

# BFP720FESD

Robust High Performance Low Noise Bipolar RF Transistor

## Data Sheet

Revision 1.1, 2010-06-29

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**BFP720FESD, Robust High Performance Low Noise Bipolar RF Transistor**

**Revision History: 2010-06-29, Revision 1.1**

**Previous Revision 1.0:**

| Page  | Subjects (major changes since last revision)       |
|-------|--|
| 10    | Icmax changed from 25mA to 30mA, PRFin value added |
| 18-21 | Characteristic DC diagrams and OIP3 diagram added  |
|       |  |

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Last Trademarks Update 2010-03-22

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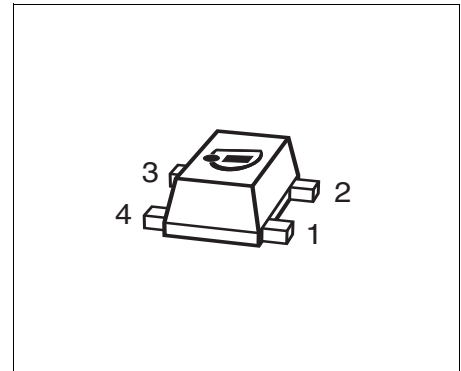
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## 1 Features

- Robust high performance 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
- 0.6 dB minimum noise figure typical at 2.4 GHz, 0.8 dB at 10 GHz, 5 mA
- 26 dB maximum gain ( $G_{ms}$ ) typical at 2.4 GHz, 22 dB at 5.5 GHz, 15 mA
- 21 dBm OIP3 typical at 5.5 GHz, 15 mA
- Accurate SPICE GP model available to enable effective design in process (see chapter 6)
- Thin, small, flat, Pb- and halogen free (RoHS compliant) package with visible leads



## 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 (GPS, Glonass), satellite radio (SDARs, DAB) and LNB
- 3G/4G UMTS/LTE mobile phone applications
- Multimedia applications such as mobile/portable TV, CATV, FM Radio
- ISM applications like RKE, AMR and Zigbee, as well as for emerging wireless applications

As discrete active mixer, amplifier in VCO's and buffer amplifier.

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

| Product Name | Package  | Pin Configuration |       |       |       | Marking |
|--------------|----------|-------------------|-------|-------|-------|---------|
| BFP720FESD   | TSFP-4-1 | 1 = B             | 2 = E | 3 = C | 4 = E | T3s     |



## 2 Product Brief

The BFP720FESD is a Silicon Germanium Carbon (SiGe:C) NPN Heterojunction wideband Bipolar RF Transistor (HBT) in a thin, small, flat, 4-pin dual emitter plastic package with visible leads. The device is fitted with internal protection circuits, which enhance robustness against ESD and high RF input power strongly. The device combines robustness with very high RF gain and lowest noise figure at low operation current for use in a wide range of wireless applications.

The BFP720FESD is especially well-suited for portable battery-powered applications in which reduced power consumption is a key requirement. Device design supports collector voltages up to 4.2 V.

**Table 1 Quick Reference DC Characteristics at  $T_A = 25^\circ\text{C}$**

| Parameter                           | Symbol        | Values |      |      | Unit | Note / Test Condition                              |
|-------------------------------------|---------------|--------|------|------|------|--|
|                                     |               | Min.   | Typ. | Max. |      |  |
| Collector emitter breakdown voltage | $V_{(BR)CEO}$ | 4.2    | 4.7  | –    | V    | $I_C = 1 \text{ mA}$ , $I_B = 0$<br>Open base      |
| Collector base leakage current      | $I_{CBO}$     | –      | –    | 400  | nA   | $V_{CB} = 2 \text{ V}$ , $I_E = 0$<br>Open emitter |
| DC current gain                     | $h_{FE}$      | 160    | 250  | 400  |      | $V_{CE} = 3 \text{ V}$ , $I_C = 15 \text{ mA}$     |
| Collector current                   | $I_C$         | –      | –    | 30   | mA   |  |
| Total power dissipation             | $P_{tot}$     | –      | –    | 100  | mW   | $T_S \leq 109^\circ\text{C}$                       |



**Table 2 Quick Reference AC Characteristics at  $T_A = 25^\circ\text{C}$** 

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition  |
|--|------------|--------|------|------|------|--|
|  |            | Min.   | Typ. | Max. |      |  |
| Transition frequency   | $f_T$      | –      | 45   | –    | GHz  | $V_{CE} = 3\text{ V}$ , $I_C = 15\text{ mA}$<br>$f = 1\text{ GHz}$ |
| <b><math>V_{CE} = 3\text{ V}</math>, <math>f = 2.4\text{ GHz}</math></b> |            |        |      |      |      |  |
| <b>Maximum Power Gain</b>  |            |        |      |      |      |  |
| Low noise operation point  | $G_{ms}$   | –      | 22.5 | –    | dB   | $I_C = 5\text{ mA}$  |
| High linearity operation point   | $G_{ms}$   | –      | 26   | –    |      | $I_C = 15\text{ mA}$   |
| <b>Transducer Gain</b>   |            |        |      |      |      |  |
| Low noise operation point  | $S_{21}$   | –      | 20   | –    | dB   | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 5\text{ mA}$                    |
| High linearity operation point   | $S_{21}$   | –      | 23.5 | –    |      | $I_C = 15\text{ mA}$   |
| <b>Minimum Noise Figure</b>  |            |        |      |      |      |  |
| Minimum noise figure   | $NF_{min}$ | –      | 0.6  | –    | dB   | $Z_S = Z_{opt}$<br>$I_C = 5\text{ mA}$                             |
| Associated gain  | $G_{ass}$  | –      | 21   | –    |      | $I_C = 5\text{ mA}$  |
| <b>Linearity</b>   |            |        |      |      |      |  |
| 1 dB gain compression point  | $OP_{1dB}$ | –      | 7    | –    | dBm  | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 15\text{ mA}$                   |
| 3rd order intercept point  | $OIP_3$    | –      | 22   | –    |      | $I_C = 15\text{ mA}$   |
| <b><math>V_{CE} = 3\text{ V}</math>, <math>f = 5.5\text{ GHz}</math></b> |            |        |      |      |      |  |
| <b>Maximum Power Gain</b>  |            |        |      |      |      |  |
| Low noise operation point  | $G_{ms}$   | –      | 19.5 | –    | dB   | $I_C = 5\text{ mA}$  |
| High linearity operation point   | $G_{ms}$   | –      | 22   | –    |      | $I_C = 15\text{ mA}$   |
| <b>Transducer Gain</b>   |            |        |      |      |      |  |
| Low noise operation point  | $S_{21}$   | –      | 15   | –    | dB   | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 5\text{ mA}$                    |
| High linearity operation point   | $S_{21}$   | –      | 17   | –    |      | $I_C = 15\text{ mA}$   |
| <b>Minimum Noise Figure</b>  |            |        |      |      |      |  |
| Minimum noise figure   | $NF_{min}$ | –      | 0.8  | –    | dB   | $Z_S = Z_{opt}$<br>$I_C = 5\text{ mA}$                             |
| Associated gain  | $G_{ass}$  | –      | 16   | –    |      | $I_C = 5\text{ mA}$  |
| <b>Linearity</b>   |            |        |      |      |      |  |
| 1 dB gain compression point  | $OP_{1dB}$ | –      | 7    | –    | dBm  | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 15\text{ mA}$                   |
| 3rd order intercept point  | $OIP_3$    | –      | 21   | –    |      | $I_C = 15\text{ mA}$   |

### 3 Maximum Ratings

**Table 3 Maximum Ratings at  $T_A = 25^\circ\text{C}$  (unless otherwise specified)**

| Parameter                               | Symbol            | Values |      | Unit             | Note / Test Condition                                |
|---|-------------------|--------|------|------------------|--|
|   |                   | Min.   | Max. |                  |  |
| Collector emitter voltage               | $V_{\text{CEO}}$  | –      | 4.2  | V                | Open base<br>$T_A = 25^\circ\text{C}$                |
|   |                   | –      | 3.7  | V                | $T_A = -55^\circ\text{C}$                            |
| Collector base voltage <sup>1)</sup>    | $V_{\text{CBO}}$  | –      | 4.9  | V                | Open emitter<br>$T_A = 25^\circ\text{C}$             |
|   |                   | –      | 4.4  | V                | $T_A = -55^\circ\text{C}$                            |
| Collector emitter voltage <sup>2)</sup> | $V_{\text{CES}}$  | –      | 4.2  | V                | Emitter / base shortened<br>$T_A = 25^\circ\text{C}$ |
|   |                   | –      | 3.7  | V                | $T_A = -55^\circ\text{C}$                            |
| Base current <sup>3)</sup>              | $I_B$             | -10    | 3    | mA               | –  |
| Collector current                       | $I_C$             | –      | 30   | mA               | –  |
| RF input power                          | $P_{\text{RFIn}}$ | –      | 21   | dBm              | –  |
| ESD stress pulse <sup>4)</sup>          | $V_{\text{ESD}}$  | -2     | 2    | kV               | HBM, all pins, acc. to<br>JESD22-A114                |
| Total power dissipation <sup>5)</sup>   | $P_{\text{tot}}$  | –      | 100  | mW               | $T_S \leq 109^\circ\text{C}$                         |
| Junction temperature                    | $T_J$             | –      | 150  | $^\circ\text{C}$ | –  |
| Storage temperature                     | $T_{\text{Stg}}$  | -55    | 150  | $^\circ\text{C}$ | –  |

1) Low  $V_{\text{CBO}}$  due to integrated protection circuits.

2)  $V_{\text{CES}}$  is identical to  $V_{\text{CEO}}$  due to integrated protection circuits.

3) Sustainable reverse bias current is high due to integrated protection circuits.

4) ESD robustness is high due to integrated protection circuits.

5)  $T_S$  is the soldering point temperature.  $T_S$  measured on the emitter lead at the soldering point of the pcb.

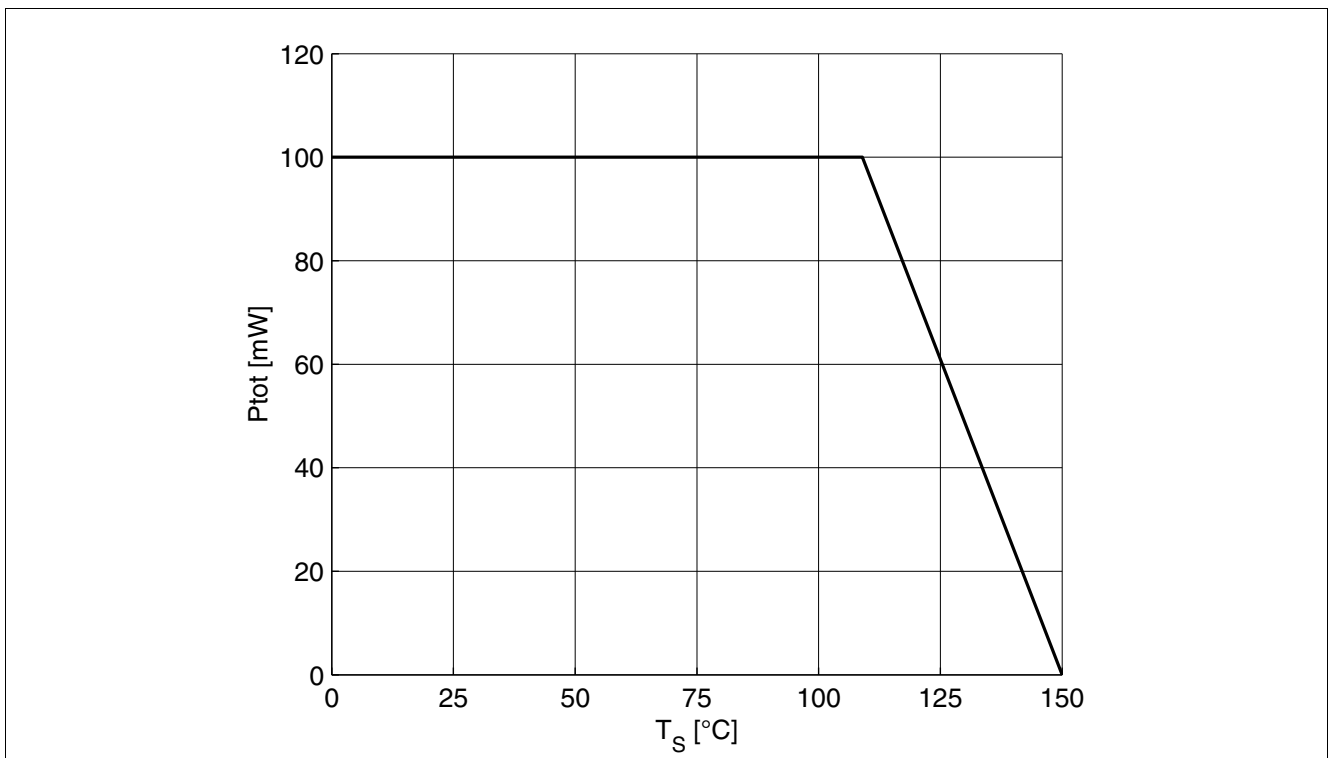
**Attention: Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.**

## 4 Thermal Characteristics

**Table 4 Thermal Resistance**

| Parameter                                | Symbol     | Values |      |      | Unit | Note / Test Condition |
|--|------------|--------|------|------|------|-----------------------|
|  |            | Min.   | Typ. | Max. |      |                       |
| Junction - soldering point <sup>1)</sup> | $R_{thJS}$ | –      | 405  | –    | K/W  | –                     |

1) For calculation of  $R_{thJA}$  please refer to Application Note Thermal Resistance AN 077



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

## 5 Electrical Characteristics

### 5.1 DC Characteristics

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

| Parameter                           | Symbol        | Values |      |      | Unit          | Note / Test Condition  |
|-------------------------------------|---------------|--------|------|------|---------------|--|
|                                     |               | Min.   | Typ. | Max. |               |  |
| Collector emitter breakdown voltage | $V_{(BR)CEO}$ | 4.2    | 4.7  | –    | V             | $I_C = 1\text{ mA}$ , $I_B = 0$<br>Open base                   |
| Collector emitter leakage current   | $I_{CES}$     | –      | –    | 400  | nA            | $V_{CE} = 2\text{ V}$ , $V_{BE} = 0$<br>Emitter/base shortened |
| Collector base leakage current      | $I_{CBO}$     | –      | –    | 400  | nA            | $V_{CB} = 2\text{ V}$ , $I_E = 0$<br>Open emitter              |
| Emitter base leakage current        | $I_{EBO}$     | –      | –    | 10   | $\mu\text{A}$ | $V_{EB} = 0.5\text{ V}$ , $I_C = 0$<br>Open collector          |
| DC current gain                     | $h_{FE}$      | 160    | 250  | 400  |               | $V_{CE} = 3\text{ V}$ , $I_C = 15\text{ mA}$<br>Pulse measured |

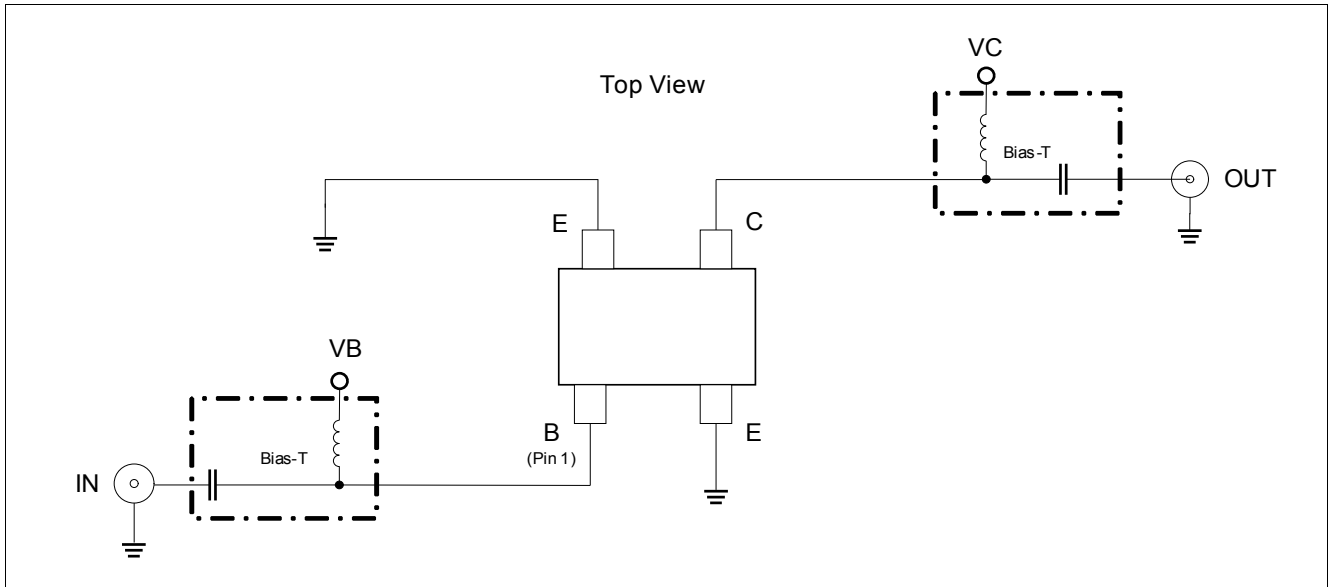
### 5.2 General AC Characteristics

**Table 6 General AC Characteristics at  $T_A = 25\text{ °C}$** 

| Parameter                     | Symbol   | Values |      |      | Unit | Note / Test Condition   |
|-------------------------------|----------|--------|------|------|------|---|
|                               |          | Min.   | Typ. | Max. |      |   |
| Transition frequency          | $f_T$    | –      | 45   | –    | GHz  | $V_{CE} = 3\text{ V}$ , $I_C = 15\text{ mA}$<br>$f = 1\text{ GHz}$                          |
| Collector base capacitance    | $C_{CB}$ | –      | 0.05 | –    | pF   | $V_{CB} = 3\text{ V}$ , $V_{BE} = 0\text{ V}$<br>$f = 1\text{ MHz}$<br>Emitter grounded     |
| Collector emitter capacitance | $C_{CE}$ | –      | 0.35 | –    | pF   | $V_{CE} = 3\text{ V}$ , $V_{BE} = 0\text{ V}$<br>$f = 1\text{ MHz}$<br>Base grounded        |
| Emitter base capacitance      | $C_{EB}$ | –      | 0.4  | –    | pF   | $V_{EB} = 0.4\text{ V}$ , $V_{CB} = 0\text{ V}$<br>$f = 1\text{ MHz}$<br>Collector grounded |

### 5.3 Frequency Dependent AC Characteristics

Measurement setup is a test fixture with Bias T's in a 50  $\Omega$  system,  $T_A = 25\text{ }^\circ\text{C}$



**Figure 2 BFP720FESD Testing Circuit**

**Table 7 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 150\text{ MHz}$**

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ms}$   | –      | 34.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ms}$   | –      | 38.5 | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 23.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 30.5 | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 0.5  | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 29   | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 6    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 21.5 | –    |      | $I_C = 15\text{ mA}$     |

**Table 8 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 450\text{ MHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition                            |
|--------------------------------|------------|--------|------|------|------|--|
|                                |            | Min.   | Typ. | Max. |      |  |
| <b>Maximum power gain</b>      |            |        |      |      |      |  |
| Low noise operation point      | $G_{ms}$   | –      | 30   | –    | dB   | $I_C = 5\text{ mA}$                              |
| High linearity operation point | $G_{ms}$   | –      | 33.5 | –    |      | $I_C = 15\text{ mA}$                             |
| <b>Transducer gain</b>         |            |        |      |      |      |  |
| Low noise operation point      | $S_{21}$   | –      | 23   | –    | dB   | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 5\text{ mA}$  |
| High linearity operation point | $S_{21}$   | –      | 30   | –    |      | $I_C = 15\text{ mA}$                             |
| <b>Minimum noise figure</b>    |            |        |      |      |      |  |
| Minimum noise figure           | $NF_{min}$ | –      | 0.5  | –    | dB   | $Z_S = Z_{opt}$<br>$I_C = 5\text{ mA}$           |
| Associated gain                | $G_{ass}$  | –      | 27.5 | –    |      | $I_C = 5\text{ mA}$                              |
| <b>Linearity</b>               |            |        |      |      |      |  |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 6    | –    | dBm  | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 15\text{ mA}$ |
| 3rd order intercept point      | $OIP_3$    | –      | 21.5 | –    |      | $I_C = 15\text{ mA}$                             |

**Table 9 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 900\text{ MHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition                            |
|--------------------------------|------------|--------|------|------|------|--|
|                                |            | Min.   | Typ. | Max. |      |  |
| <b>Maximum power gain</b>      |            |        |      |      |      |  |
| Low noise operation point      | $G_{ms}$   | –      | 26.5 | –    | dB   | $I_C = 5\text{ mA}$                              |
| High linearity operation point | $G_{ms}$   | –      | 30.5 | –    |      | $I_C = 15\text{ mA}$                             |
| <b>Transducer gain</b>         |            |        |      |      |      |  |
| Low noise operation point      | $S_{21}$   | –      | 22.5 | –    | dB   | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 5\text{ mA}$  |
| High linearity operation point | $S_{21}$   | –      | 28.5 | –    |      | $I_C = 15\text{ mA}$                             |
| <b>Minimum noise figure</b>    |            |        |      |      |      |  |
| Minimum noise figure           | $NF_{min}$ | –      | 0.55 | –    | dB   | $Z_S = Z_{opt}$<br>$I_C = 5\text{ mA}$           |
| Associated gain                | $G_{ass}$  | –      | 25.5 | –    |      | $I_C = 5\text{ mA}$                              |
| <b>Linearity</b>               |            |        |      |      |      |  |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 6.5  | –    | dBm  | $Z_S = Z_L = 50\ \Omega$<br>$I_C = 15\text{ mA}$ |
| 3rd order intercept point      | $OIP_3$    | –      | 22   | –    |      | $I_C = 15\text{ mA}$                             |

**Electrical Characteristics**
**Table 10 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 1.5\text{ GHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ms}$   | –      | 24.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ms}$   | –      | 28   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 21.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 26   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 0.55 | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 23.5 | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 7    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 22   | –    |      | $I_C = 15\text{ mA}$     |

**Table 11 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 1.9\text{ GHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ms}$   | –      | 23.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ms}$   | –      | 27   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 21   | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 25   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 0.55 | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 22.5 | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 7    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 22   | –    |      | $I_C = 15\text{ mA}$     |



**Electrical Characteristics**
**Table 12 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 2.4\text{ GHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ms}$   | –      | 22.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ms}$   | –      | 26   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 20   | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 23.5 | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 0.6  | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 21   | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 7    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 22   | –    |      | $I_C = 15\text{ mA}$     |

**Table 13 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 3.5\text{ GHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ms}$   | –      | 21   | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ms}$   | –      | 24.5 | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 18   | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 20.5 | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 0.65 | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 19   | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 7    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 21.5 | –    |      | $I_C = 15\text{ mA}$     |

**Table 14 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 5.5\text{ GHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ms}$   | –      | 19.5 | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ms}$   | –      | 22   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 15   | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 17   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 0.8  | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 16   | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 7    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 21   | –    |      | $I_C = 15\text{ mA}$     |

**Table 15 AC Characteristics,  $V_{CE} = 3\text{ V}$ ,  $f = 10\text{ GHz}$** 

| Parameter                      | Symbol     | Values |      |      | Unit | Note / Test Condition    |
|--------------------------------|------------|--------|------|------|------|--------------------------|
|                                |            | Min.   | Typ. | Max. |      |                          |
| <b>Maximum power gain</b>      |            |        |      |      | dB   |                          |
| Low noise operation point      | $G_{ma}$   | –      | 14   | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $G_{ma}$   | –      | 15   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Transducer gain</b>         |            |        |      |      | dB   | $Z_S = Z_L = 50\ \Omega$ |
| Low noise operation point      | $S_{21}$   | –      | 9    | –    |      | $I_C = 5\text{ mA}$      |
| High linearity operation point | $S_{21}$   | –      | 11   | –    |      | $I_C = 15\text{ mA}$     |
| <b>Minimum noise figure</b>    |            |        |      |      | dB   | $Z_S = Z_{opt}$          |
| Minimum noise figure           | $NF_{min}$ | –      | 1.3  | –    |      | $I_C = 5\text{ mA}$      |
| Associated gain                | $G_{ass}$  | –      | 10   | –    |      | $I_C = 5\text{ mA}$      |
| <b>Linearity</b>               |            |        |      |      | dBm  | $Z_S = Z_L = 50\ \Omega$ |
| 1 dB gain compression point    | $OP_{1dB}$ | –      | 6    | –    |      | $I_C = 15\text{ mA}$     |
| 3rd order intercept point      | $OIP_3$    | –      | 20   | –    |      | $I_C = 15\text{ mA}$     |

Note:

- $G_{ms} = |S_{21} / S_{12}|$  for  $k < 1$ ;  $G_{ma} = |S_{21} / S_{12}|(k - (k^2 - 1)^{1/2})$  for  $k > 1$
- In order to get the  $NF_{min}$  values stated in this chapter the test fixture losses have been subtracted from all measured results.
- $OIP_3$  value depends on termination of all intermodulation frequency components. Termination used for this measurement is  $50\ \Omega$  from 0.2 MHz to 12 GHz.

5.4 Characteristic DC Diagrams

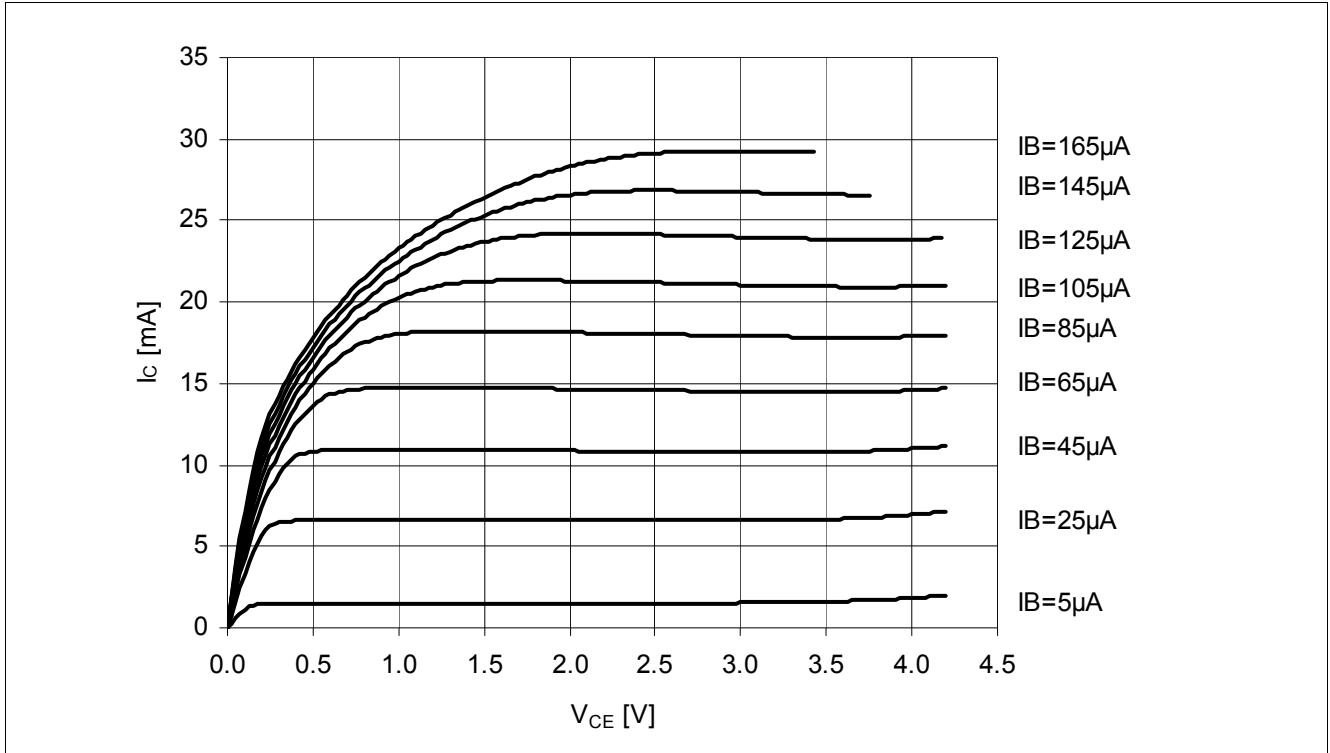


Figure 3 Collector Current vs. Collector Emitter Voltage  $I_C = f(V_{CE})$ ,  $I_B = \text{Parameter}$

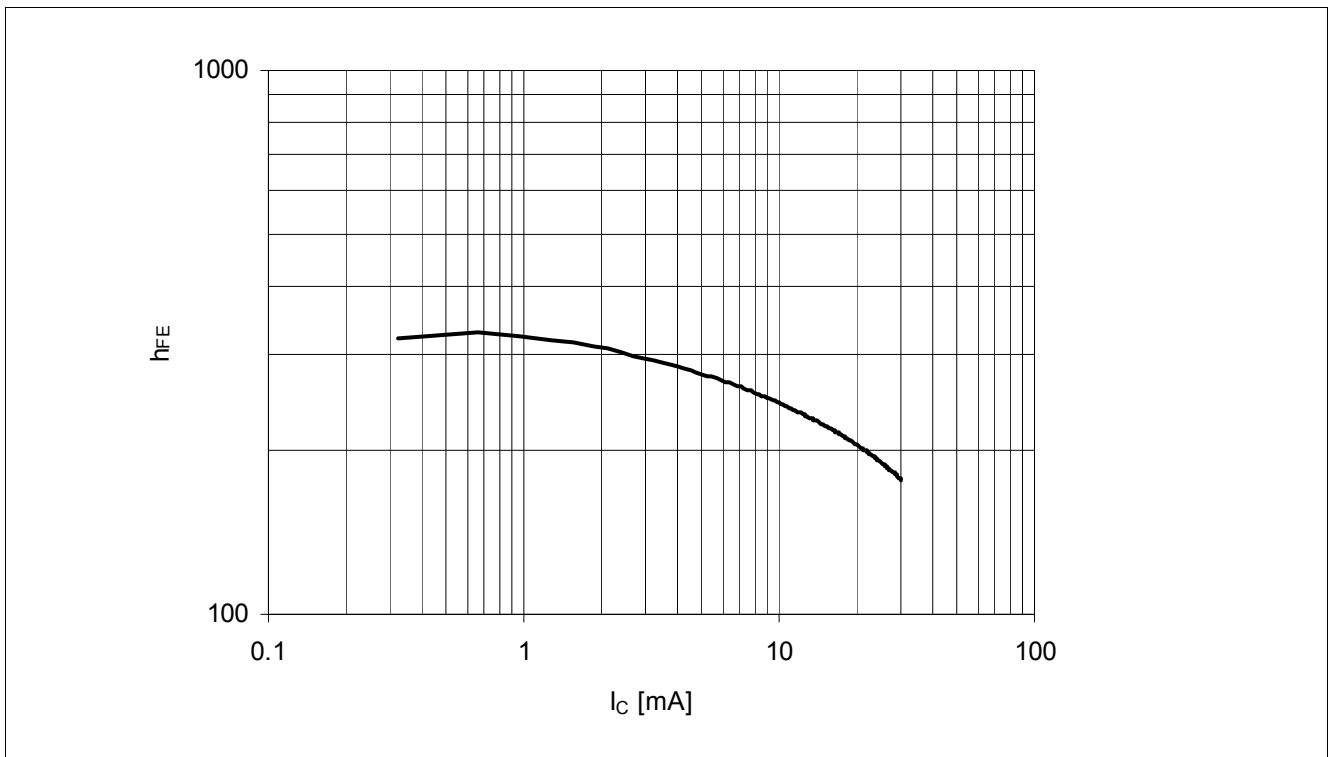


Figure 4 DC Current Gain  $h_{FE} = f(I_C)$ ,  $V_{CE} = 3 \text{ V}$

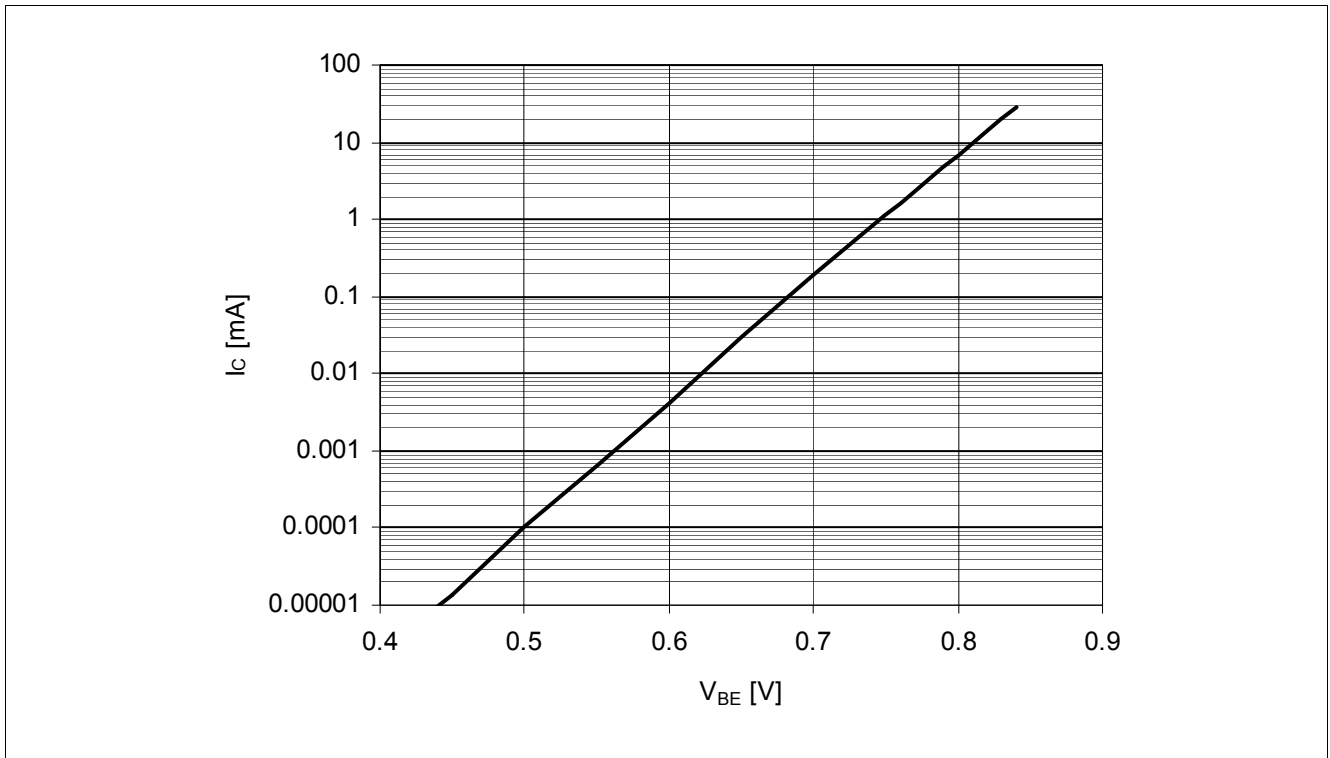


Figure 5 Collector Current vs. Base Emitter Voltage  $I_C = f(V_{BE})$ ,  $V_{CE} = 2\text{ V}$

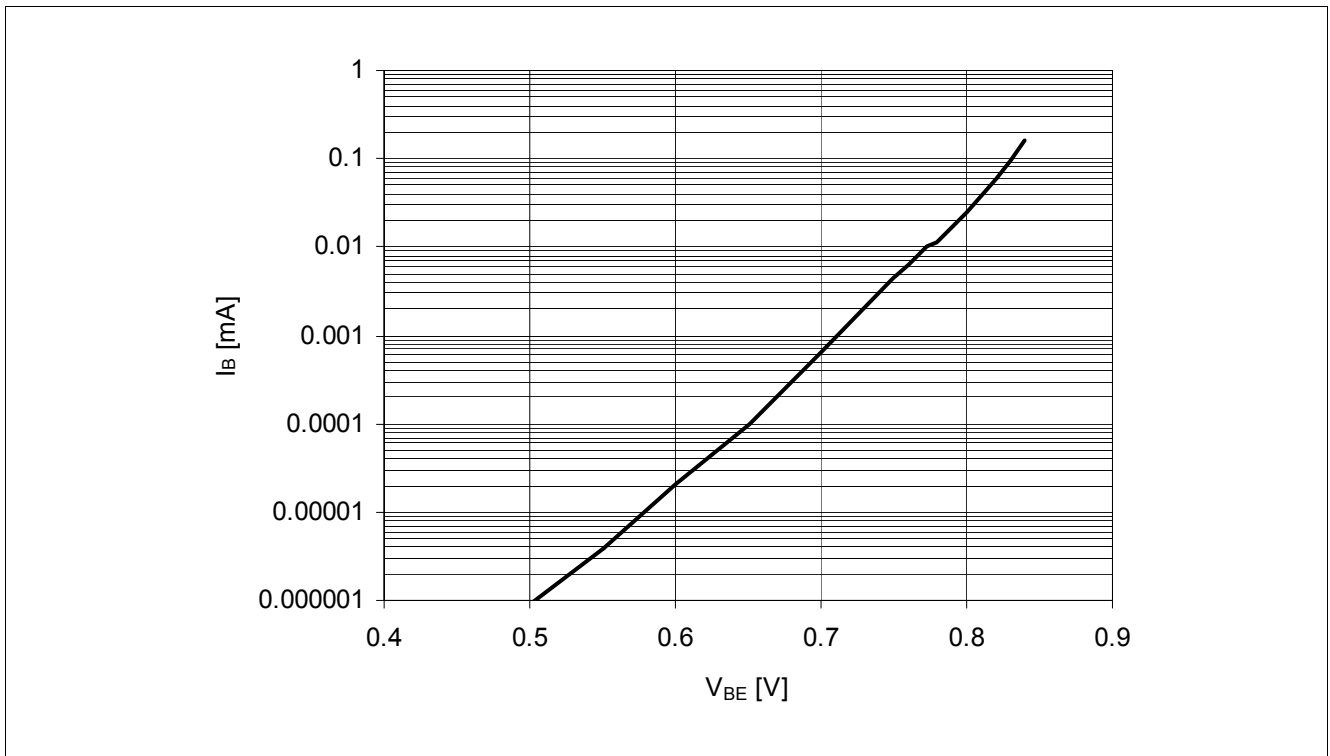


Figure 6 Base Current vs. Base Emitter Forward Voltage  $I_B = f(V_{BE})$ ,  $V_{CE} = 2\text{ V}$

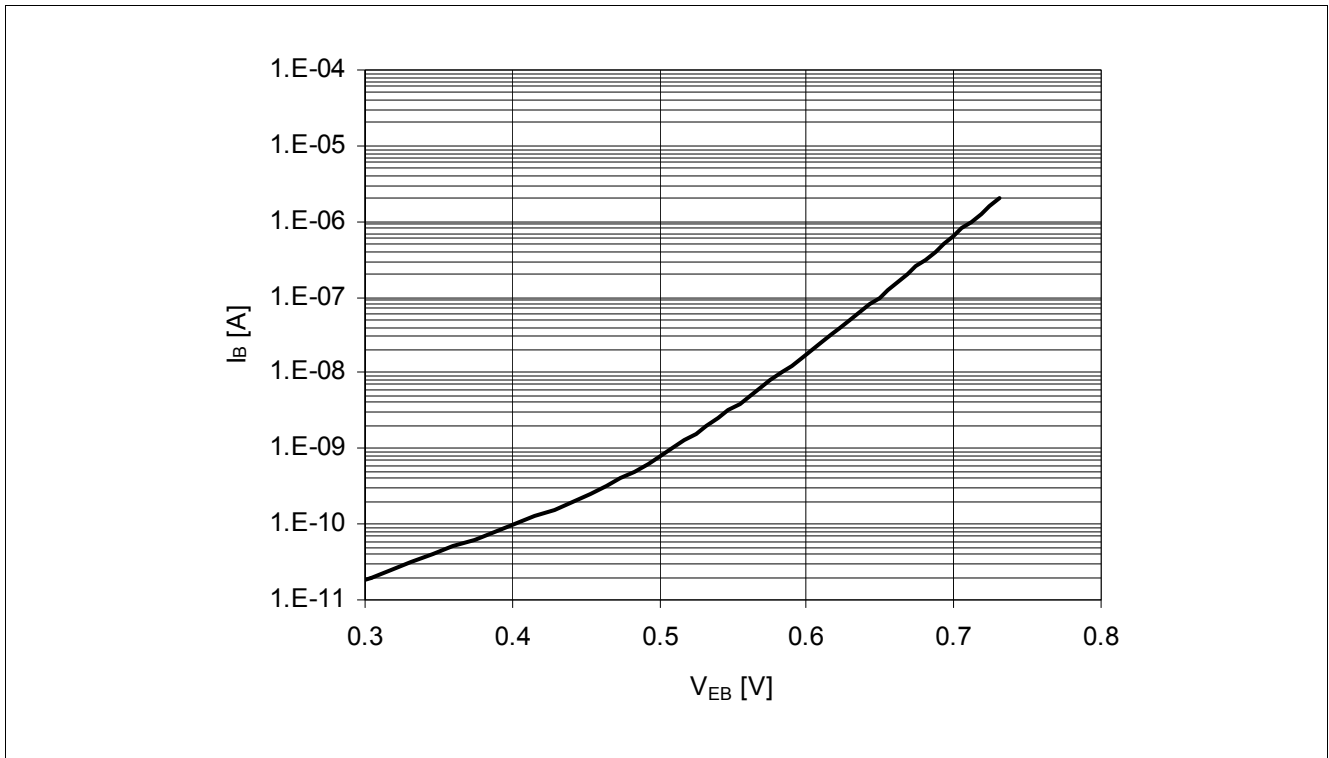


Figure 7 Base Current vs. Base Emitter Reverse Voltage  $I_B = f(V_{EB})$ ,  $V_{CE} = 2\text{ V}$

5.5 Characteristic AC Diagrams

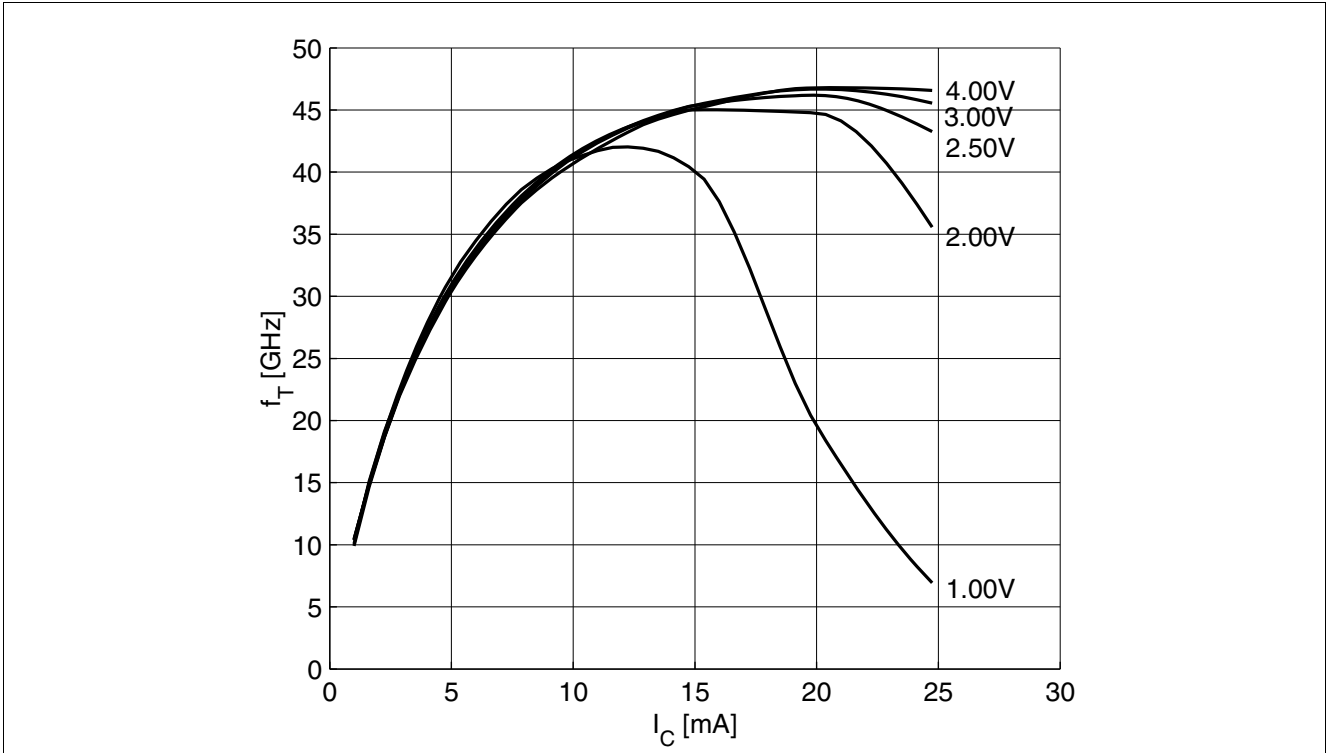


Figure 8 Transition Frequency  $f_T = f(I_C)$ ,  $f = 1 \text{ GHz}$ ,  $V_{CE} = \text{Parameter}$

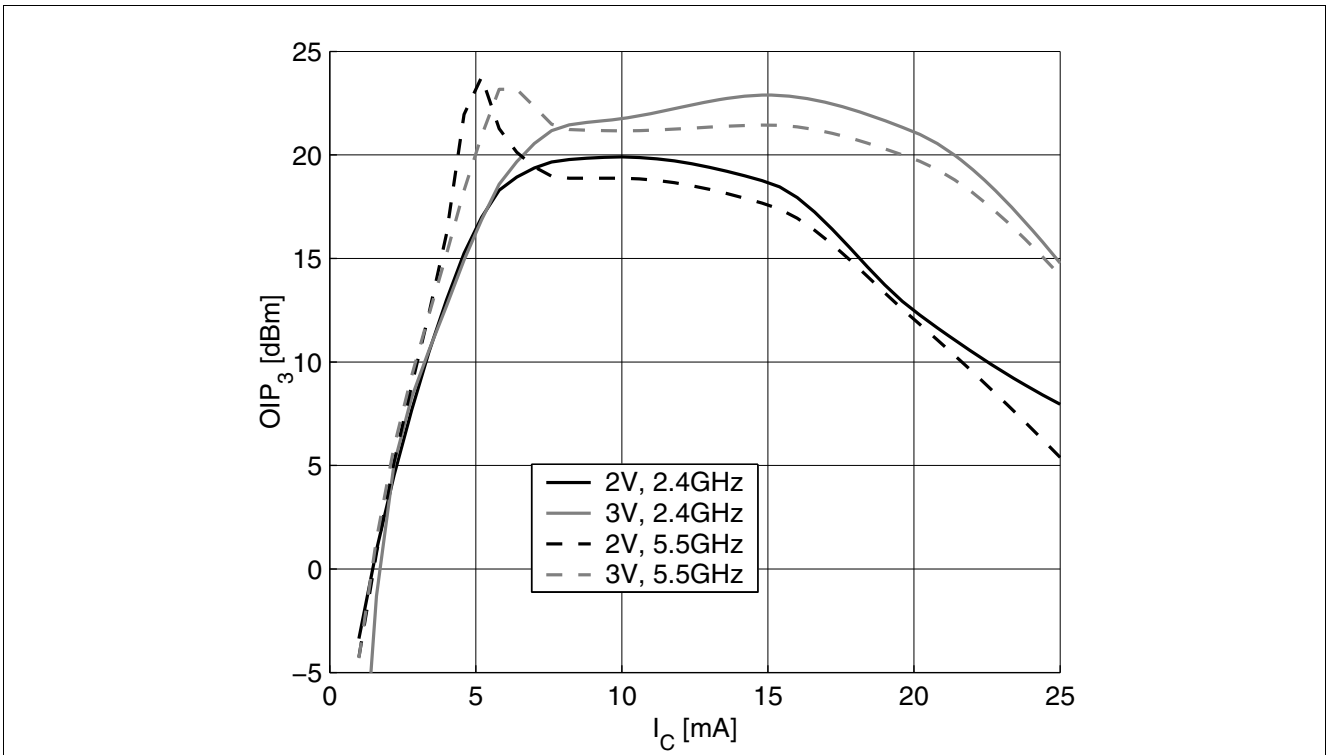


Figure 9 3rd Order Intercept Point  $OIP_3 = f(I_C)$ ,  $Z_S = Z_L = 50 \Omega$ ,  $V_{CE}, f = \text{Parameters}$

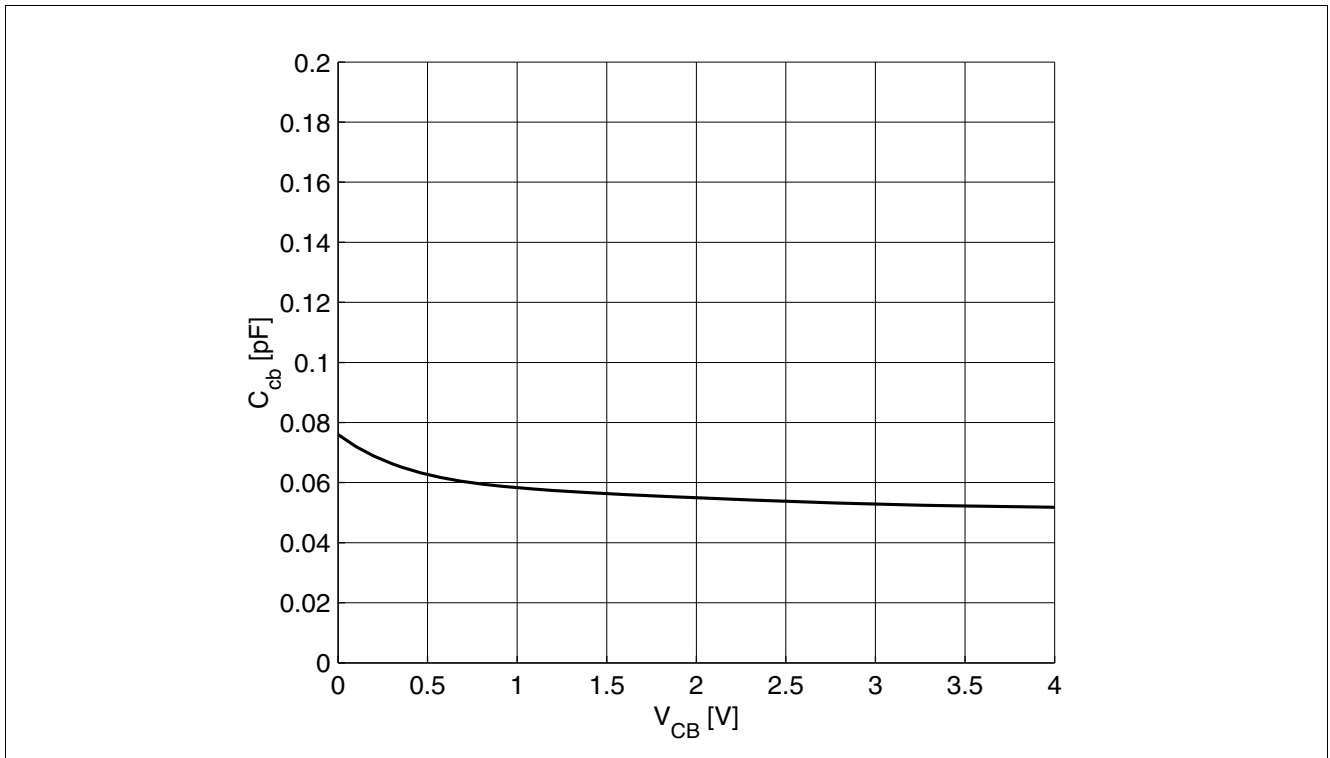


Figure 10 Collector Base Capacitance  $C_{CB} = f(V_{CB})$ ,  $f = 1$  MHz

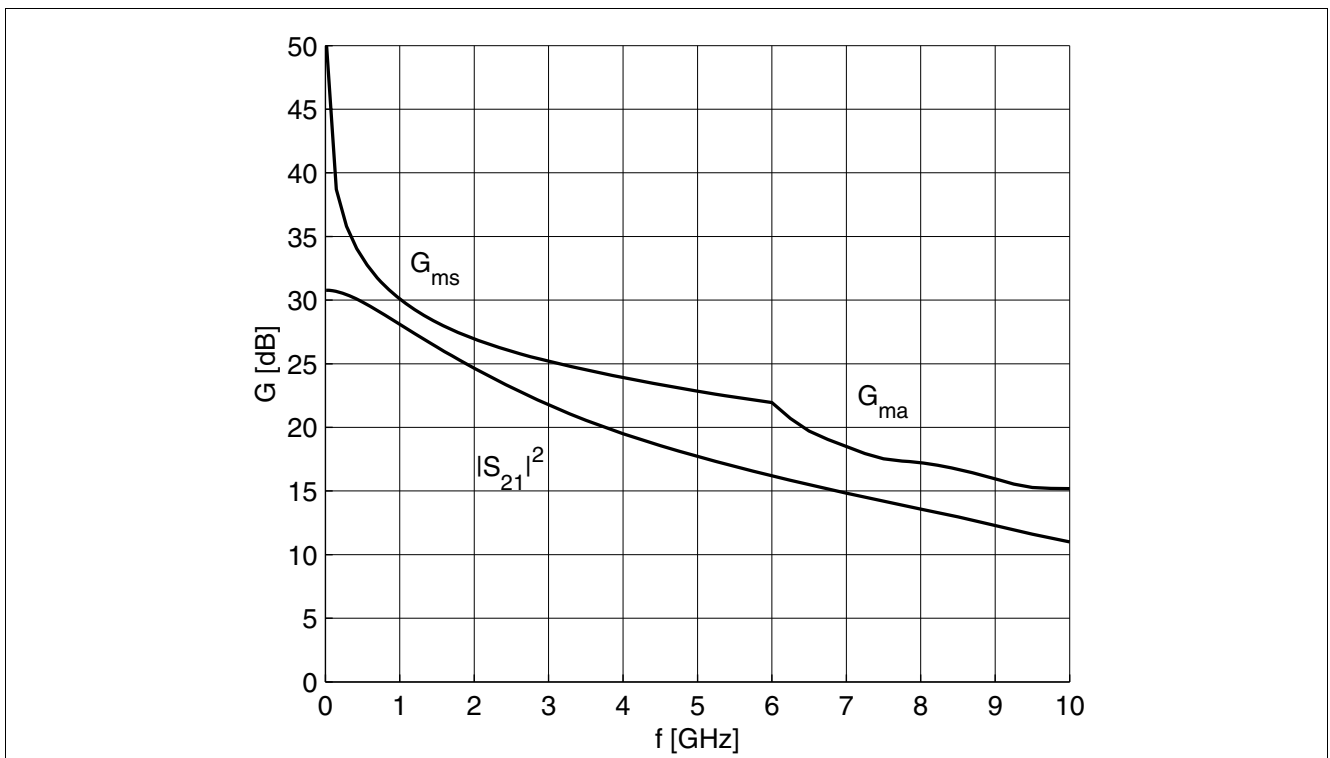


Figure 11 Gain  $G_{ma}$ ,  $G_{ms}$ ,  $|S_{21}|^2 = f(f)$ ,  $V_{CE} = 3$  V,  $I_C = 15$  mA



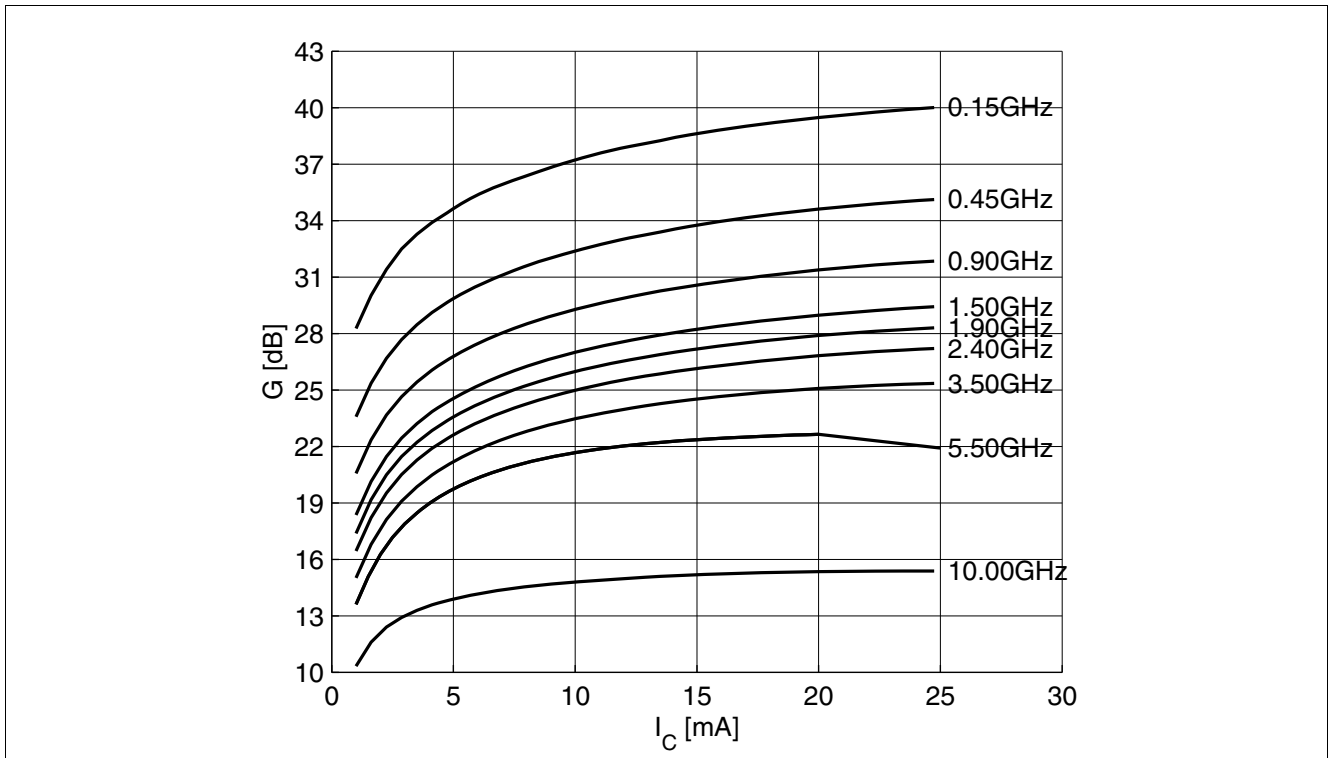


Figure 12 Maximum Power Gain  $G_{\max} = f(I_C)$ ,  $V_{CE} = 3\text{ V}$ ,  $f = \text{Parameter in GHz}$

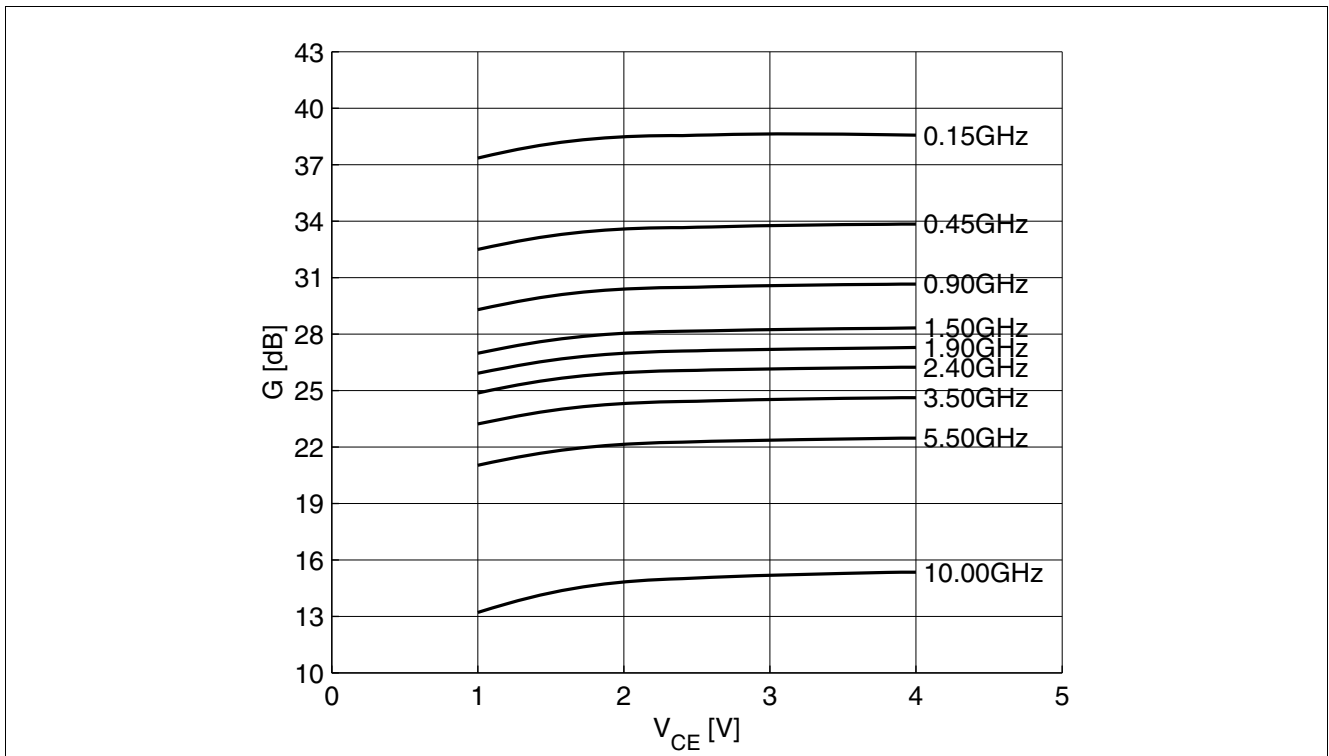


Figure 13 Maximum Power Gain  $G_{\max} = f(V_{CE})$ ,  $I_C = 15\text{ mA}$ ,  $f = \text{Parameter in GHz}$

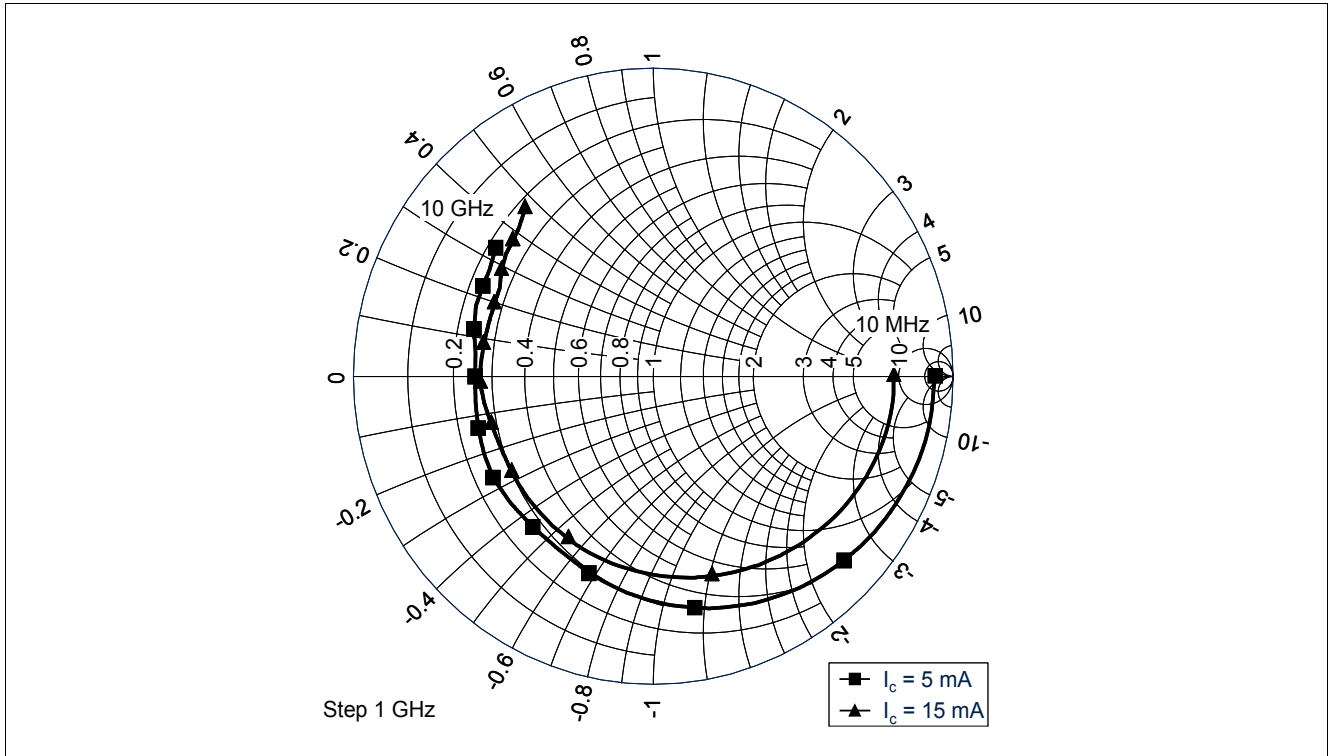


Figure 14 Input Matching  $S_{11} = f(f)$ ,  $V_{CE} = 3\text{ V}$ ,  $I_C = 5 / 15\text{ mA}$

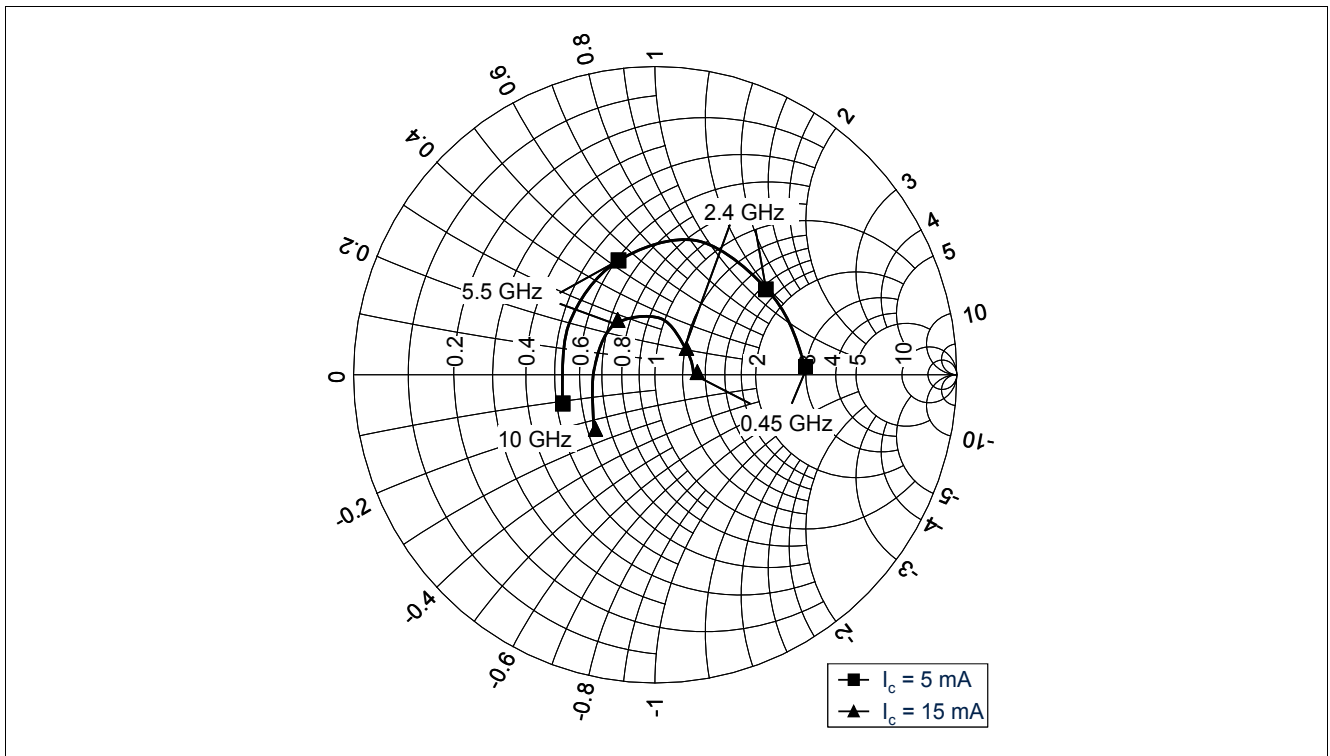


Figure 15 Source Impedance for Minimum Noise Figure  $Z_{opt} = f(f)$ ,  $V_{CE} = 3\text{ V}$ ,  $I_C = 5 / 15\text{ mA}$

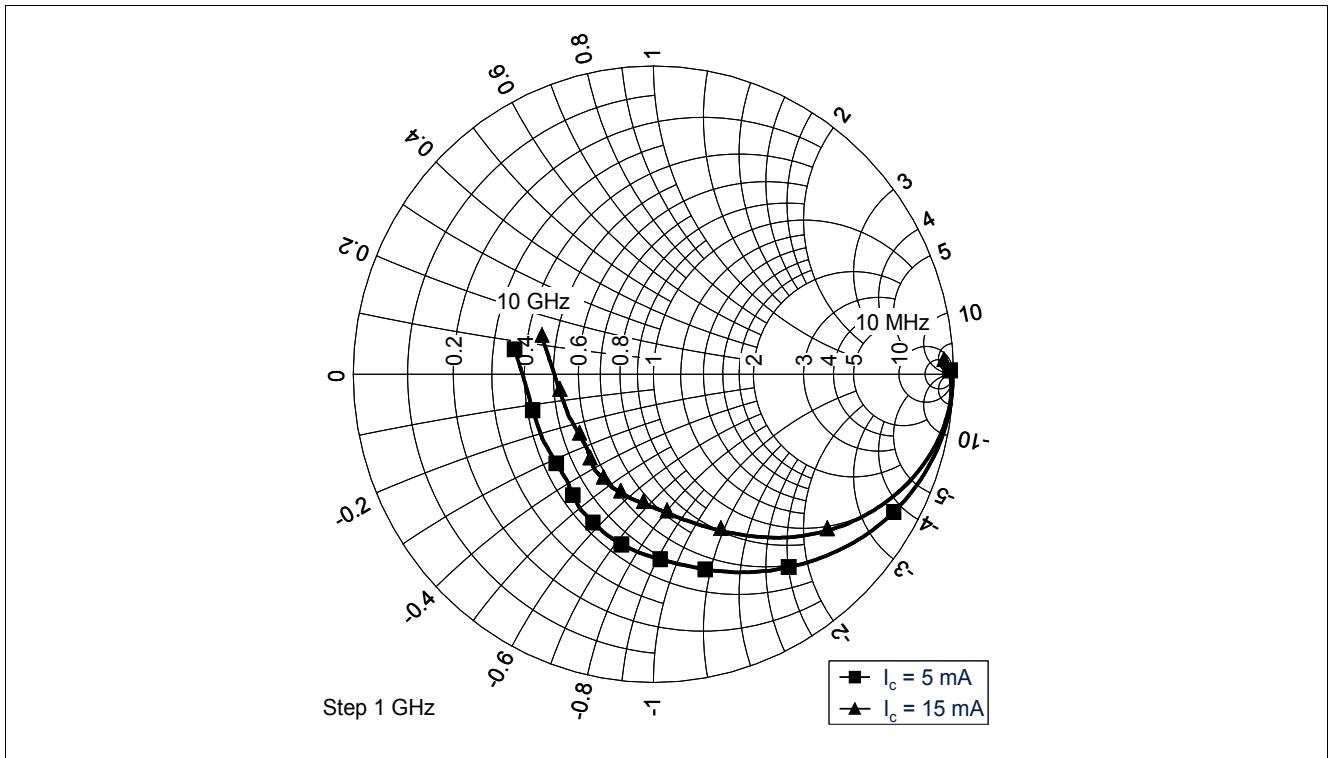


Figure 16 Output Matching  $S_{22} = f(f)$ ,  $V_{CE} = 3 \text{ V}$ ,  $I_C = 5 / 15 \text{ mA}$

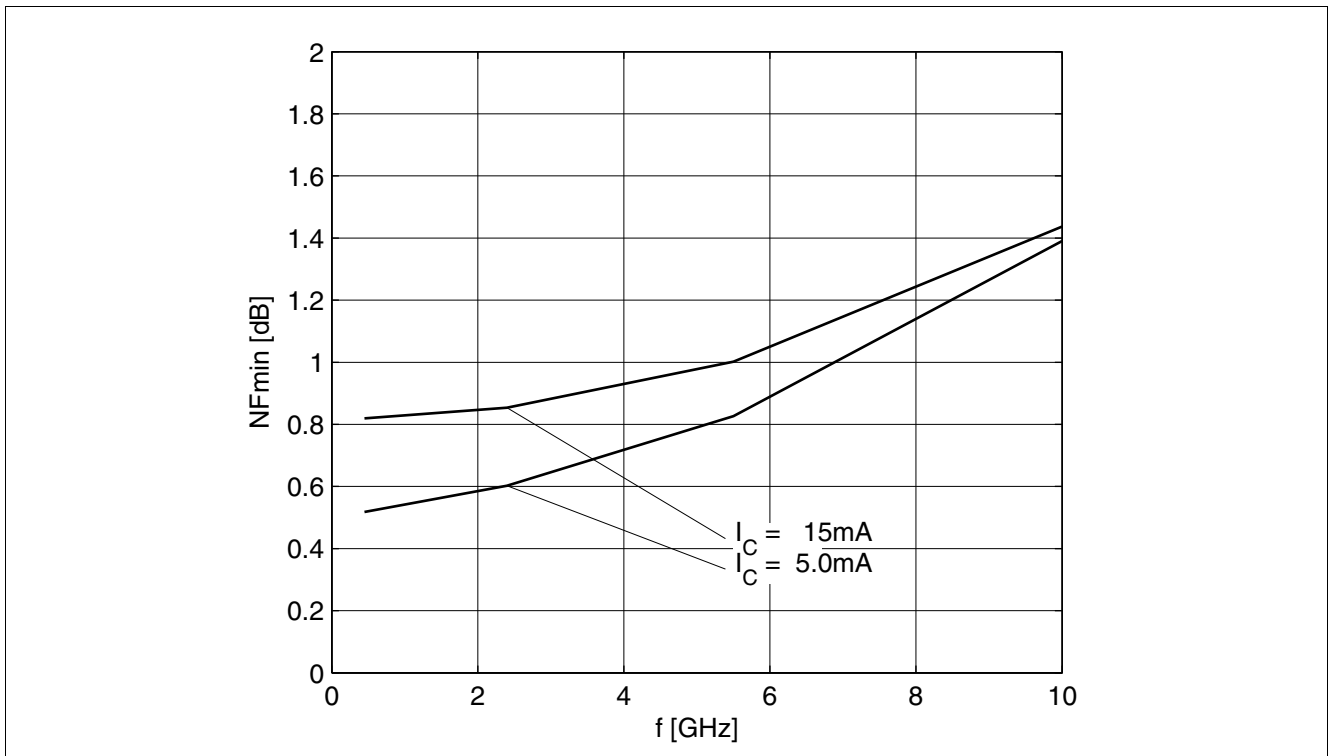


Figure 17 Noise Figure  $NF_{min} = f(f)$ ,  $V_{CE} = 3 \text{ V}$ ,  $I_C = 5 / 15 \text{ mA}$ ,  $Z_S = Z_{opt}$

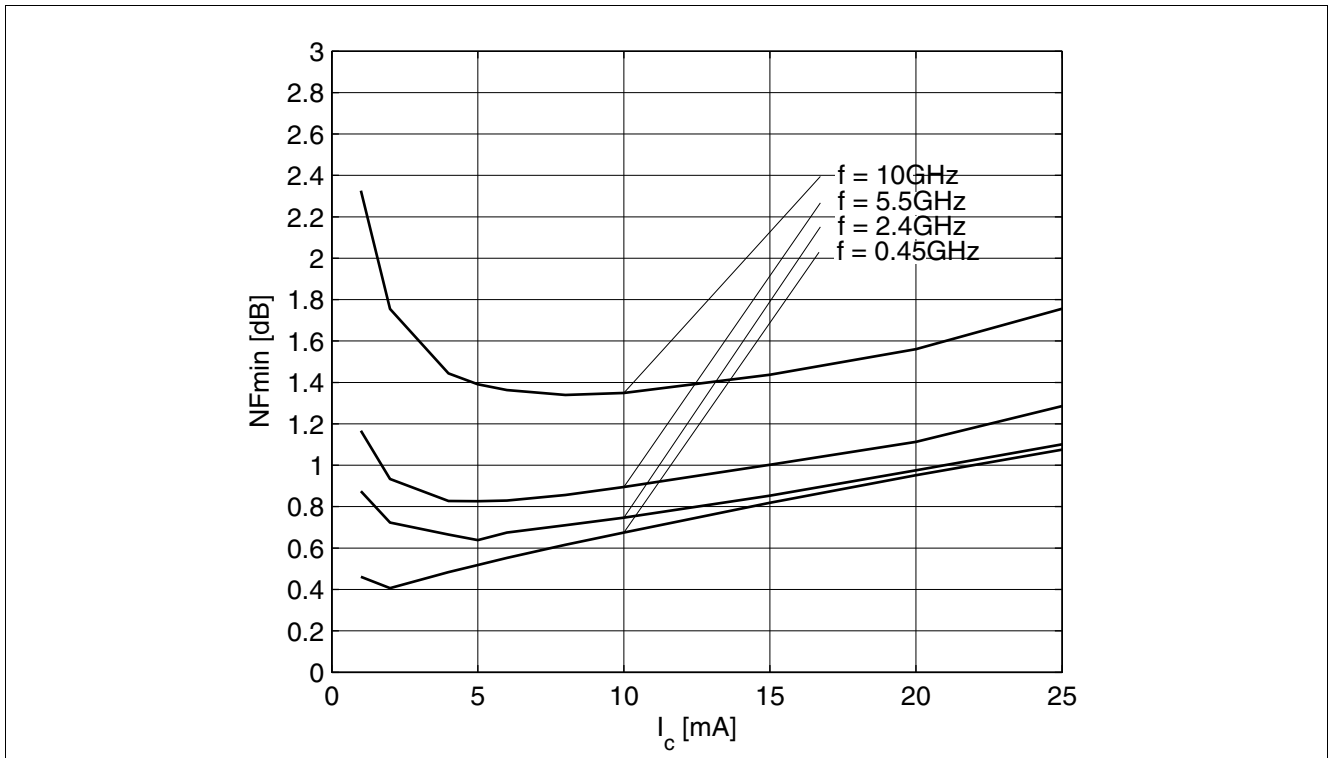


Figure 18 Noise Figure  $NF_{min} = f(I_C)$ ,  $V_{CE} = 3\text{ V}$ ,  $Z_S = Z_{opt}$ ,  $f = \text{Parameter in GHz}$

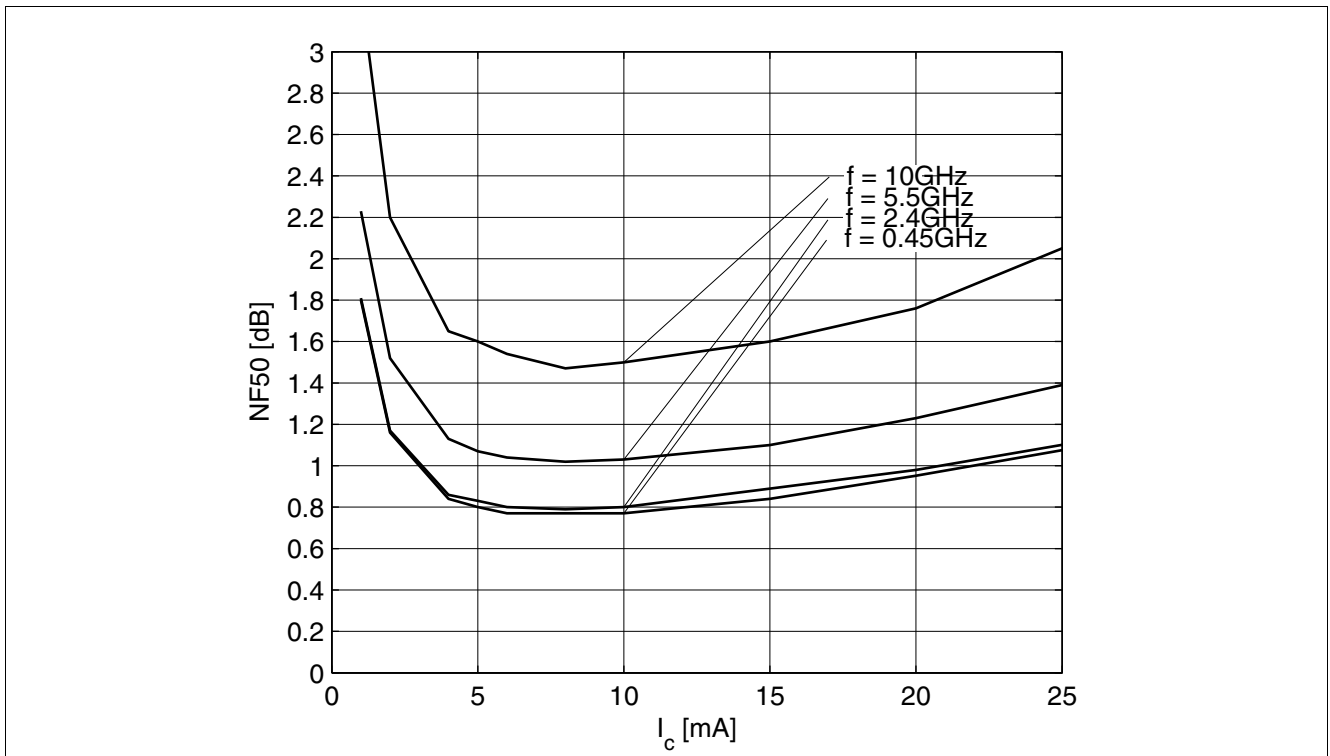


Figure 19 Noise Figure  $NF_{50} = f(I_C)$ ,  $V_{CE} = 3\text{ V}$ ,  $Z_S = 50\ \Omega$ ,  $f = \text{Parameter in GHz}$

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

## 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](http://www.infineon.com/rf.models). Please consult our website and download the latest versions before actually starting your design.

You find the BFP720FESD 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 BFP720FESD 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 TSFP-4-1

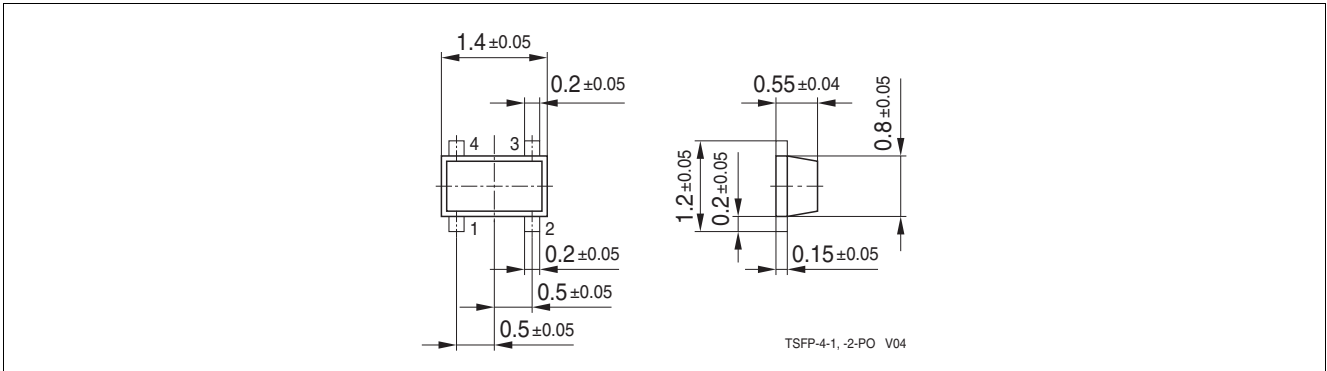


Figure 20 Package Outline

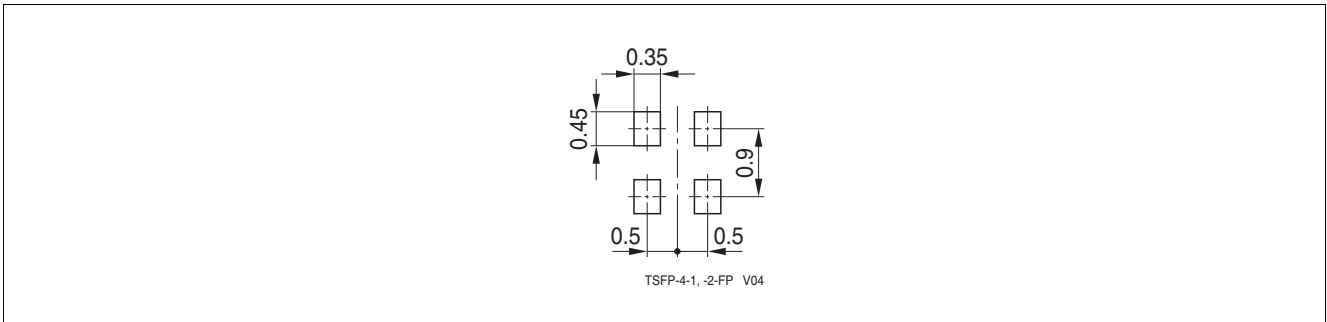


Figure 21 Package Foot Print

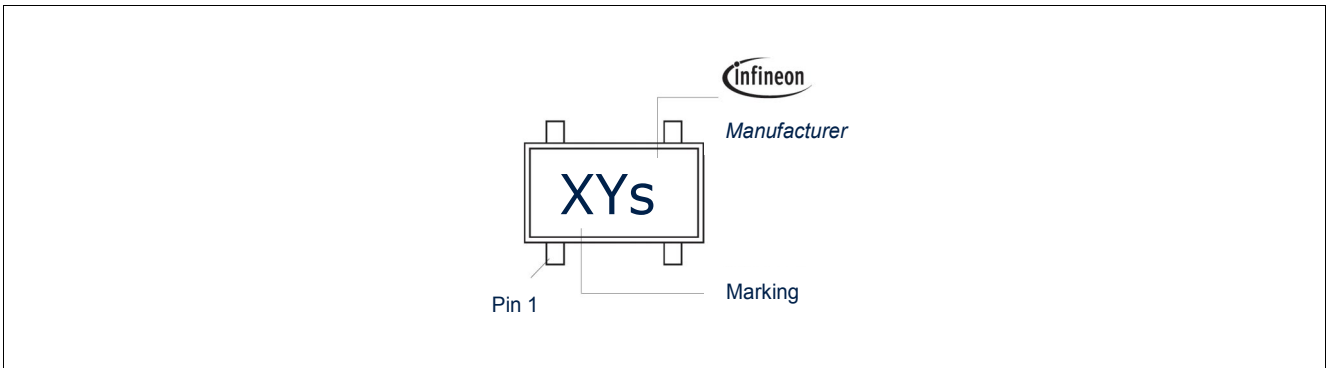


Figure 22 Marking Description (Marking BFP720FESD: T3s)

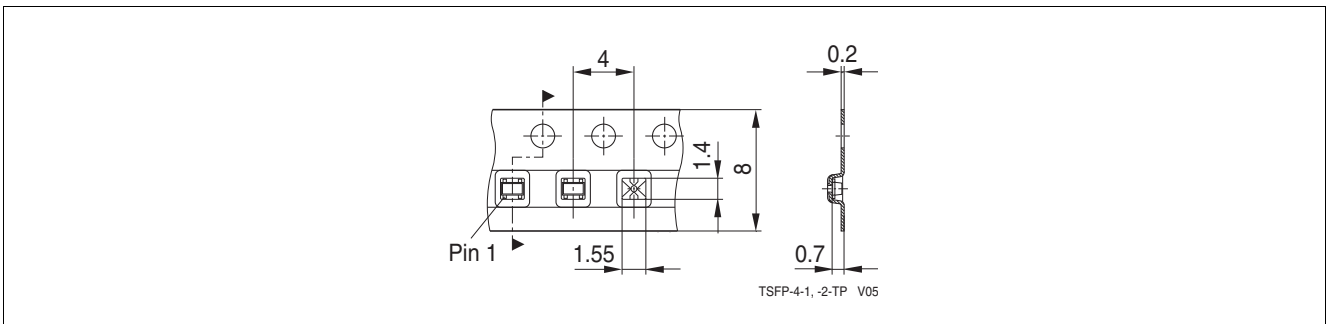


Figure 23 Tape Dimensions

[www.infineon.com](http://www.infineon.com)

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