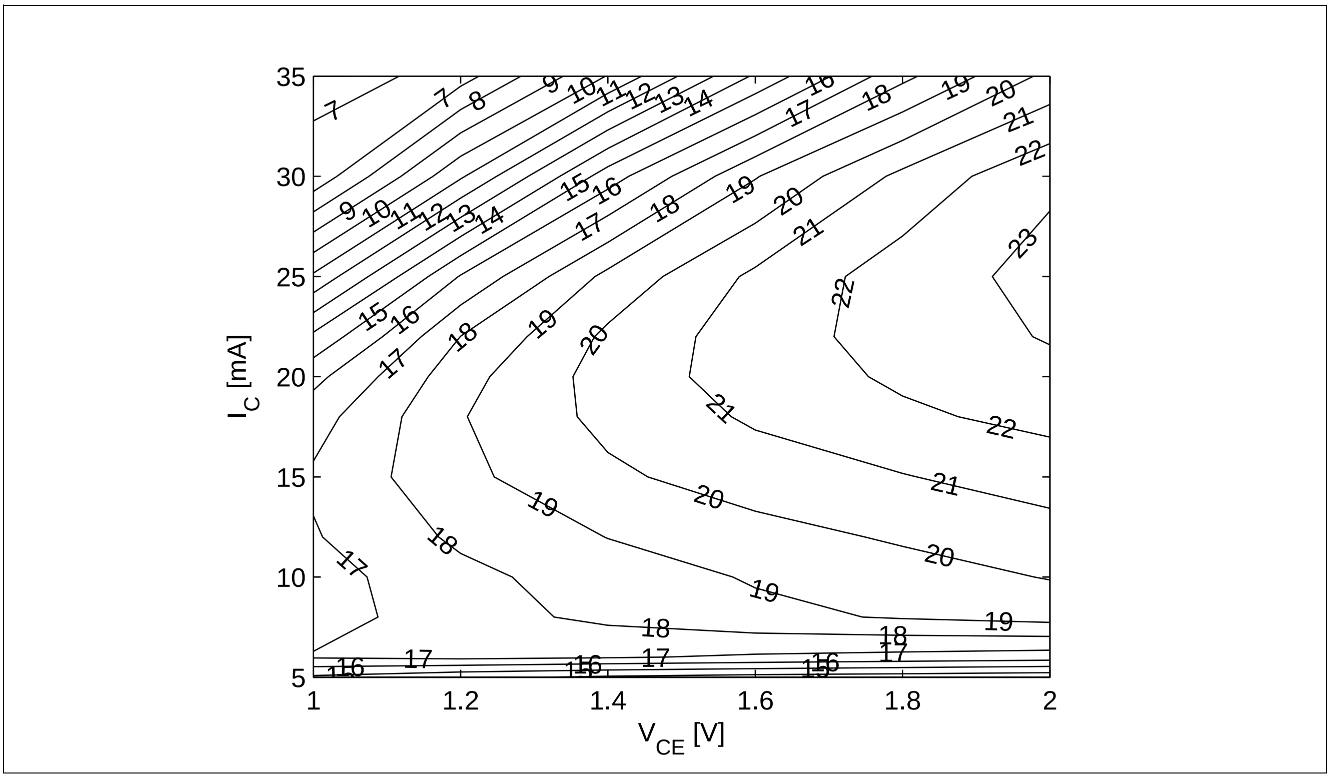


Figure 7-2 3rd Order Intercept Point at Output $OIP3$ **[dBm]** $= f(I_C, V_{CE})$, $Z_S = Z_L = 50\ \Omega$, f **= 5.5 GHz**

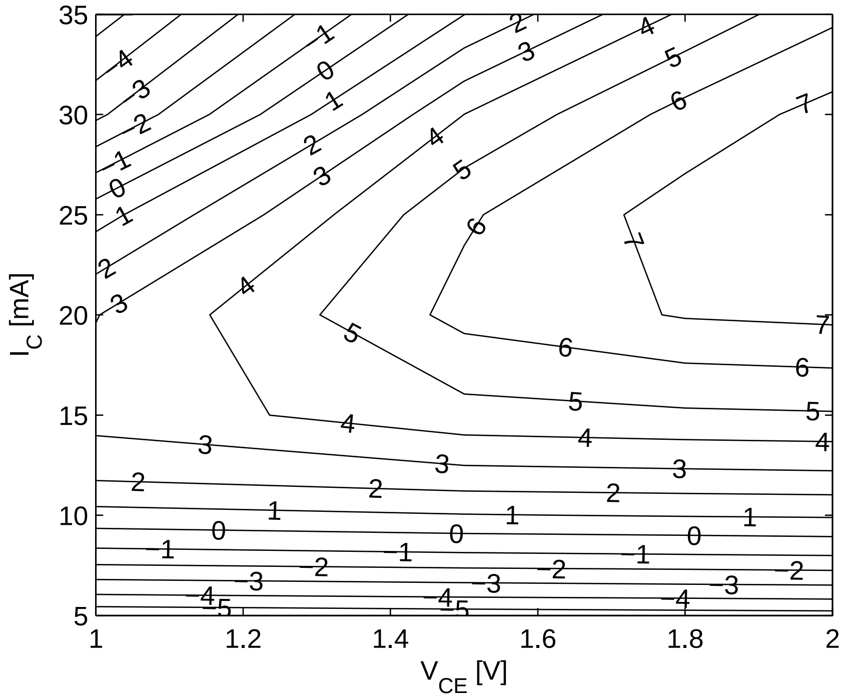


Figure 7-3 Compression Point at Output OP_{1dB} [dBm] = *f* (I_C, V_{CE}), Z_S = Z_L = 50 Ω, *f* = 5.5 GHz

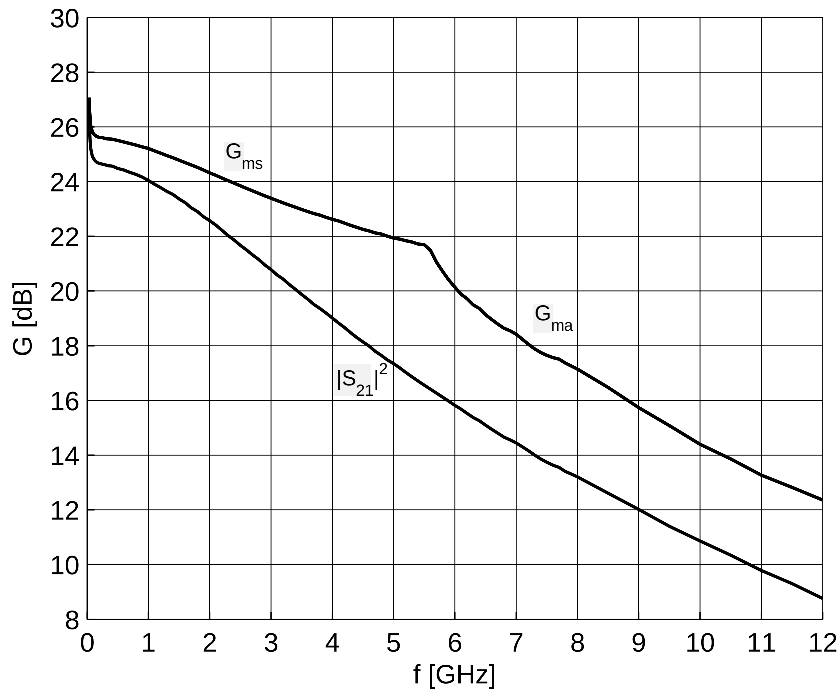


Figure 7-4 Gain G_{ma}, G_{ms}, $|S_{21}|^2$ = *f* (*f*), V_{CE} = 1.8 V, I_C = 15 mA

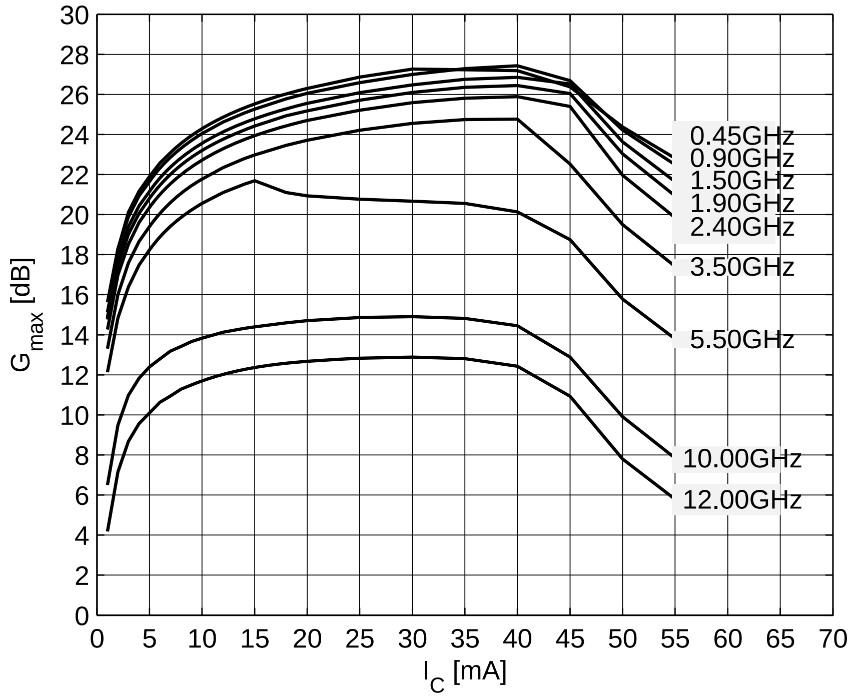


Figure 7-5 Maximum Power Gain G_{max} = f (I_C), V_{CE} = 1.8 V, f = Parameter in GHz

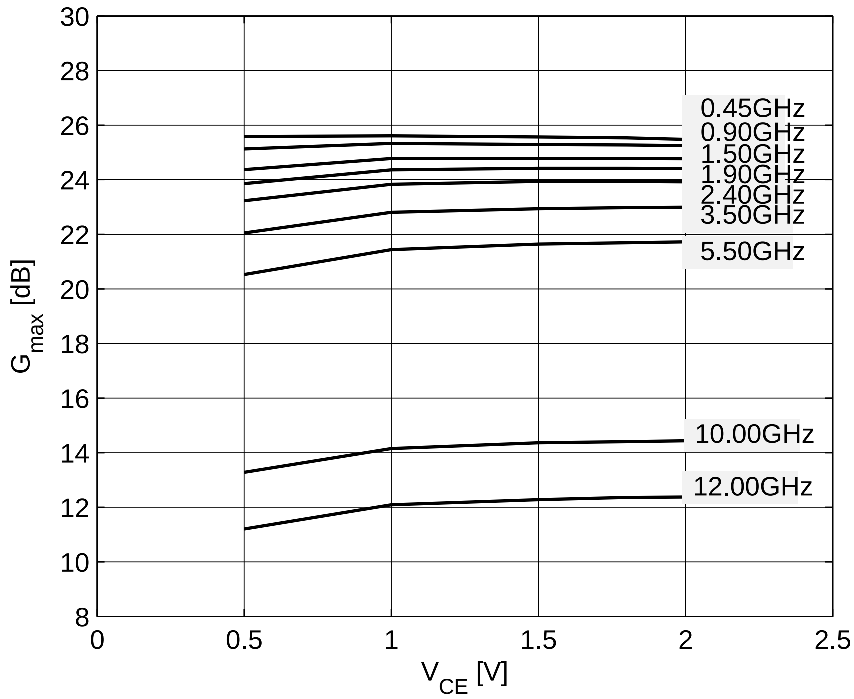


Figure 7-6 Maximum Power Gain G_{max} = f (V_{CE}), I_C = 15 mA, f = Parameter in GHz

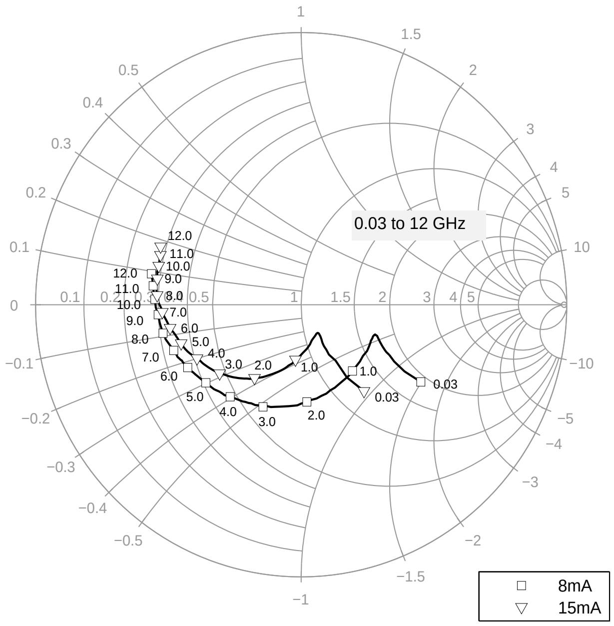


Figure 7-7 Input Reflection Coefficient $S_{11} = f(f)$, V_{CE} = 1.8 V, I_C = 8 / 15 mA

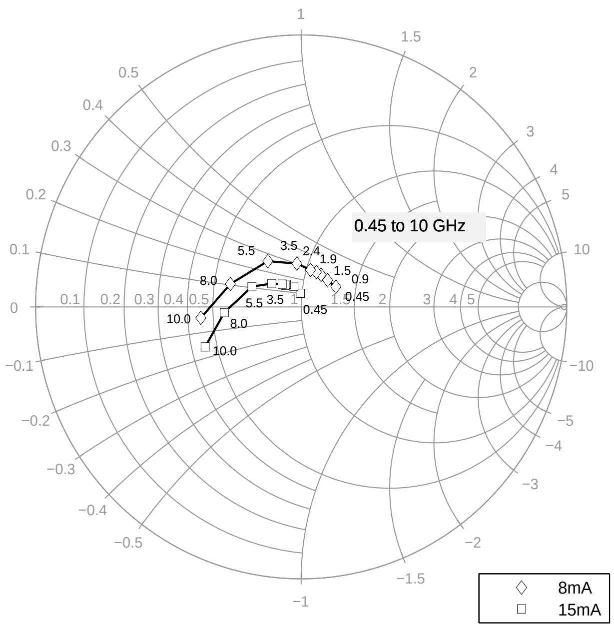


Figure 7-8 Source Impedance for Minimum Noise Figure $Z_{opt} = f(f)$, V_{CE} = 1.8 V, I_C = 8 / 15 mA

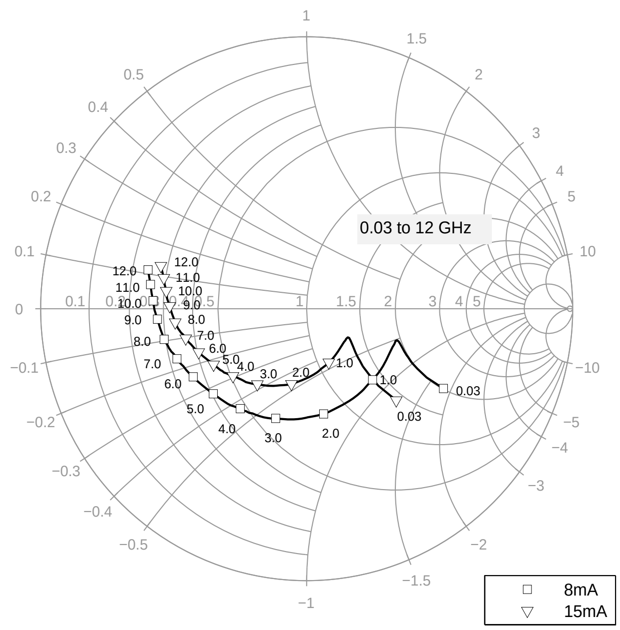


Figure 7-9 Output Reflection Coefficient S_{22} = f (f), V_{CE} = 1.8 V, I_C = 8 / 15 mA

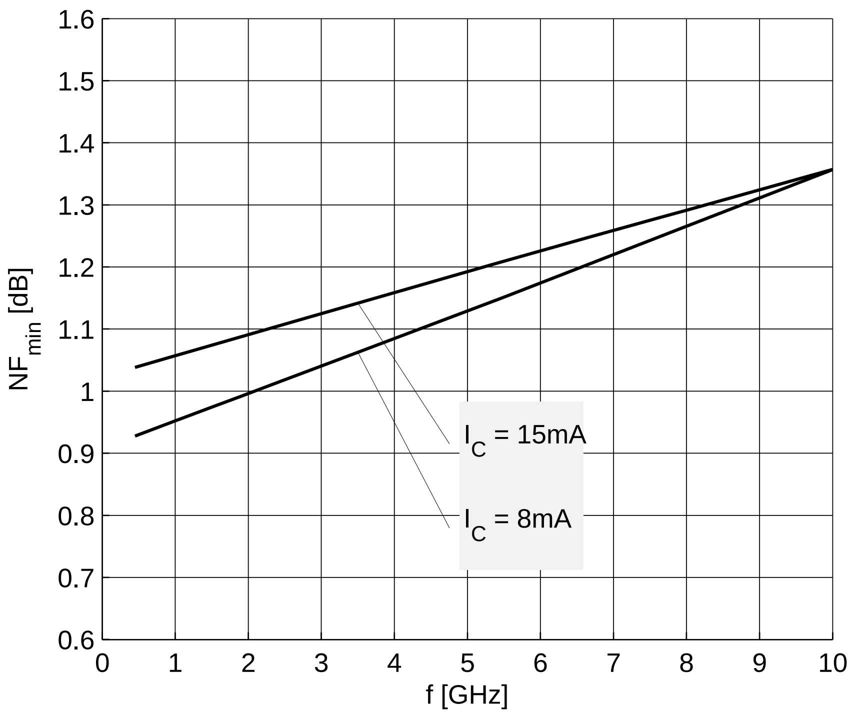


Figure 7-10 Noise Figure NF_{min} = f (f), V_{CE} = 1.8 V, I_C = 8 / 15 mA, Z_S = Z_{opt}

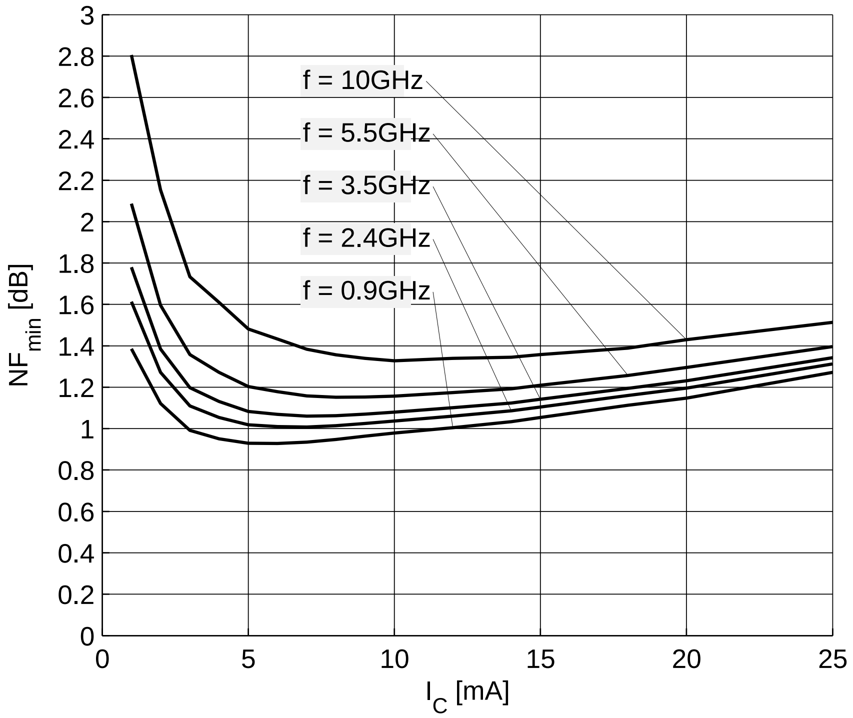


Figure 7-11 Noise Figure NF_{min} = f (I_C), V_{CE} = 1.8 V, Z_S = Z_{opt}, f = Parameter in GHz

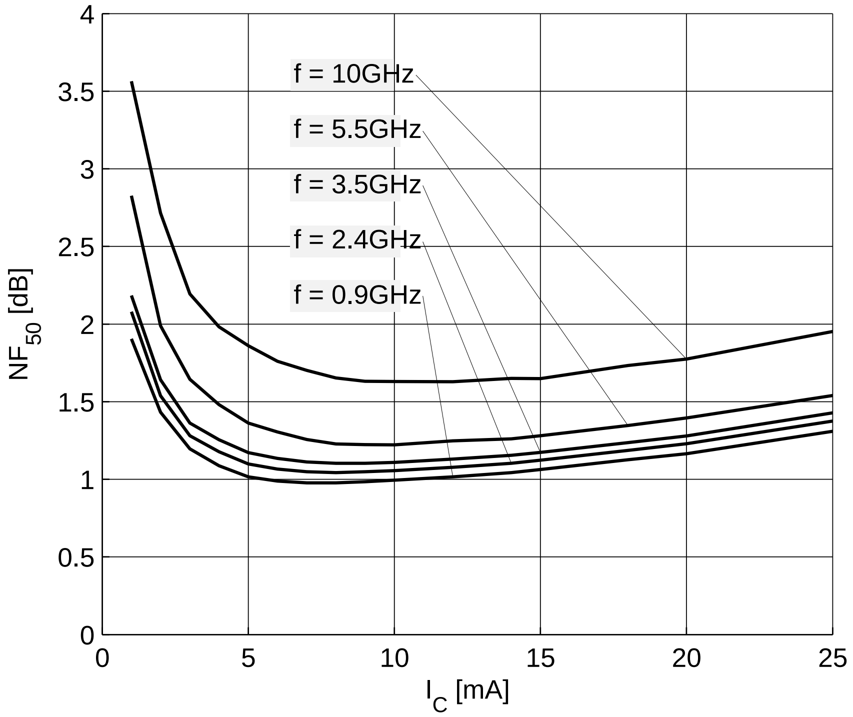


Figure 7-12 Noise Figure NF_{50} = f (I_C), V_{CE} = 1.8 V, Z_S = 50 Ω, f = Parameter in GHz

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.

8 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. Please consult our website and download the latest versions before actually starting your design.
You find the BFR843EL3 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 12 GHz using typical devices. The BFR843EL3 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.

9 Package Information TSLP-3-10

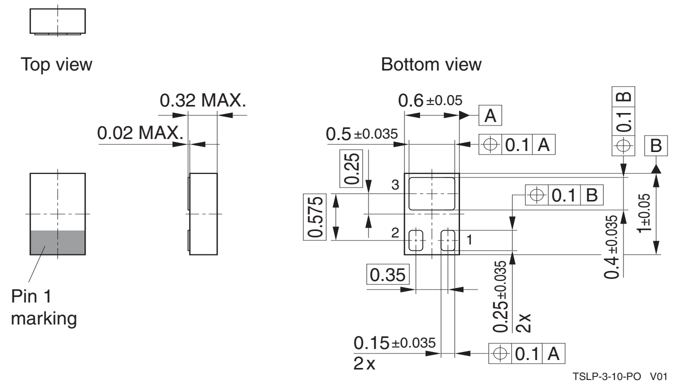


Figure 9-1 Package Outline

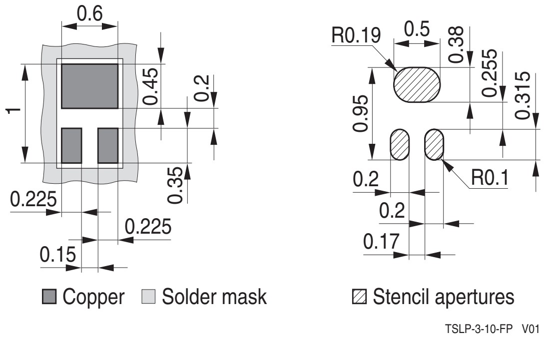


Figure 9-2 Package Footprint

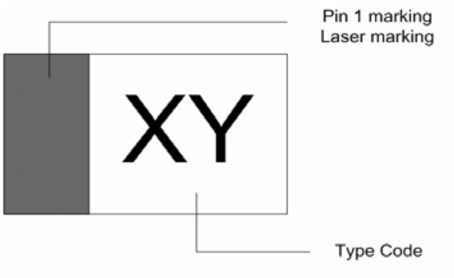


Figure 9-3 Marking Description (Marking BFR843EL3: T2)

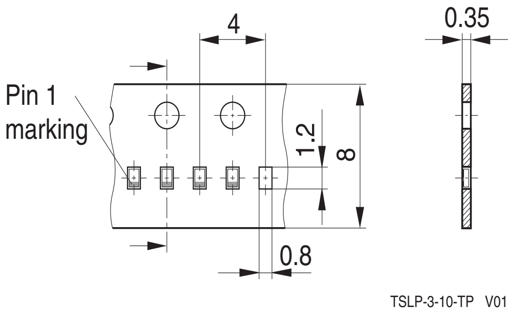


Figure 9-4 Tape dimensions

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

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