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BFP843F

Robust Low Noise Broadband Pre-Matched Bipolar RF Transistor

Data Sheet

Revision 1.0, 2013-06-19

Edition 2013-06-19

**Published by
Infineon Technologies AG
81726 Munich, Germany**

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BFP843F, Robust Low Noise Broadband Pre-Matched Bipolar RF Transistor

Revision History: 2013-06-19, Revision 1.0

| Page | Subjects (major changes since last revision) |
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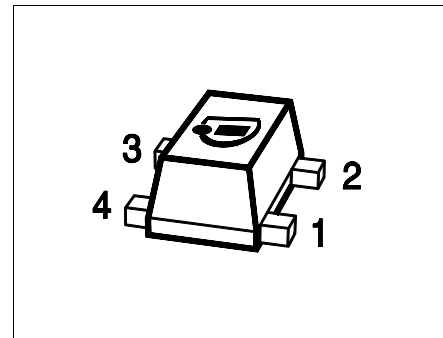
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1 Product Brief

The BFP843F is a very low noise broadband NPN bipolar RF transistor. Its integrated feedback provides a broadband pre-match to $50\ \Omega$ 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 $V_{\text{CEO}} = 2.25\ \text{V}$ and currents up to $I_{\text{C}} = 55\ \text{mA}$. 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 an easy to use plastic thin flat package with visible leads.

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
20 dBm maximum RF input power, 1.5 KV HBM ESD hardness
- Unique combination of high RF performance, robustness and ease of application circuit design
- Low noise figure: $NF_{min} = 0.95$ dB at 2.4 GHz and 1.1 dB at 5.5 GHz, 1.8 V, 8 mA
- High gain $|S_{21}|^2 = 21.5$ dB at 2.4 GHz and 16.5 dB at 5.5 GHz, 1.8 V, 15 mA
- $OIP_3 = 22.5$ dBm at 2.4 GHz and 20 dBm at 5.5 GHz, 1.8 V, 15 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
- Thin small flat Pb-free (RoHS compliant) and halogen-free package with visible leads
- Qualification report according to AEC-Q101 available



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 |
|--------------|----------|-------------------|-------|-------|-------|---------|
| BFP843F | TSFP-4-1 | 1 = B | 2 = E | 3 = C | 4 = E | T2s |

3 Maximum Ratings

Table 3-1 Maximum Ratings at $T_A = 25\text{ °C}$ (unless otherwise specified)

| Parameter | Symbol | Values | | Unit | Note / Test Condition |
|---|------------|--------|-------------|------|--|
| | | Min. | Max. | | |
| Collector emitter voltage | V_{CEO} | – | 2.25 2.0 | V | $T_A = 25\text{ °C}$ $T_A = -55\text{ °C}$ Open base |
| Collector emitter voltage ¹⁾ | V_{CES} | – | 2.25 2.0 | V | $T_A = 25\text{ °C}$ $T_A = -55\text{ °C}$ E-B short circuited |
| Collector base voltage ²⁾ | V_{CBO} | – | 2.9 2.6 | V | $T_A = 25\text{ °C}$ $T_A = -55\text{ °C}$ Open emitter |
| Base current | I_B | -5 | 5 | mA | |
| Collector current | I_C | – | 55 | mA | |
| RF input power | P_{RFIn} | – | 20 | dBm | |
| ESD stress pulse | V_{ESD} | -1.5 | 1.5 | kV | HBM, all pins, acc. to JESD22-A114 |
| Total power dissipation ³⁾ | P_{tot} | – | 125 | mW | $T_S \leq 101\text{ °C}$ |
| 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} | – | 395 | – | K/W | – |

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

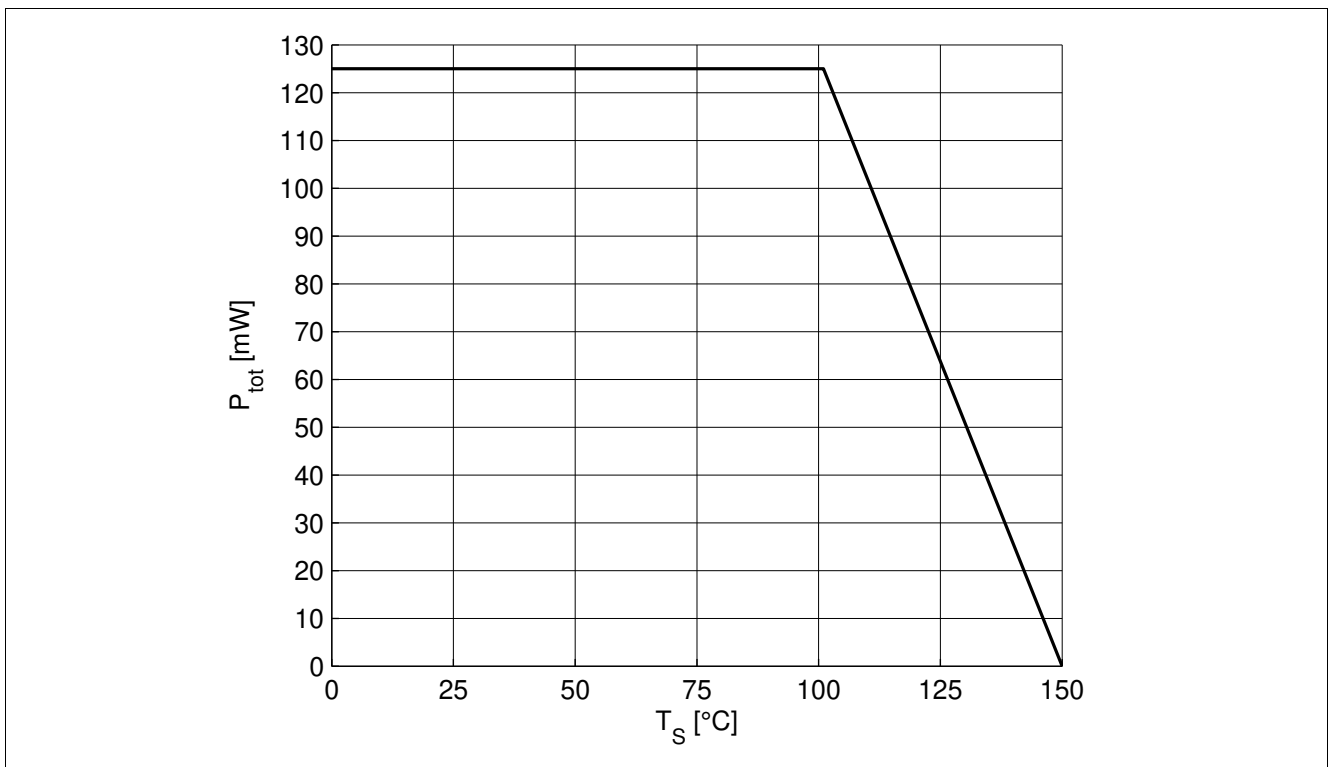


Figure 4-1 Total Power Dissipation $P_{tot} = f(T_s)$

5 Electrical Characteristics

5.1 DC Characteristics

Table 5-1 DC Characteristics at $T_A = 25\text{ °C}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|---------------|--------|------|------|---------------|--|
| | | Min. | Typ. | Max. | | |
| Collector emitter breakdown voltage | $V_{(BR)CEO}$ | 2.25 | 2.6 | | V | $I_C = 1\text{ mA}$, $I_B = 0$ Open base |
| Collector emitter leakage current | I_{CES} | – | – | 400 | nA | $V_{CE} = 1.5\text{ V}$, $V_{BE} = 0$ E-B short circuited |
| Collector base leakage current | I_{CBO} | – | – | 400 | nA | $V_{CB} = 1.5\text{ V}$, $I_E = 0$ Open emitter |
| Emitter base leakage current | I_{EBO} | – | – | 10 | μA | $V_{EB} = 0.5\text{ V}$, $I_C = 0$ Open collector |
| DC current gain | h_{FE} | 150 | 260 | 450 | | $V_{CE} = 1.8\text{ V}$, $I_C = 15\text{ mA}$ Pulse measured |

5.2 General AC Characteristics

Table 5-2 General AC Characteristics at $T_A = 25\text{ °C}$

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|----------|--------|--------------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Collector base capacitance ¹⁾ | C_{CB} | – | 5.23 0.06 | – | pF | $f = 1\text{ MHz}$ $f = 1\text{ GHz}$ $V_{CB} = 1.8\text{ V}$, $V_{BE} = 0$ Emitter grounded |
| Collector emitter capacitance | C_{CE} | – | 0.46 | – | pF | $f = 1\text{ MHz}$ $V_{CE} = 1.8\text{ V}$, $V_{BE} = 0$ Base grounded |
| Emitter base capacitance | C_{EB} | – | 0.70 | – | pF | $f = 1\text{ MHz}$ $V_{EB} = 0.4\text{ V}$, $V_{CB} = 0$ 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, $T_A = 25\text{ }^\circ\text{C}$

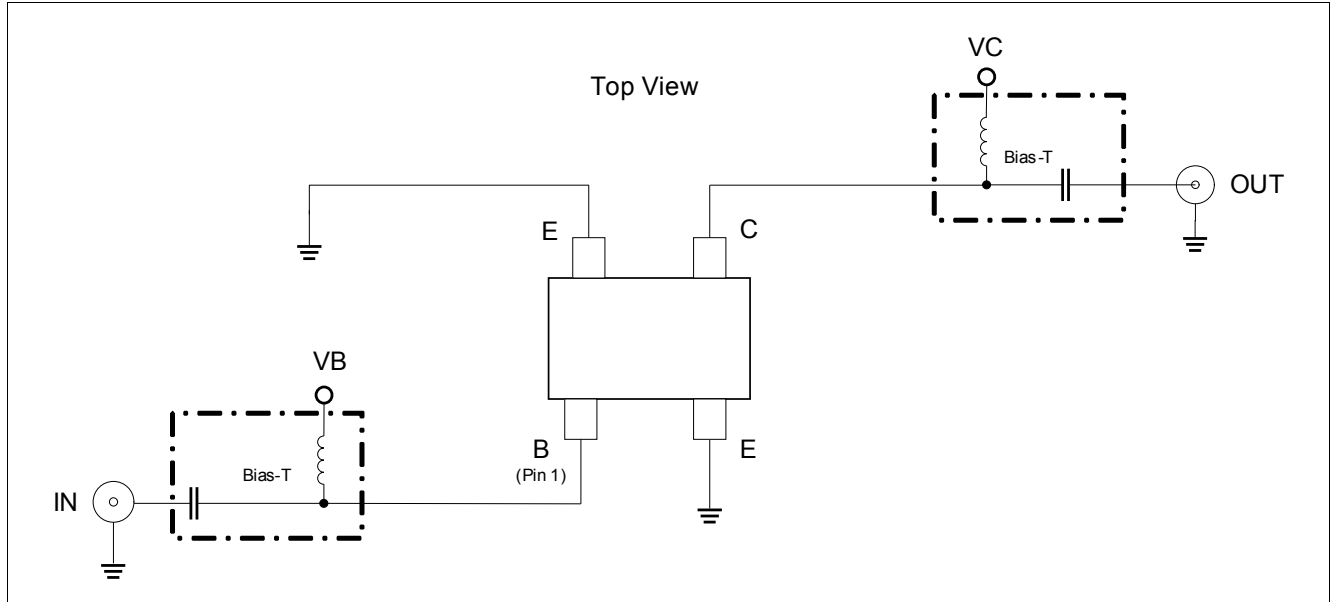


Figure 5-1 BFP843F Testing Circuit

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | dB | |
| Maximum power gain | G_{ma} | – | 25 | – | | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 24.5 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | dB | |
| Minimum noise figure | NF_{min} | – | 0.8 | – | | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 22.5 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | dBm | $Z_S = Z_L = 50\text{ }\Omega$ |
| 1 dB compression point at output | OP_{1dB} | – | 7 | – | | $I_C = 15\text{ mA}$ |
| 3rd order intercept point at output | $OIP3$ | – | 24.5 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | dB | |
| Maximum power gain | G_{ma} | – | 24.5 | – | | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 24 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | dB | |
| Minimum noise figure | NF_{min} | – | 0.8 | – | | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 22 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | dBm | $Z_S = Z_L = 50\text{ }\Omega$ |
| 1 dB compression point at output | OP_{1dB} | – | 8 | – | | $I_C = 15\text{ mA}$ |
| 3rd order intercept point at output | $OIP3$ | – | 24 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | | |
| Maximum power gain | G_{ma} | – | 24 | – | dB | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 23 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | | |
| Minimum noise figure | NF_{min} | – | 0.85 | – | dB | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 21 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | | |
| 1 dB compression point at output | OP_{1dB} | – | 7 | – | dBm | $Z_S = Z_L = 50\ \Omega$ |
| 3rd order intercept point at output | $OIP3$ | – | 23 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | | |
| Maximum power gain | G_{ma} | – | 23.5 | – | dB | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 22.5 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | | |
| Minimum noise figure | NF_{min} | – | 0.9 | – | dB | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 20.5 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | | |
| 1 dB compression point at output | OP_{1dB} | – | 7.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$ |
| 3rd order intercept point at output | $OIP3$ | – | 23.5 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | | |
| Maximum power gain | G_{ma} | – | 22.5 | – | dB | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 21.5 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | | |
| Minimum noise figure | NF_{min} | – | 0.95 | – | dB | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 20 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | | |
| 1 dB compression point at output | OP_{1dB} | – | 6.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$ |
| 3rd order intercept point at output | $OIP3$ | – | 22.5 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | | |
| Maximum power gain | G_{ma} | – | 21 | – | dB | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 19.5 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | | |
| Minimum noise figure | NF_{min} | – | 1.0 | – | dB | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 18 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | | |
| 1 dB compression point at output | OP_{1dB} | – | 6 | – | dBm | $Z_S = Z_L = 50\ \Omega$ |
| 3rd order intercept point at output | $OIP3$ | – | 22 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | | |
| Maximum power gain | G_{ma} | – | 18 | – | dB | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 16.5 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | | |
| Minimum noise figure | NF_{min} | – | 1.1 | – | dB | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 15.5 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | | |
| 1 dB compression point at output | OP_{1dB} | – | 4.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$ |
| 3rd order intercept point at output | $OIP3$ | – | 19.5 | – | | $I_C = 15\text{ mA}$ |

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

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------------|--------------|--------|------|------|------|--------------------------|
| | | Min. | Typ. | Max. | | |
| Power Gain | | | | | | |
| Maximum power gain | G_{ma} | – | 13.5 | – | dB | $I_C = 15\text{ mA}$ |
| Transducer gain | $ S_{21} ^2$ | – | 10 | – | | $I_C = 15\text{ mA}$ |
| Minimum Noise Figure | | | | | | |
| Minimum noise figure | NF_{min} | – | 1.7 | – | dB | $I_C = 8\text{ mA}$ |
| Associated gain | G_{ass} | – | 10 | – | | $I_C = 8\text{ mA}$ |
| Linearity | | | | | | |
| 1 dB compression point at output | OP_{1dB} | – | 0.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$ |
| 3rd order intercept point at output | $OIP3$ | – | 16.5 | – | | $I_C = 15\text{ mA}$ |

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

6 Characteristic DC Diagrams

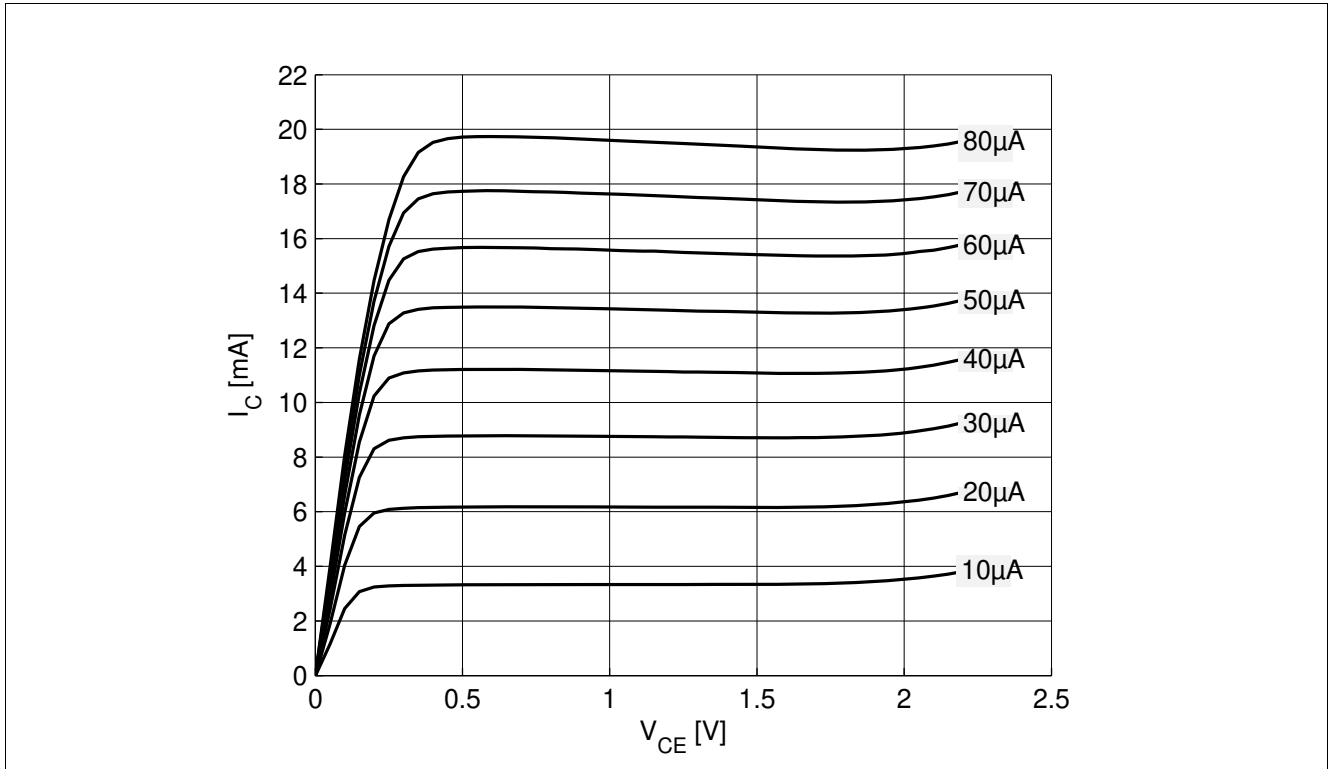


Figure 6-1 Collector Current vs. Collector Emitter Voltage $I_C = f(V_{CE}), I_B = \text{Parameter}$

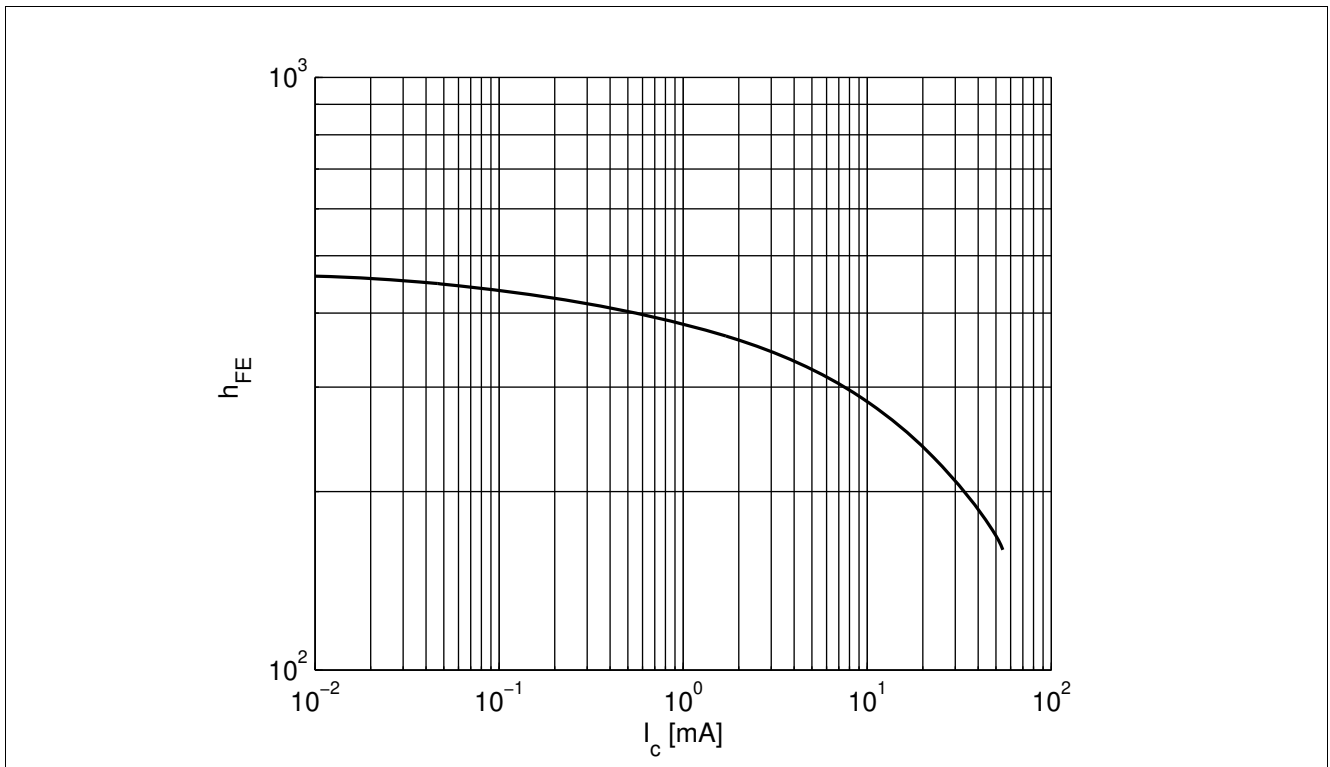


Figure 6-2 DC Current Gain $h_{FE} = f(I_C), V_{CE} = 1.8 \text{ V}$

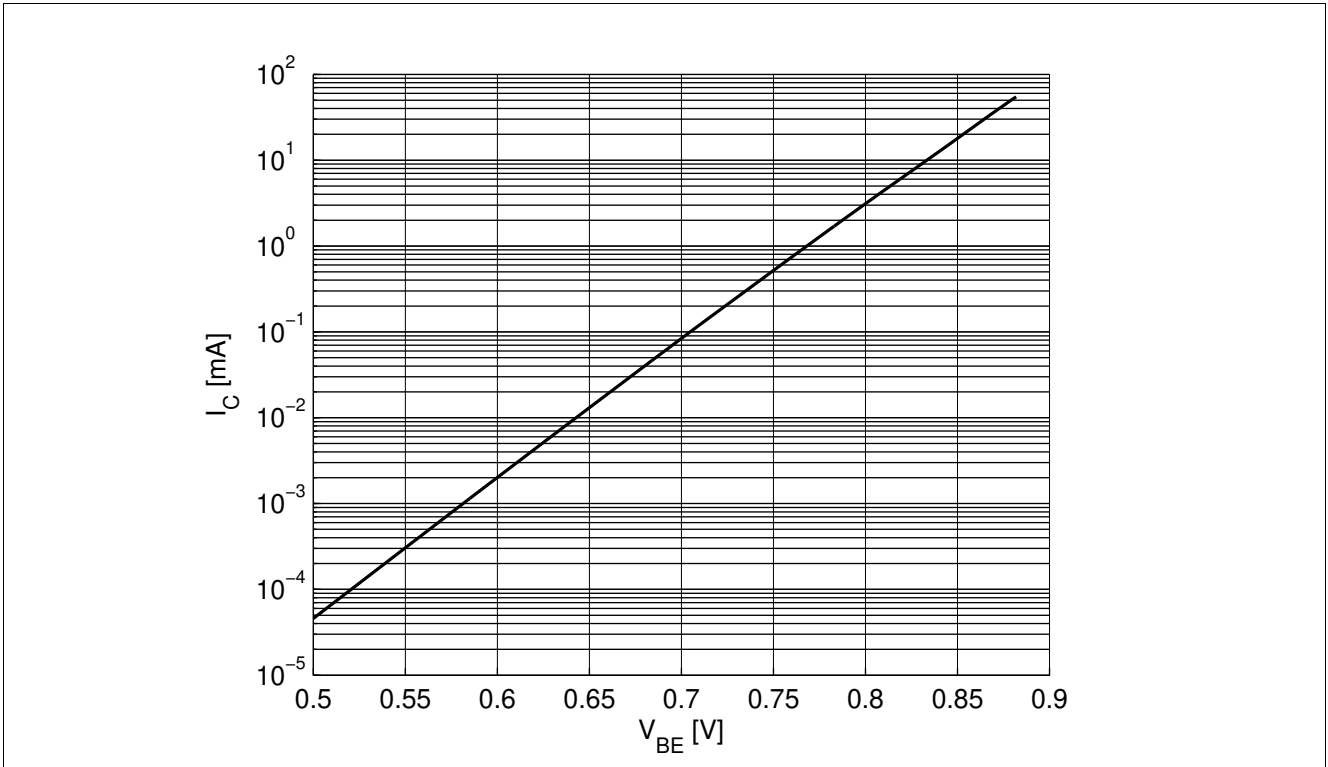


Figure 6-3 Collector Current vs. Base Emitter Forward Voltage $I_C = f(V_{BE})$, $V_{CE} = 1.8$ V

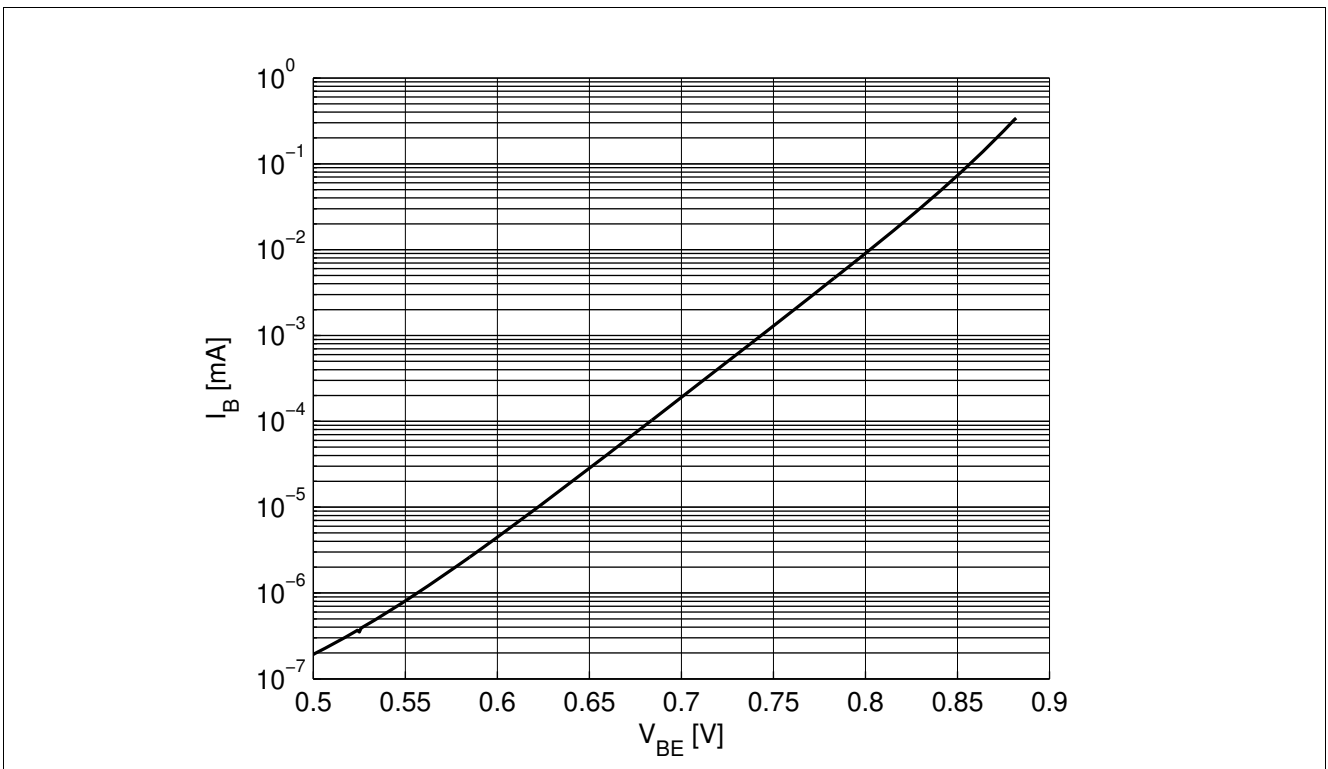


Figure 6-4 Base Current vs. Base Emitter Forward Voltage $I_B = f(V_{BE})$, $V_{CE} = 1.8$ V

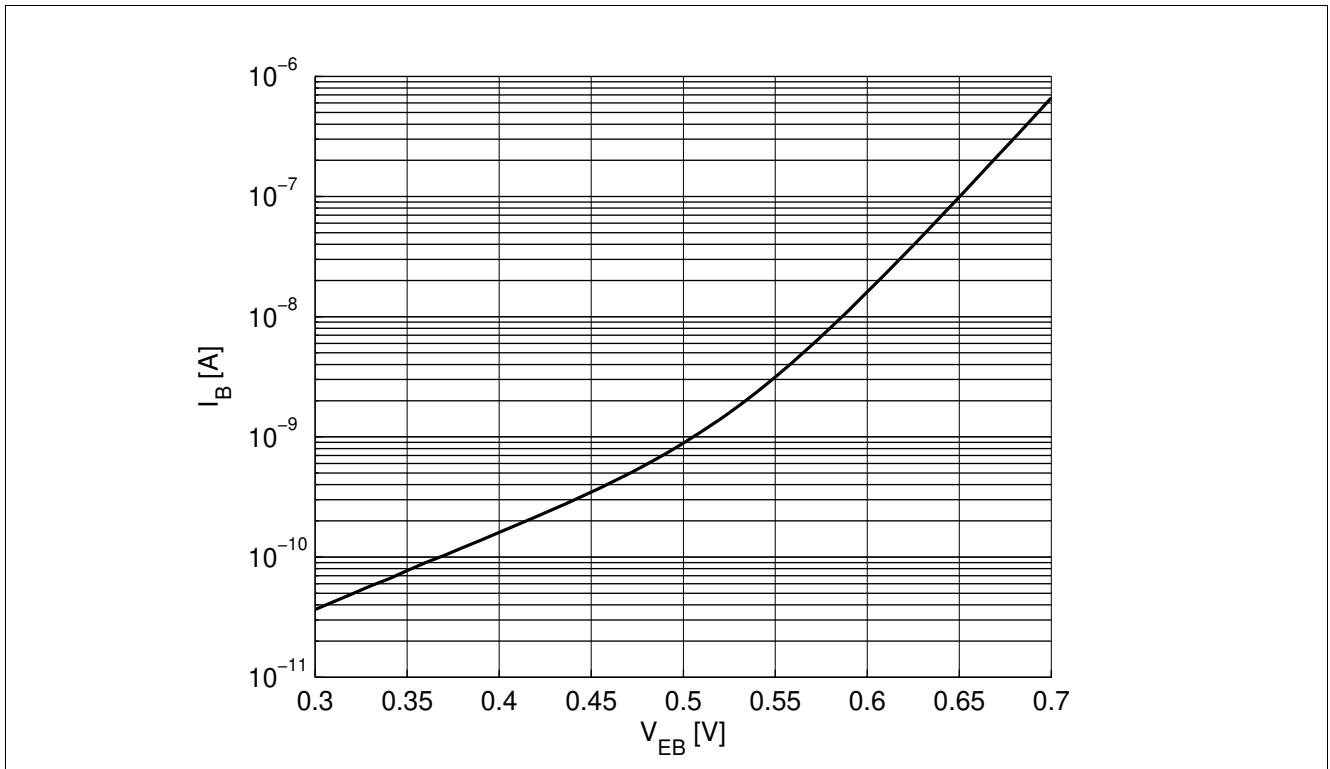


Figure 6-5 Base Current vs. Base Emitter Reverse Voltage $I_B = f(V_{EB})$, $V_{CE} = 1.8$ V

7 Characteristic AC Diagrams

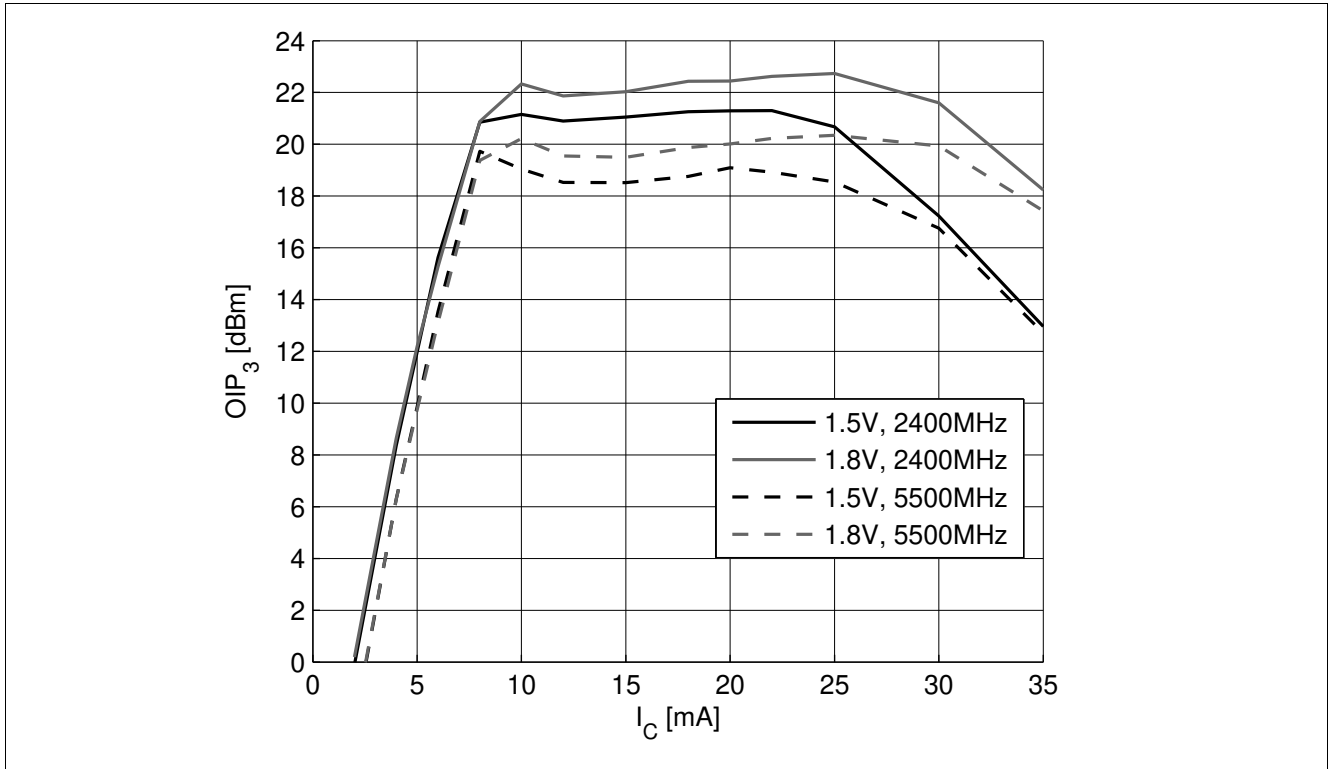


Figure 7-1 3rd Order Intercept Point at Output $OIP3 = f(I_C)$, $Z_S = Z_L = 50 \Omega$, $V_{CE}, f =$ Parameters

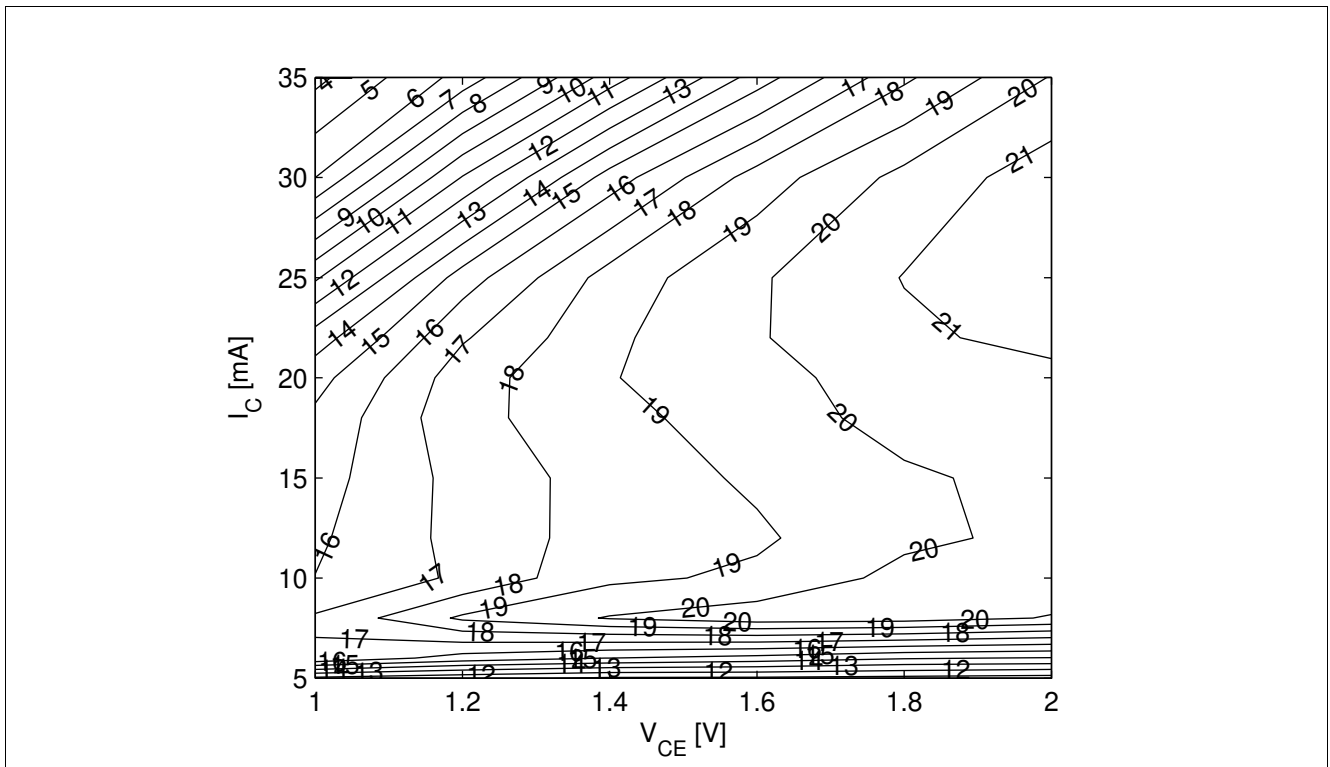


Figure 7-2 3rd Order Intercept Point at Output $OIP3 [dBm] = f(I_C, V_{CE})$, $Z_S = Z_L = 50 \Omega$, $f = 5.5 \text{ GHz}$

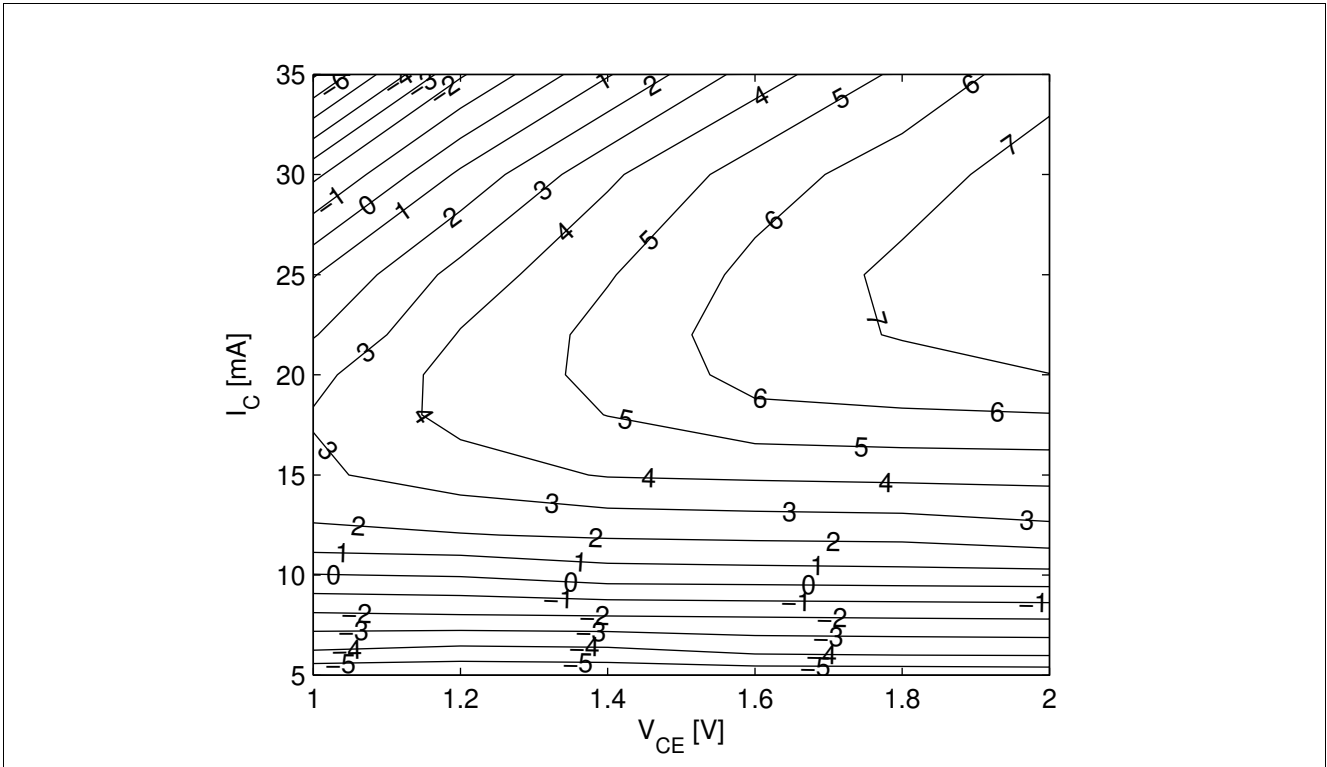


Figure 7-3 Compression Point at Output $OP_{1dB} [dBm] = f(I_C, V_{CE})$, $Z_S = Z_L = 50 \Omega$, $f = 5.5 \text{ GHz}$

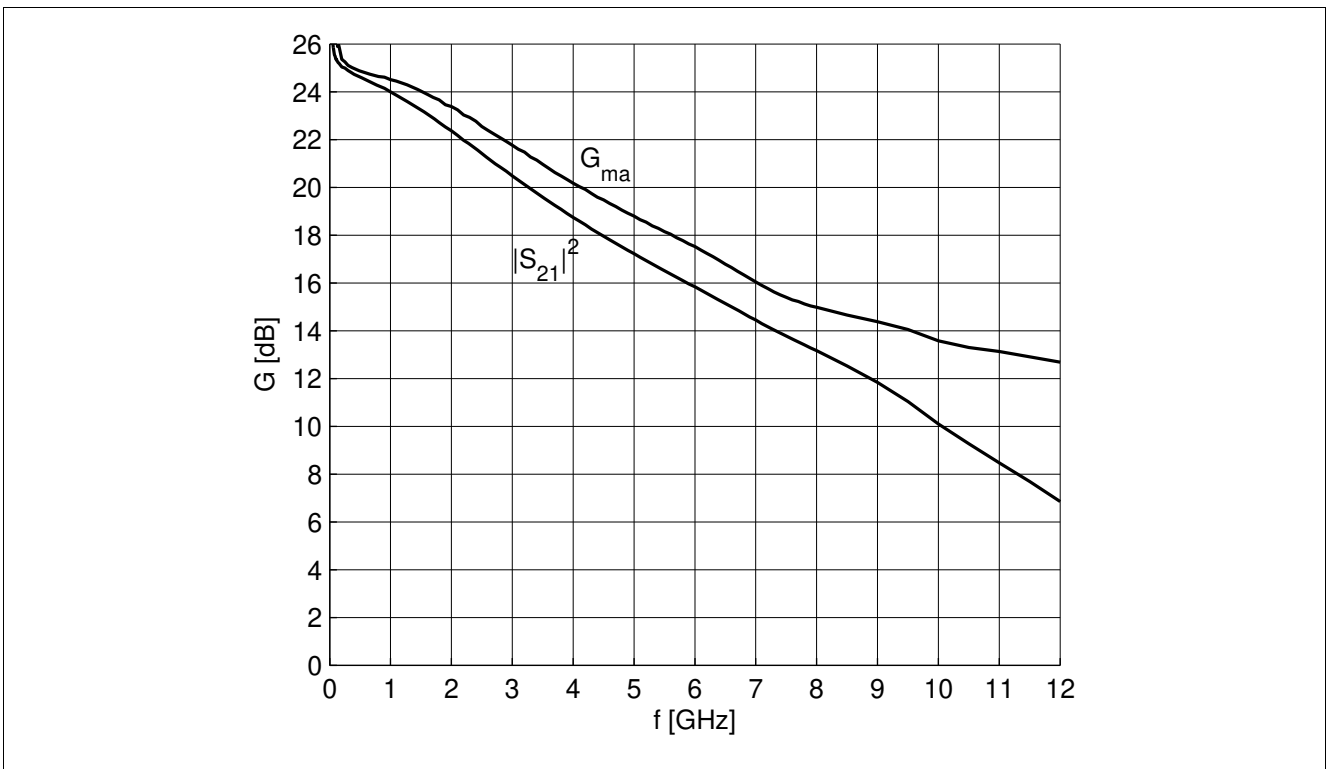


Figure 7-4 Gain G_{ma} , G_{ms} , $|S_{21}|^2 = f(f)$, $V_{CE} = 1.8 \text{ V}$, $I_C = 15 \text{ mA}$

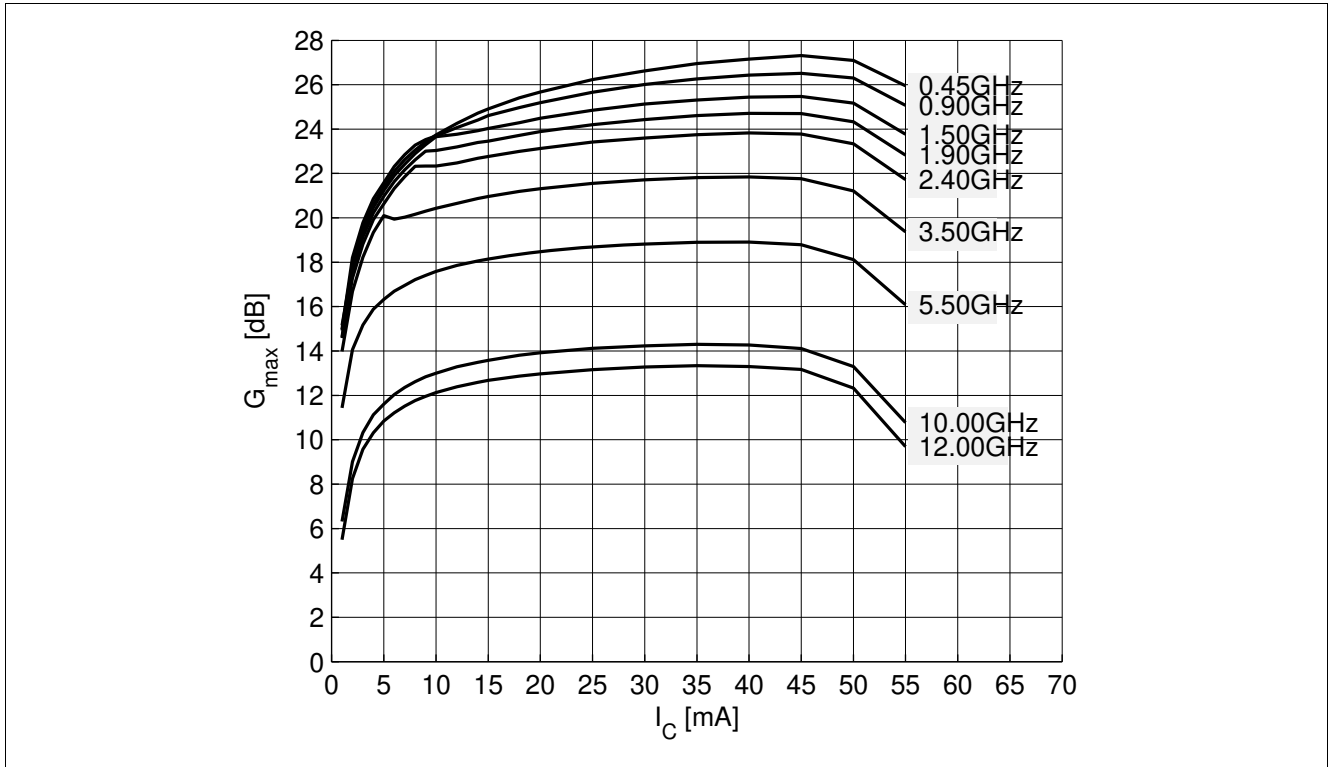


Figure 7-5 Maximum Power Gain $G_{max} = f(I_C)$, $V_{CE} = 1.8\text{ V}$, $f = \text{Parameter in GHz}$

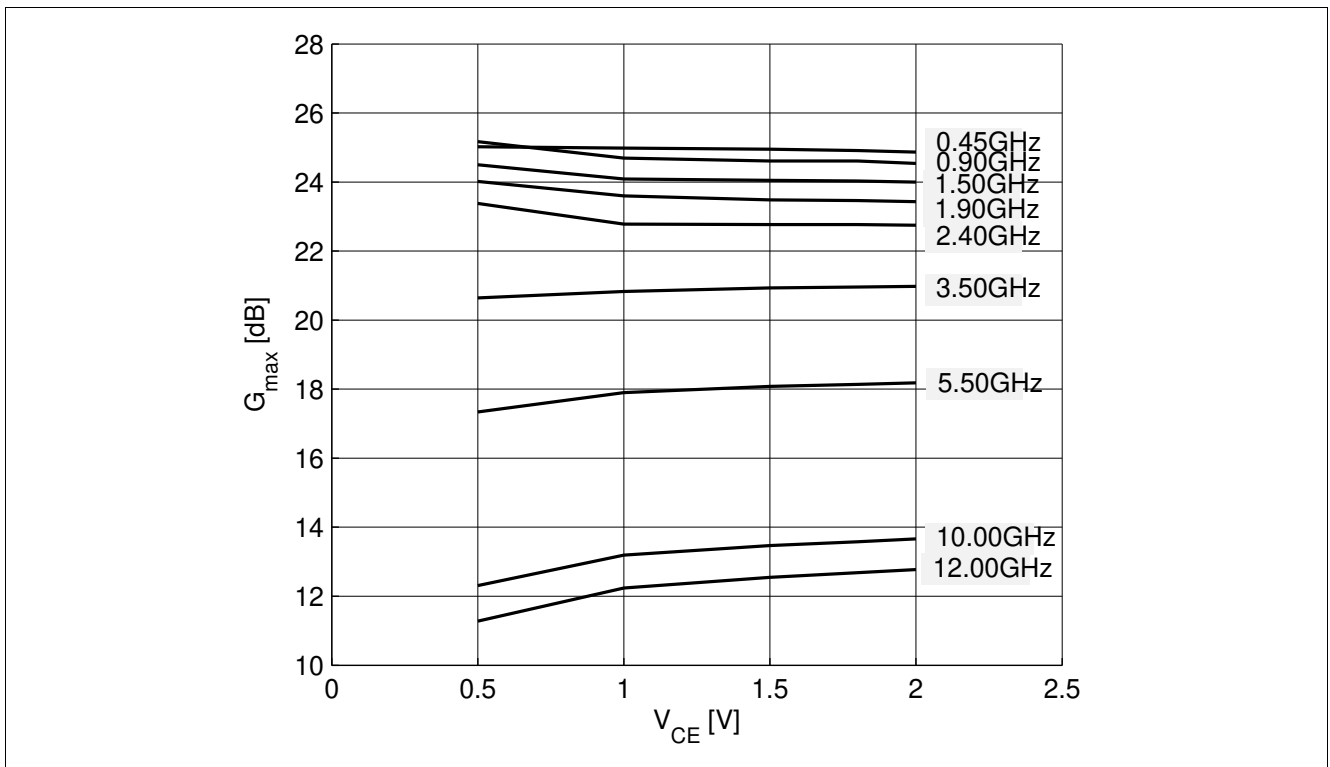


Figure 7-6 Maximum Power Gain $G_{max} = f(V_{CE})$, $I_C = 15\text{ mA}$, $f = \text{Parameter in GHz}$

Characteristic AC Diagrams

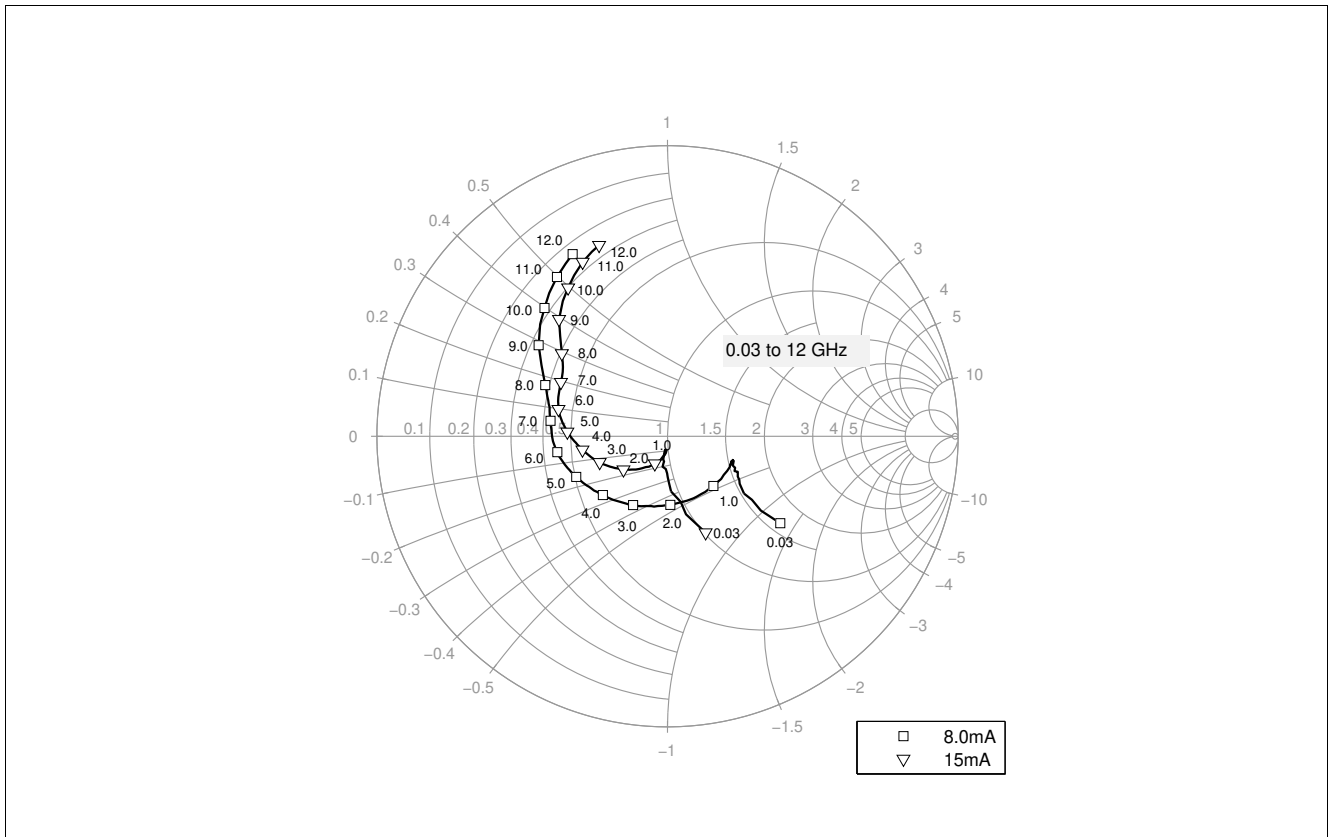


Figure 7-7 Input Reflection Coefficient $S_{11} = f(f)$, $V_{CE} = 1.8 \text{ V}$, $I_C = 8 / 15 \text{ mA}$

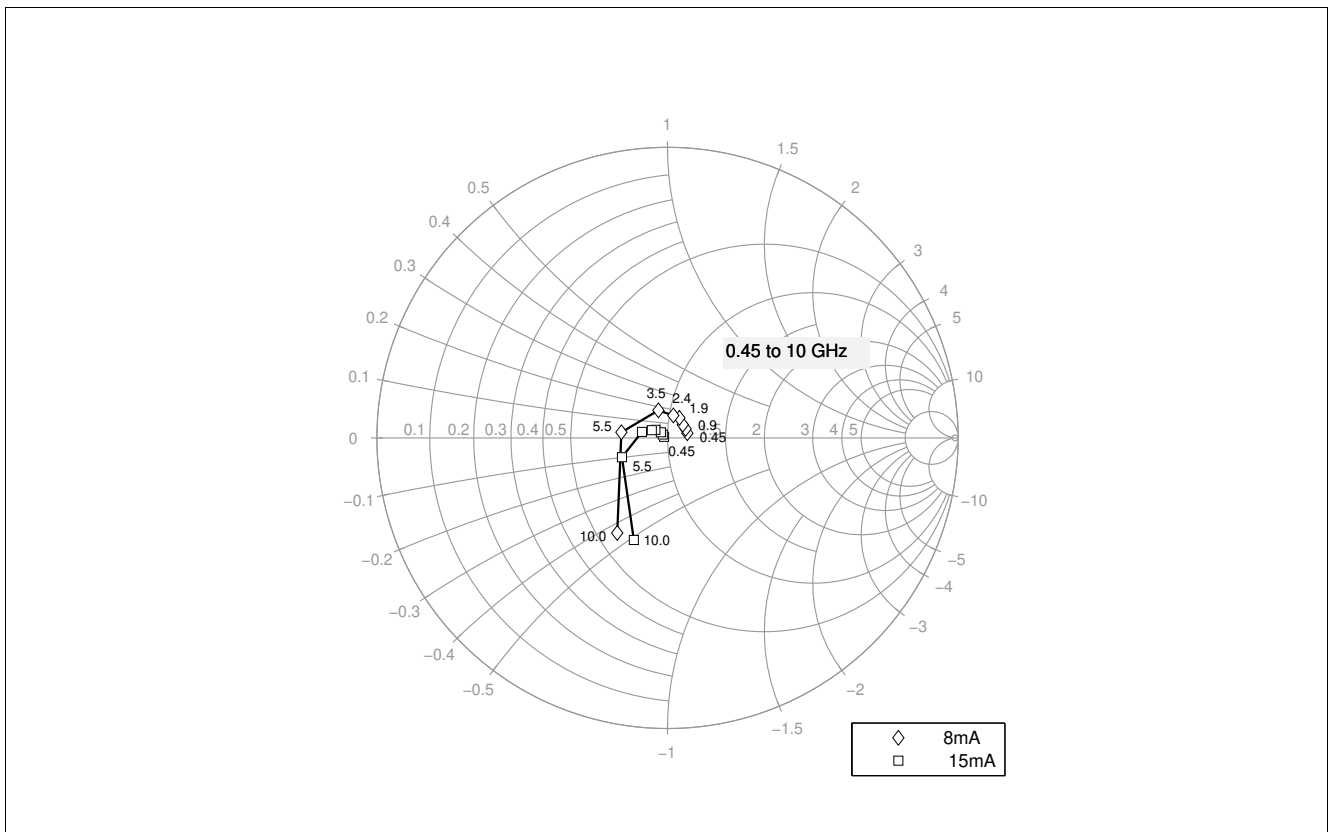


Figure 7-8 Source Impedance for Minimum Noise Figure $Z_{opt} = f(f)$, $V_{CE} = 1.8 \text{ V}$, $I_C = 8 / 15 \text{ mA}$

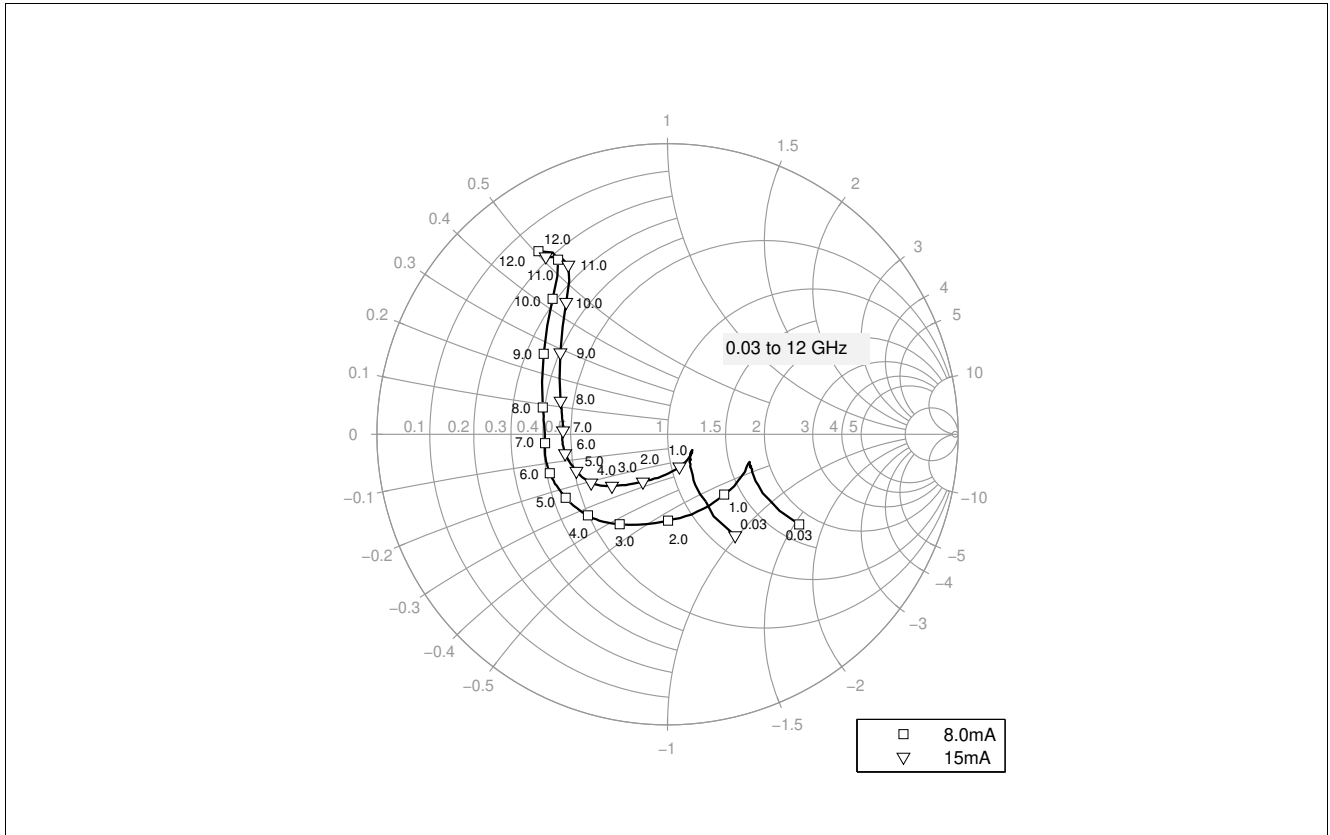


Figure 7-9 Output Reflection Coefficient $S_{22} = f(f)$, $V_{CE} = 1.8\text{ V}$, $I_C = 8 / 15\text{ mA}$

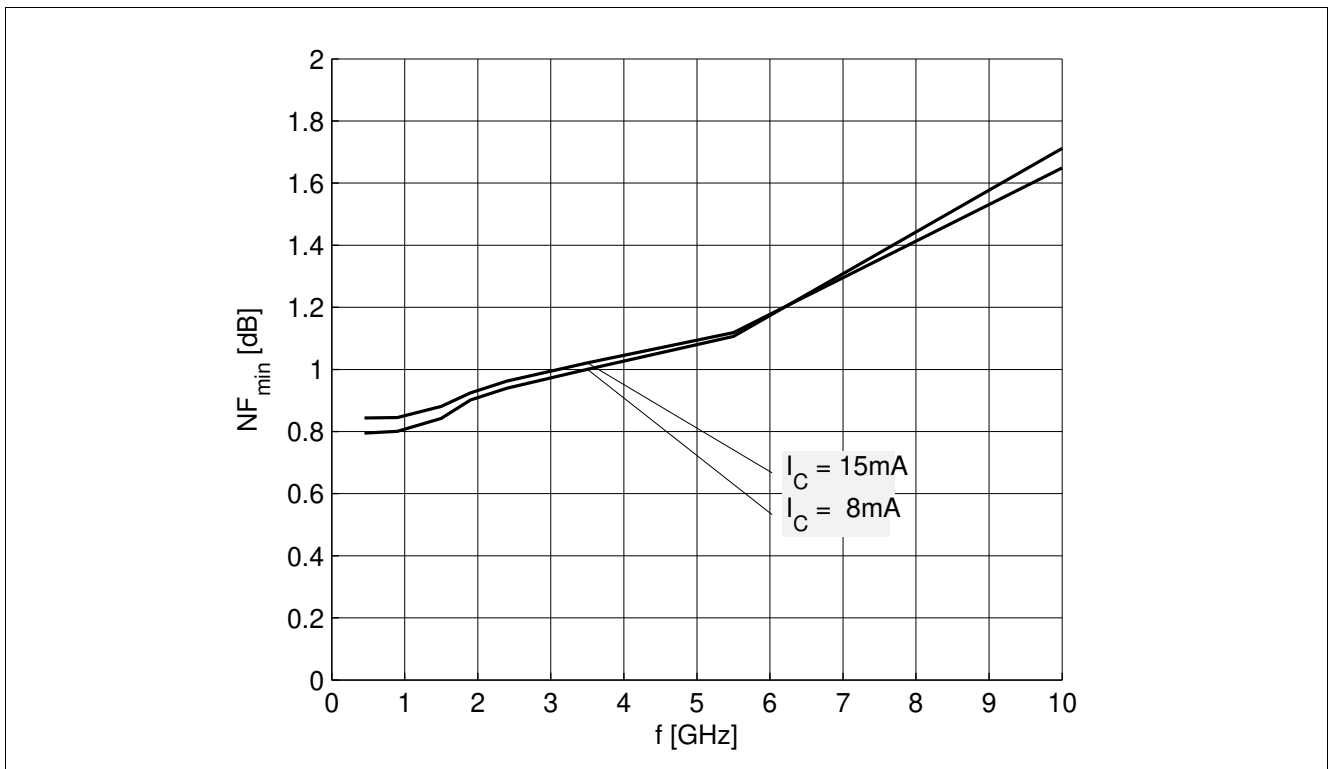


Figure 7-10 Noise Figure $NF_{min} = f(f)$, $V_{CE} = 1.8\text{ V}$, $I_C = 8 / 15\text{ mA}$, $Z_S = Z_{opt}$

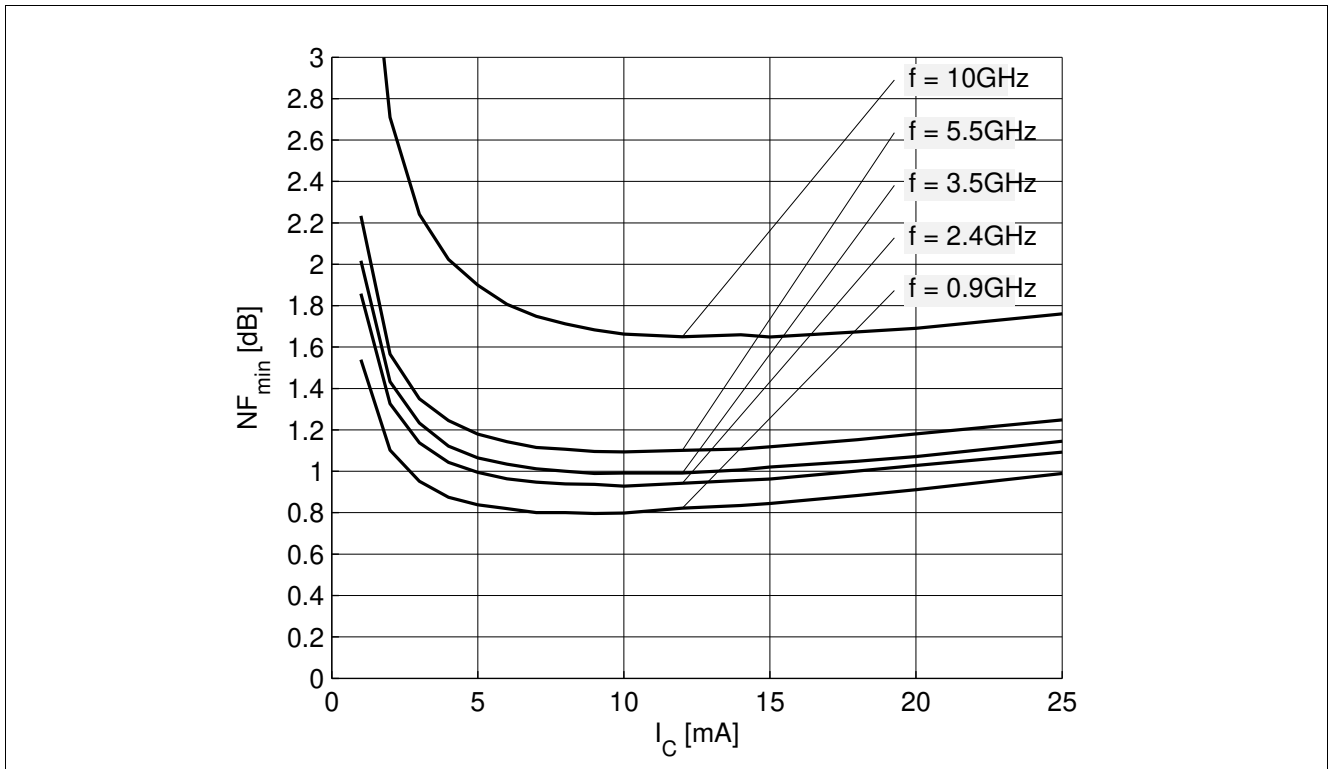


Figure 7-11 Noise Figure $NF_{min} = f(I_C)$, $V_{CE} = 1.8\text{ V}$, $Z_S = Z_{opt}$, $f = \text{Parameter in GHz}$

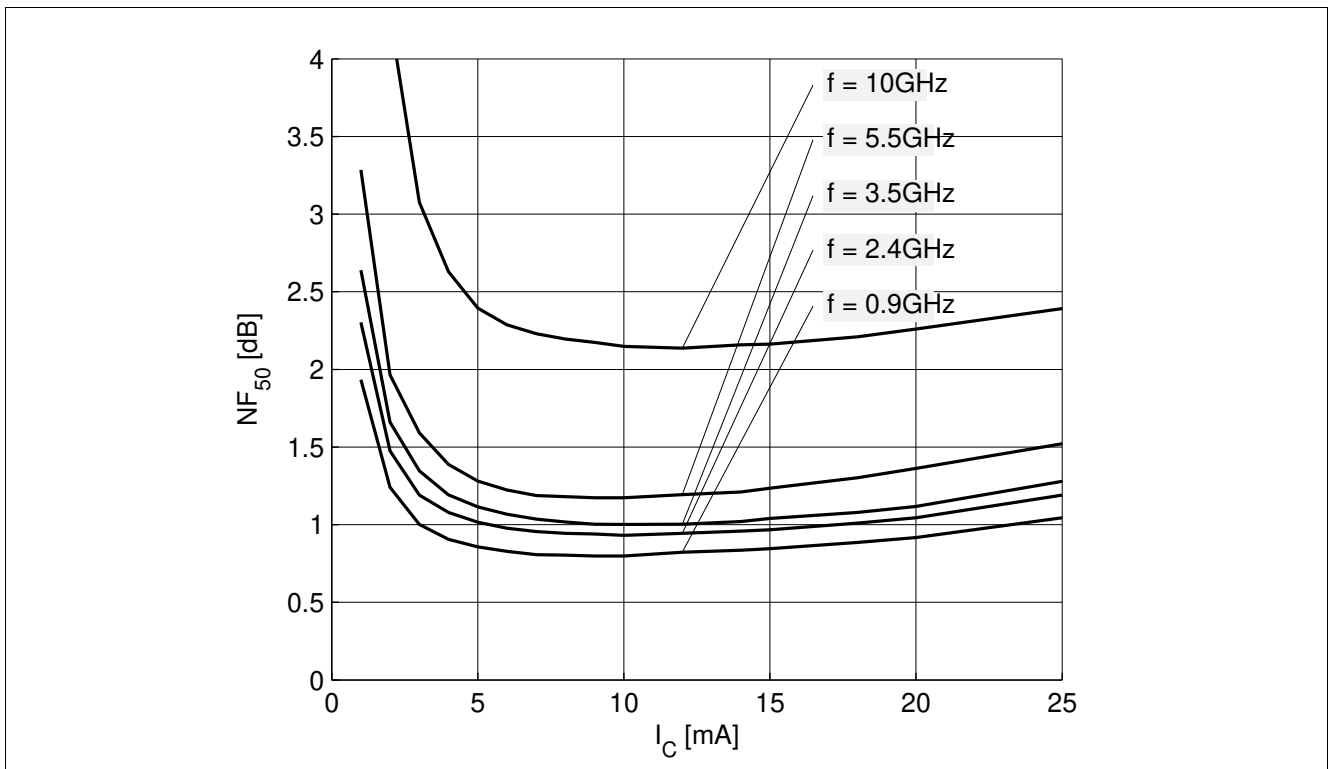


Figure 7-12 Noise Figure $NF_{50} = f(I_C)$, $V_{CE} = 1.8\text{ V}$, $Z_S = 50\ \Omega$, $f = \text{Parameter in GHz}$

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. $T_A = 25\text{ }^\circ\text{C}$.

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 BFP843F 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 BFP843F 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 TSFP-4-1

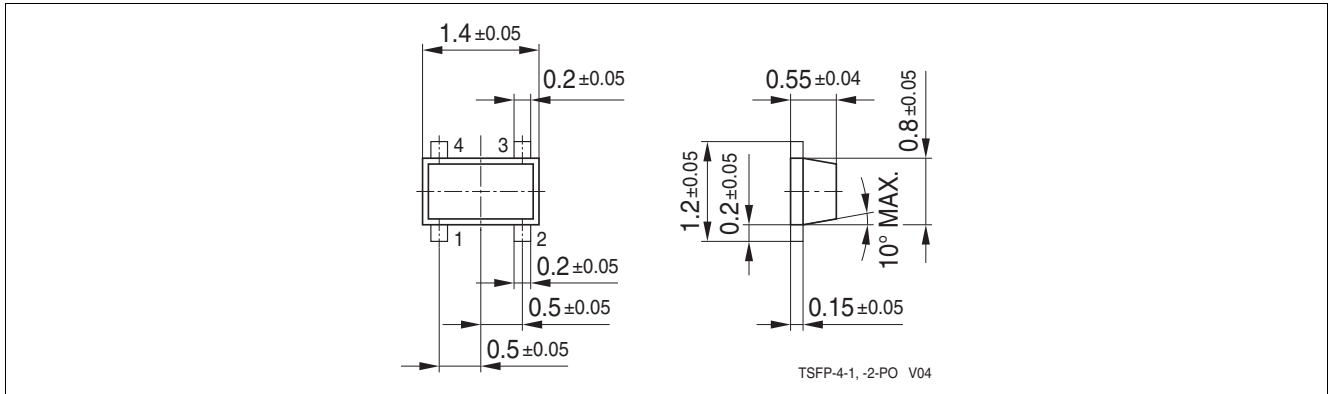


Figure 9-1 Package Outline

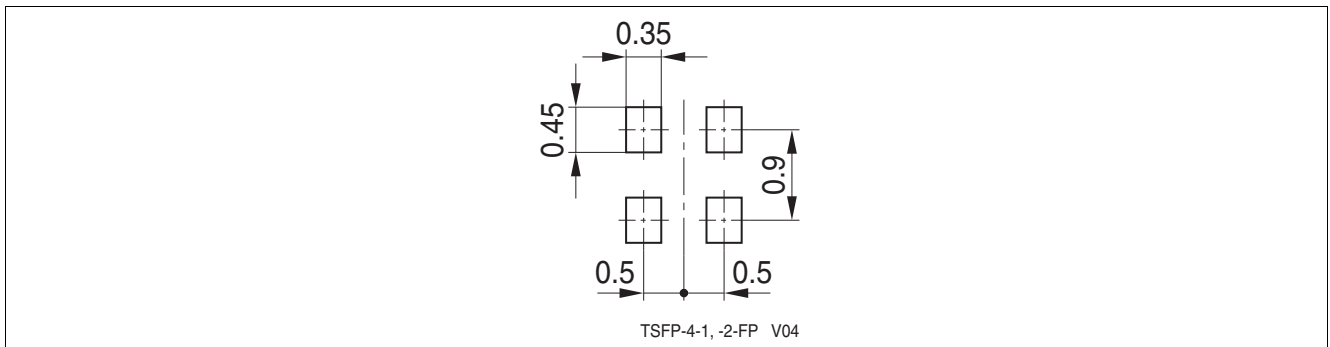


Figure 9-2 Package Footprint

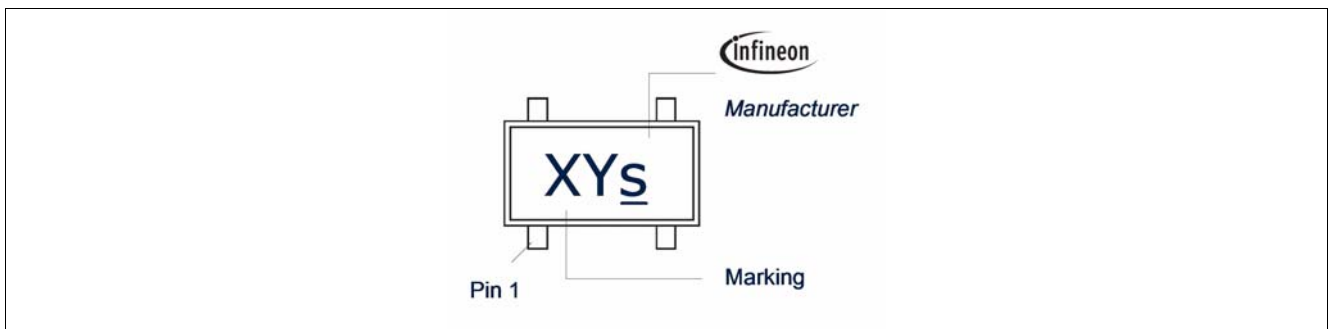


Figure 9-3 Marking Description (Marking BFP843F: T2s)

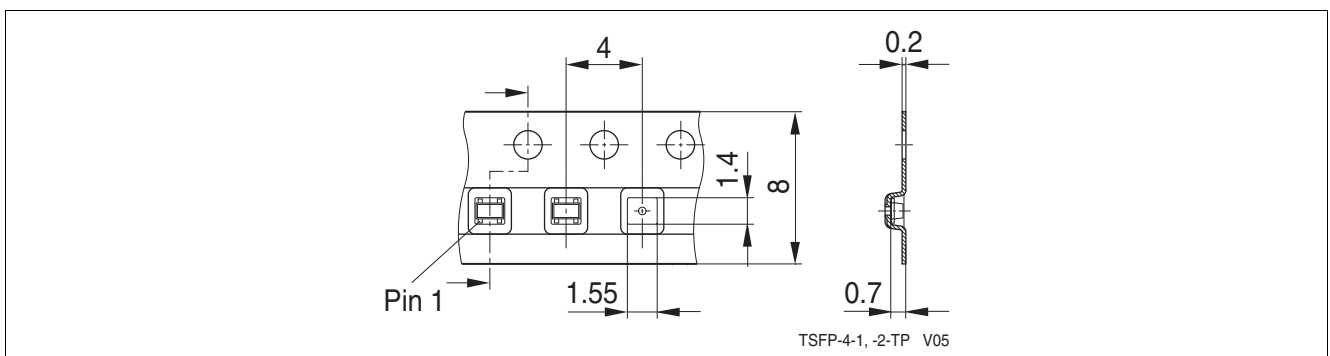


Figure 9-4 Tape dimensions