

BFP720ESD

SiGe:C NPN RF bipolar transistor

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Product description

The BFP720ESD is a wideband RF heterojunction bipolar transistor (HBT) with an integrated ESD protection.



Feature list

- Unique combination of high end RF performance and robustness: 21 dBm maximum RF input power, 2 kV HBM ESD hardness
- Low noise figure $NF_{min} = 0.65$ dB at 2.4 GHz and 0.9 dB at 5.5 GHz, 3 V, 5 mA
- High gain $G_{ms} = 26$ dB at 2.4 GHz and $G_{ma} = 19.5$ dB at 5.5 GHz, 3 V, 15 mA
- $OIP_3 = 22$ dBm at 5.5 GHz, 3 V and low current consumption of 15 mA

Product validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

Potential applications

- Wireless communications: WLAN, WiMax and UWB
- Satellite communication systems: GNSS navigation systems (GPS, GLONASS, BeiDou, Galileo), satellite radio (SDARs, DAB) and C-band LNB
- Multimedia applications such as portable TV, CATV and FM radio
- ISM applications like RKE, AMR and Zigbee, as well as for emerging wireless applications

Device information

Table 1 Part information

| Product name / Ordering code | Package | Pin configuration | | | | Marking | Pieces / Reel |
|------------------------------------|---------|-------------------|-------|-------|-------|---------|---------------|
| BFP720ESD / BFP720ESDH6327XTSA1 | SOT343 | 1 = B | 2 = E | 3 = C | 4 = E | T3s | 3000 |

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

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Absolute maximum ratings

1 Absolute maximum ratings

Table 2 Absolute maximum ratings at $T_A = 25\text{ °C}$ (unless otherwise specified)

| Parameter | Symbol | Values | | Unit | Note or test condition |
|---|------------|--------|------|------|--|
| | | Min. | Max. | | |
| Collector emitter voltage | V_{CEO} | - | 4.2 | V | Open base |
| | | | 3.7 | | $T_A = -55\text{ °C}$, open base |
| Collector base voltage ¹⁾ | V_{CBO} | | 4.9 | | Open emitter |
| | | | 4.4 | | $T_A = -55\text{ °C}$, open emitter |
| Collector emitter voltage ²⁾ | V_{CES} | | 4.2 | | E-B short circuited |
| | | | 3.7 | | $T_A = -55\text{ °C}$, E-B short circuited |
| Base current | I_B | -10 | 3 | mA | - |
| Collector current | I_C | - | 30 | | |
| RF input power | P_{RFIn} | - | 21 | dBm | |
| ESD stress pulse | V_{ESD} | -2 | 2 | kV | HBM, all pins, acc. to JESD22-A114 |
| Total power dissipation ³⁾ | P_{tot} | - | 100 | mW | $T_S \leq 108\text{ °C}$ |
| Junction temperature | T_J | - | 150 | °C | - |
| Storage temperature | T_{Stg} | -55 | | | |

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. Exceeding only one of these values may cause irreversible damage to the integrated circuit.

¹ V_{CBO} is similar to V_{CEO} due to design.

² V_{CES} is identical 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.

Thermal characteristics

2 Thermal characteristics

Table 3 Thermal resistance

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|----------------------------|------------|--------|------|------|------|------------------------|
| | | Min. | Typ. | Max. | | |
| Junction - soldering point | R_{thJS} | - | 415 | - | K/W | - |

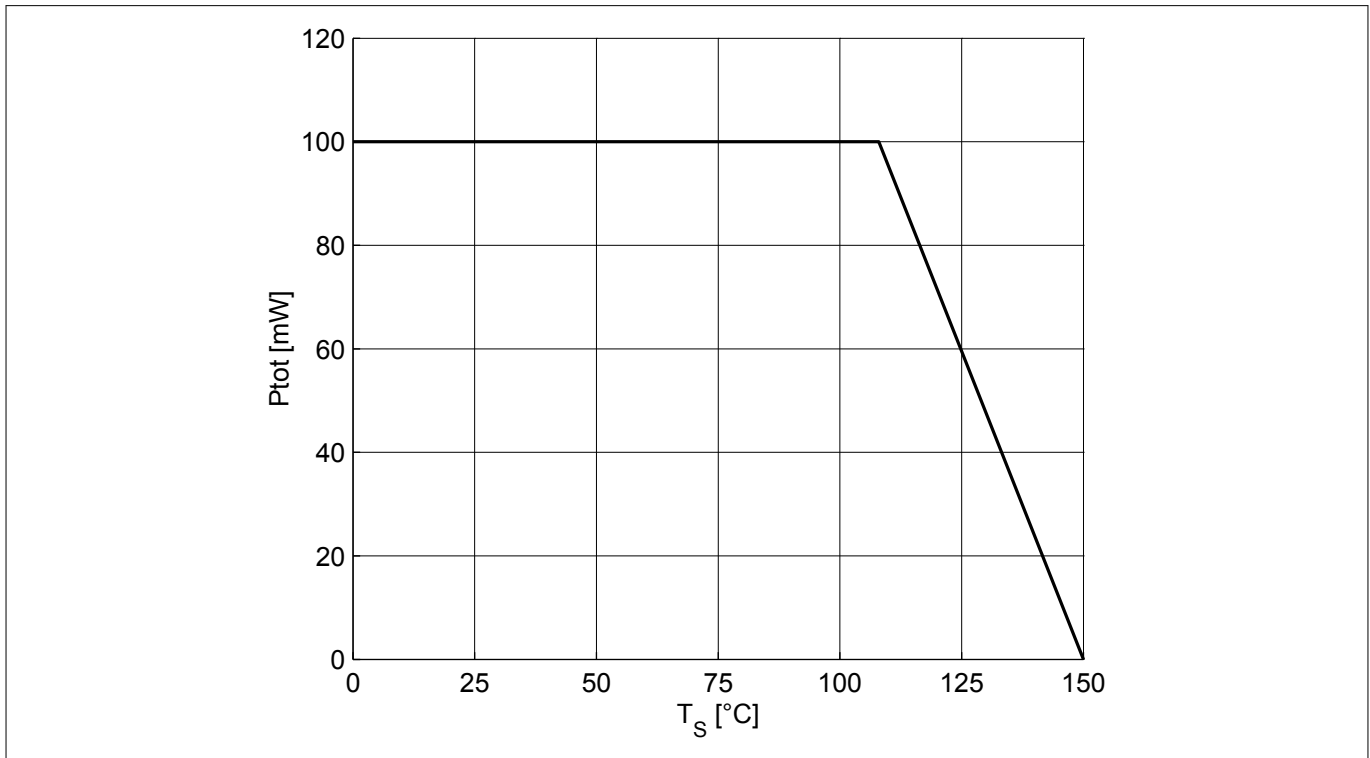


Figure 1 Total power dissipation $P_{tot} = f(T_s)$

Electrical characteristics

3 Electrical characteristics

3.1 DC characteristics

Table 4 DC characteristics at $T_A = 25\text{ °C}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|-------------------------------------|---------------|--------|------|-------------------|---------------|--|
| | | Min. | Typ. | Max. | | |
| Collector emitter breakdown voltage | $V_{(BR)CEO}$ | 4.2 | 4.7 | – | V | $I_C = 1\text{ mA}$, $I_B = 0$, open base |
| Collector emitter leakage current | I_{CES} | – | – | 400 ¹⁾ | nA | $V_{CE} = 2\text{ V}$, $V_{BE} = 0$, E-B short circuited |
| Collector base leakage current | I_{CBO} | | | 400 ¹⁾ | | $V_{CB} = 2\text{ V}$, $I_E = 0$, open emitter |
| Emitter base leakage current | I_{EBO} | | | 10 ¹⁾ | μA | $V_{EB} = 0.5\text{ V}$, $I_C = 0$, open collector |
| DC current gain | h_{FE} | 160 | 250 | 400 | | $V_{CE} = 3\text{ V}$, $I_C = 15\text{ mA}$, pulse measured |

3.2 General AC characteristics

Table 5 General AC characteristics at $T_A = 25\text{ °C}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|-------------------------------|----------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Transition frequency | f_T | – | 43 | – | GHz | $V_{CE} = 3\text{ V}$, $I_C = 15\text{ mA}$, $f = 1\text{ GHz}$ |
| Collector base capacitance | C_{CB} | | 0.05 | | pF | $V_{CB} = 3\text{ V}$, $V_{BE} = 0$, $f = 1\text{ MHz}$, emitter grounded |
| Collector emitter capacitance | C_{CE} | | 0.4 | | | $V_{CE} = 3\text{ V}$, $V_{BE} = 0$, $f = 1\text{ MHz}$, base grounded |
| Emitter base capacitance | C_{EB} | | 0.45 | | | $V_{EB} = 0.4\text{ V}$, $V_{CB} = 0$, $f = 1\text{ MHz}$, collector grounded |

¹ Maximum values not limited by the device but by the short cycle time of the 100% test

Electrical characteristics

3.3 Frequency dependent AC characteristics

Measurement setup is a test fixture with Bias-T's in a 50 Ω system, $T_A = 25\text{ °C}$.

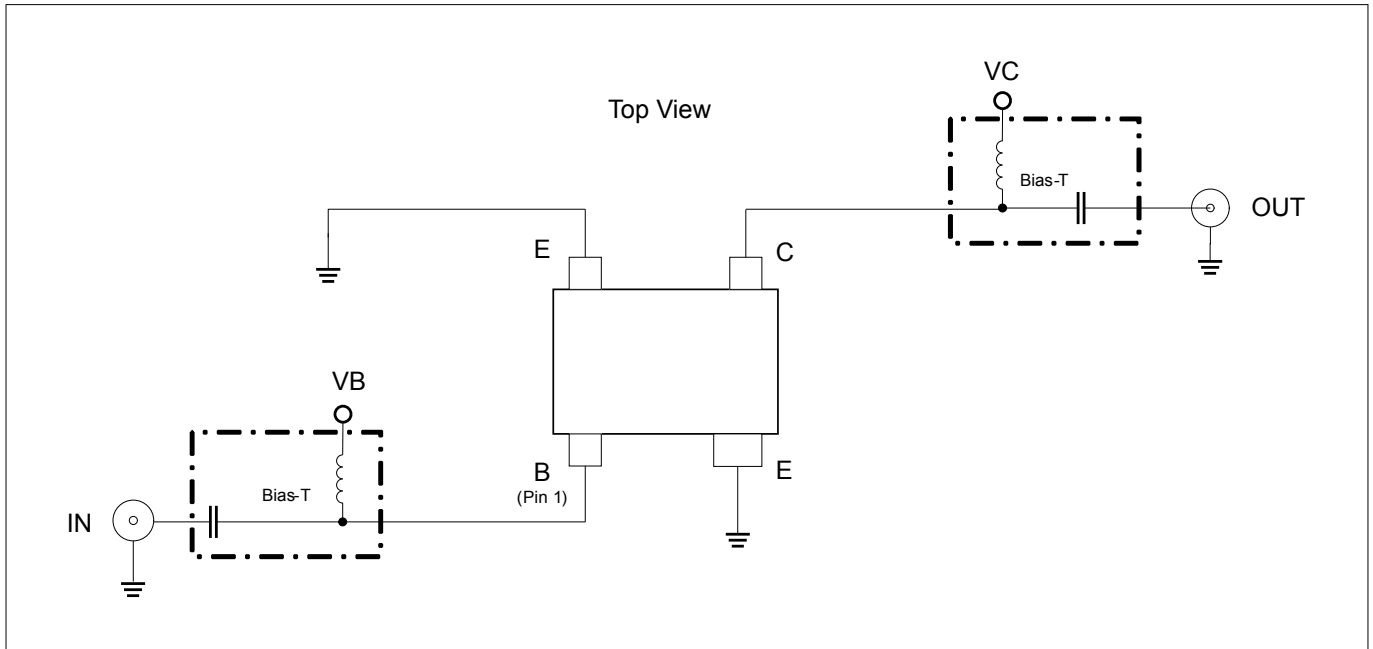


Figure 2 Testing circuit

Table 6 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 150\text{ MHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 38.5 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 30.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.55 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 30.5 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 21.5 | – | dBm | $Z_S = Z_L = 50\text{ }\Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 6.5 | | | |

Electrical characteristics

Table 7 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 450\text{ MHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 33.5 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 30 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.55 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 29 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 21.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 6.5 | | | |

Table 8 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 900\text{ MHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 30.5 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 28 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.6 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 27 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 21.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 6 | | | |

Table 9 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 1.5\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 28 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 26 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.6 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 24.5 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 21.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 6 | | | |

Electrical characteristics

Table 10 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 1.9\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 27 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 24.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.6 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 23.5 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 22 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 6.5 | | | |

Table 11 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 2.4\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 26 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 23 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.65 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 21.5 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 22.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 7.5 | | | |

Table 12 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 3.5\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 24 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 20 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.75 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 18.5 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 22.5 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 7.5 | | | |

Electrical characteristics

Table 13 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 5.5\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ma} | – | 19.5 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 16 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 0.9 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 14.5 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 22 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 8 | | | |

Table 14 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 10\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | | | | | |
| • Maximum power gain | G_{ms} | – | 15.5 | – | dB | $I_C = 15\text{ mA}$ |
| • Transducer gain | $ S_{21} ^2$ | | 9.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | – | 1.55 | – | dB | $I_C = 5\text{ mA}$ |
| • Associated gain | G_{ass} | | 11 | | | |
| Linearity | | | | | | |
| • 3rd order intercept point at output | OIP_3 | – | 20 | – | dBm | $Z_S = Z_L = 50\ \Omega$, $I_C = 15\text{ mA}$ |
| • 1 dB gain compression point at output | OP_{1dB} | | 5.5 | | | |

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.

Electrical characteristics

3.4 Characteristic DC diagrams

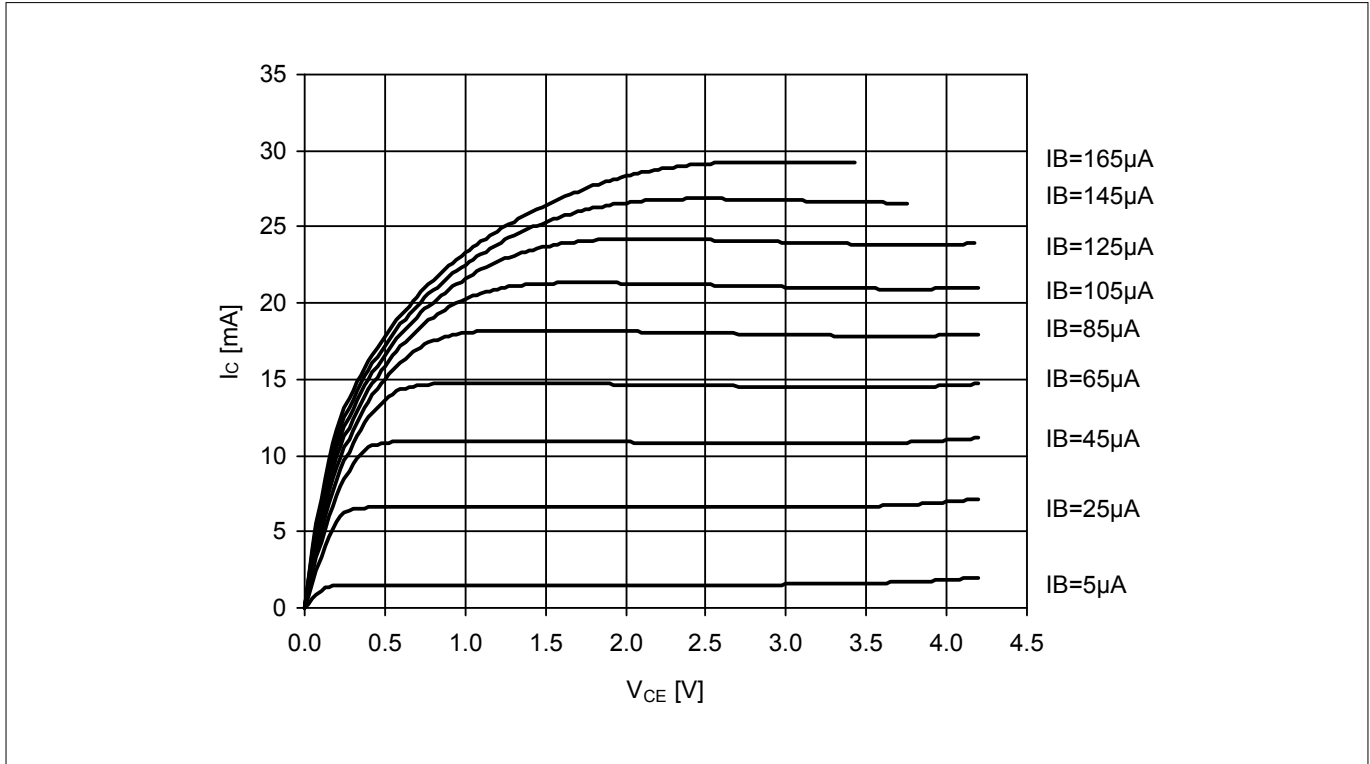


Figure 3 Collector current vs. collector emitter voltage $I_C = f(V_{CE}), I_B = \text{parameter}$

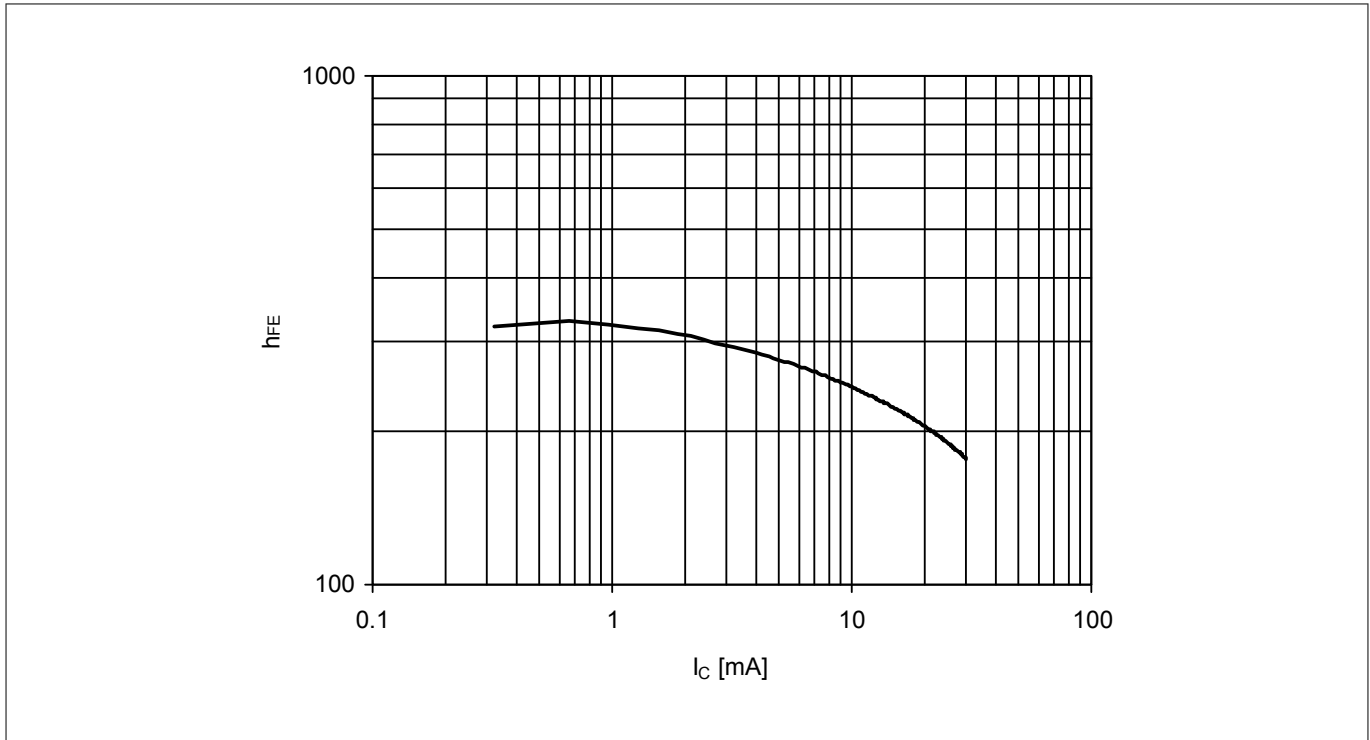


Figure 4 DC current gain $h_{FE} = f(I_C), V_{CE} = 3 \text{ V}$

Electrical characteristics

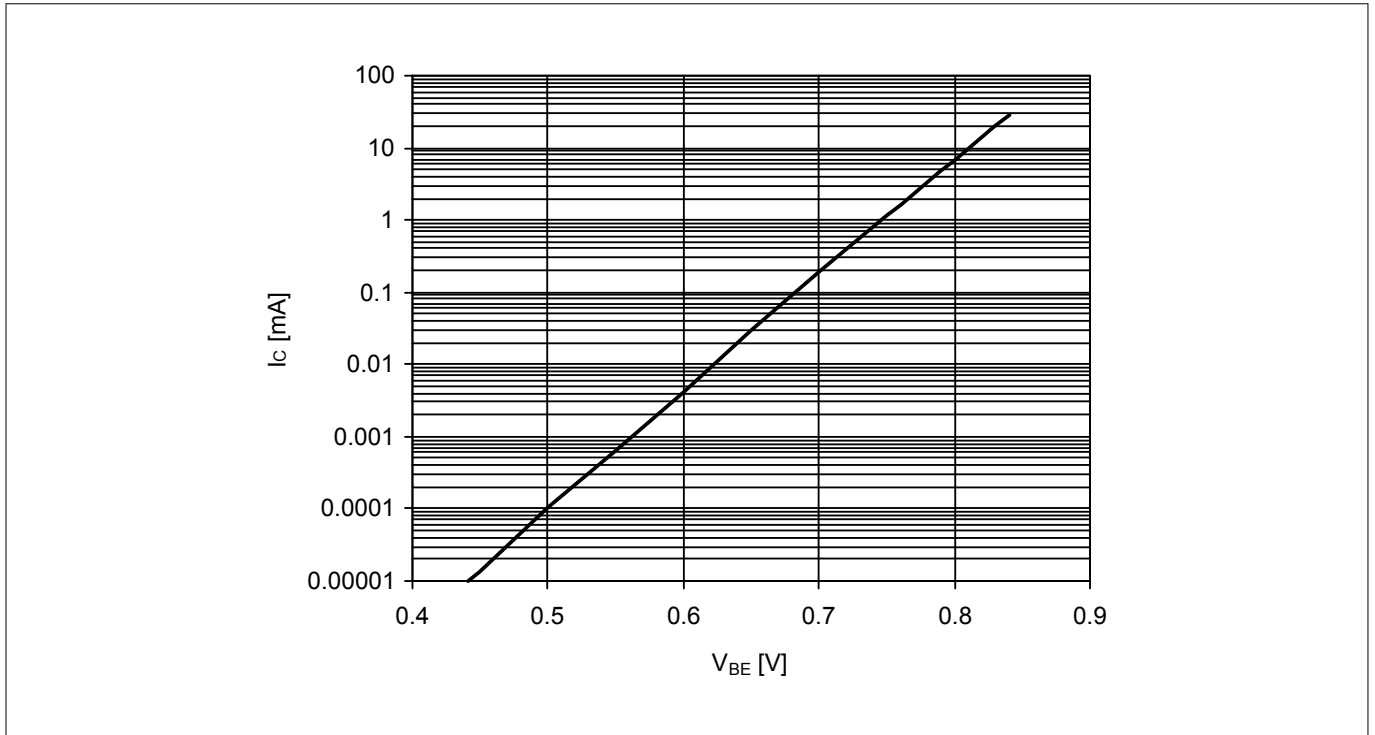


Figure 5 Collector current vs. base emitter forward voltage $I_C = f(V_{BE})$, $V_{CE} = 2\text{ V}$

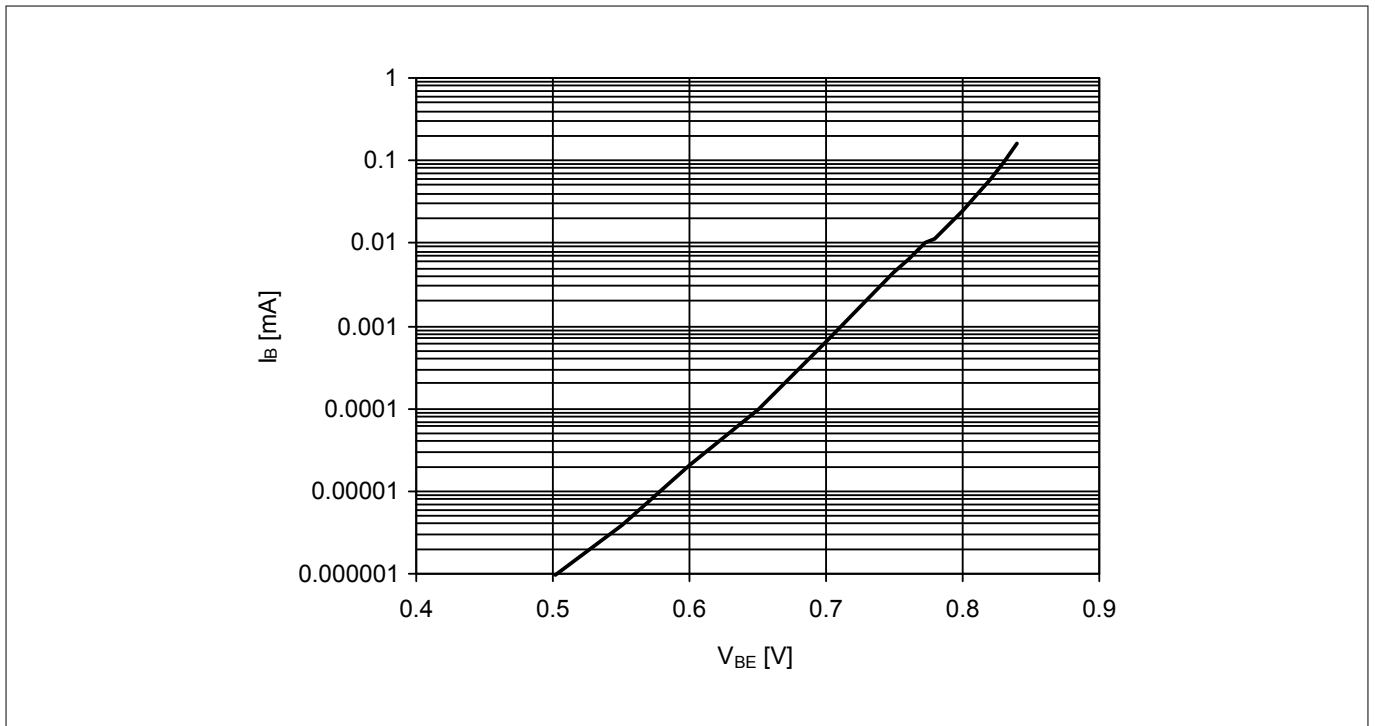


Figure 6 Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 2\text{ V}$

Electrical characteristics

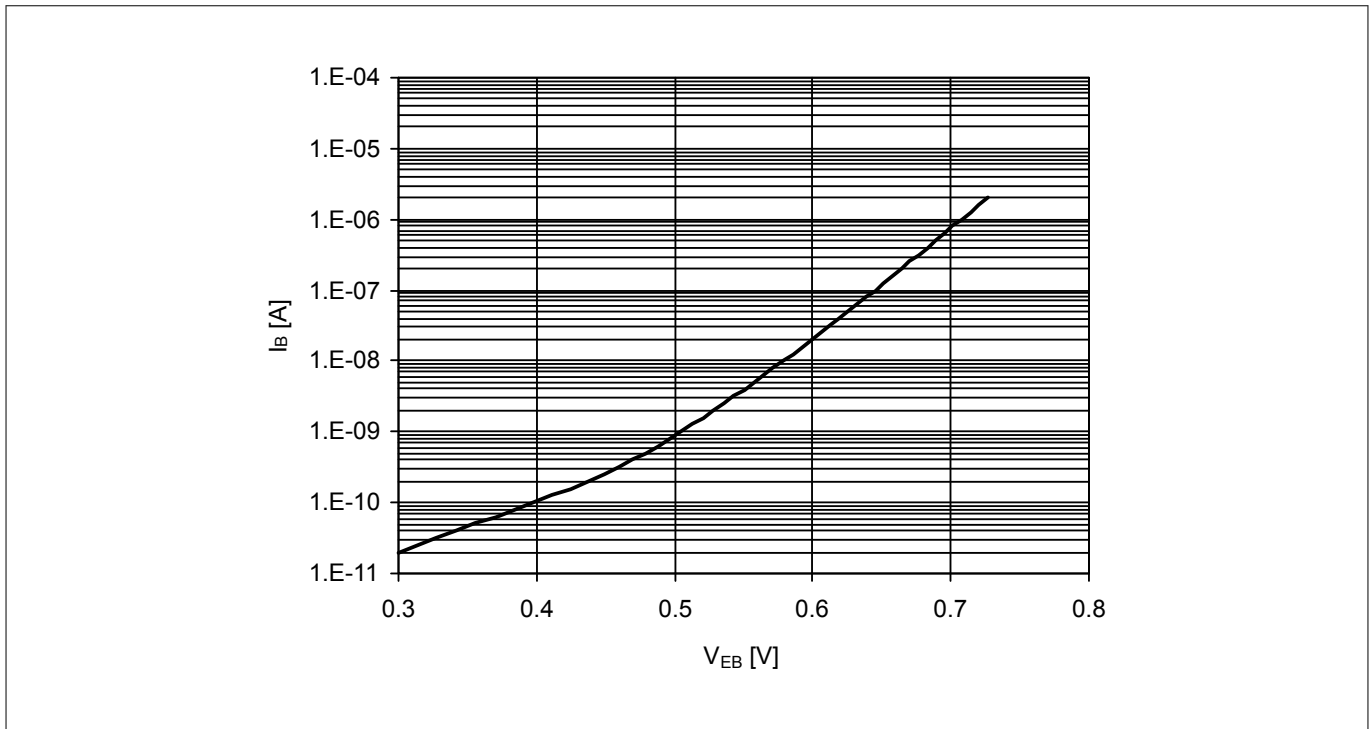


Figure 7 Base current vs. base emitter reverse voltage $I_B = f(V_{EB})$, $V_{CE} = 2\text{ V}$

Electrical characteristics

3.5 Characteristic AC diagrams

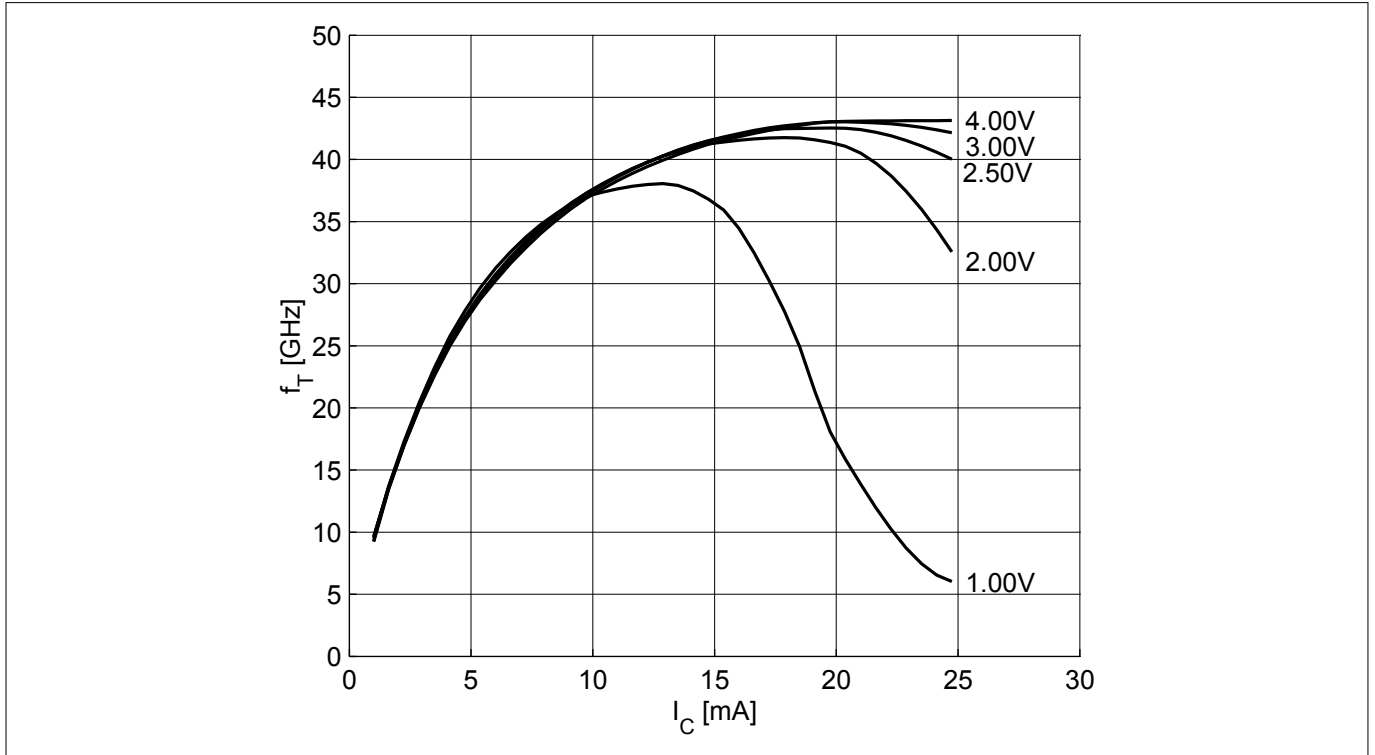


Figure 8 Transition frequency $f_T = f(I_C)$, $f = 1$ GHz, $V_{CE} =$ parameter

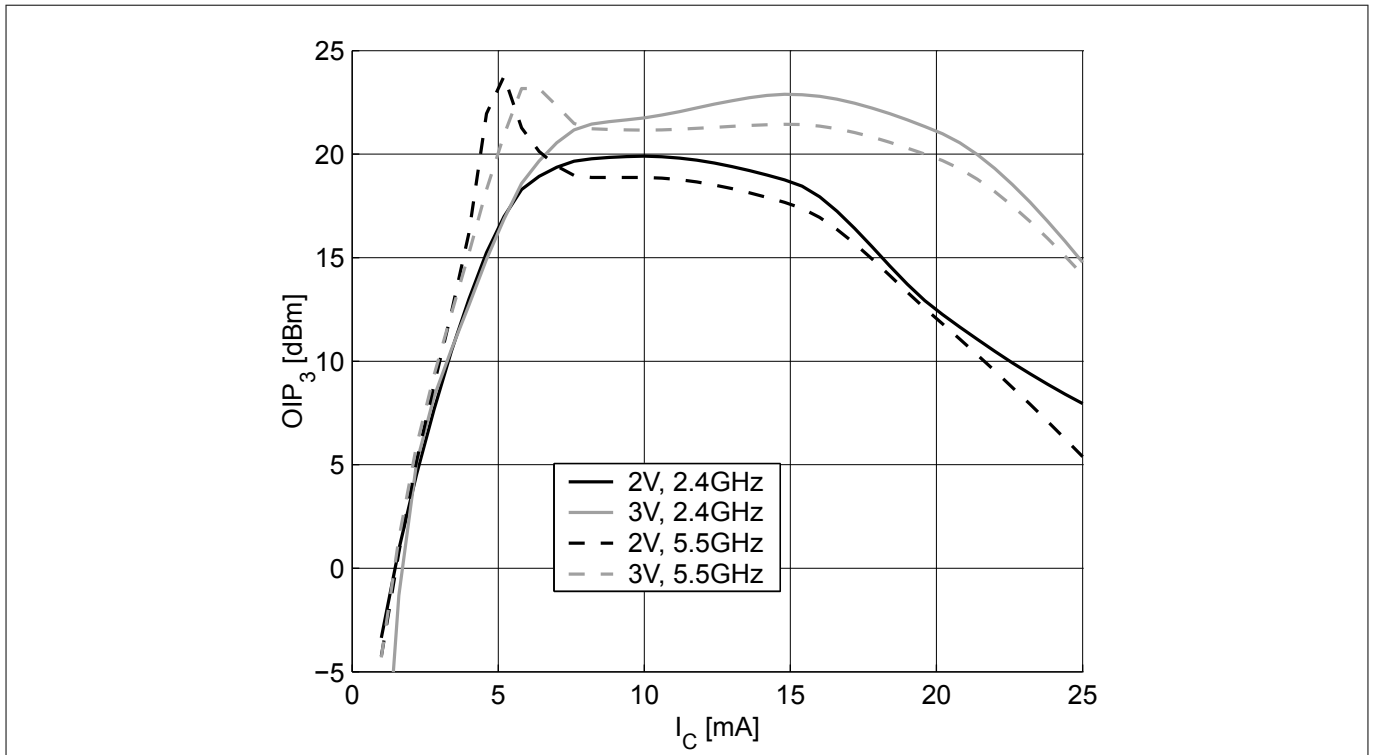


Figure 9 3rd order intercept point at output OIP_3 [dBm] = $f(I_C)$, $Z_S = Z_L = 50 \Omega$, V_{CE} , $f =$ parameters

Electrical characteristics

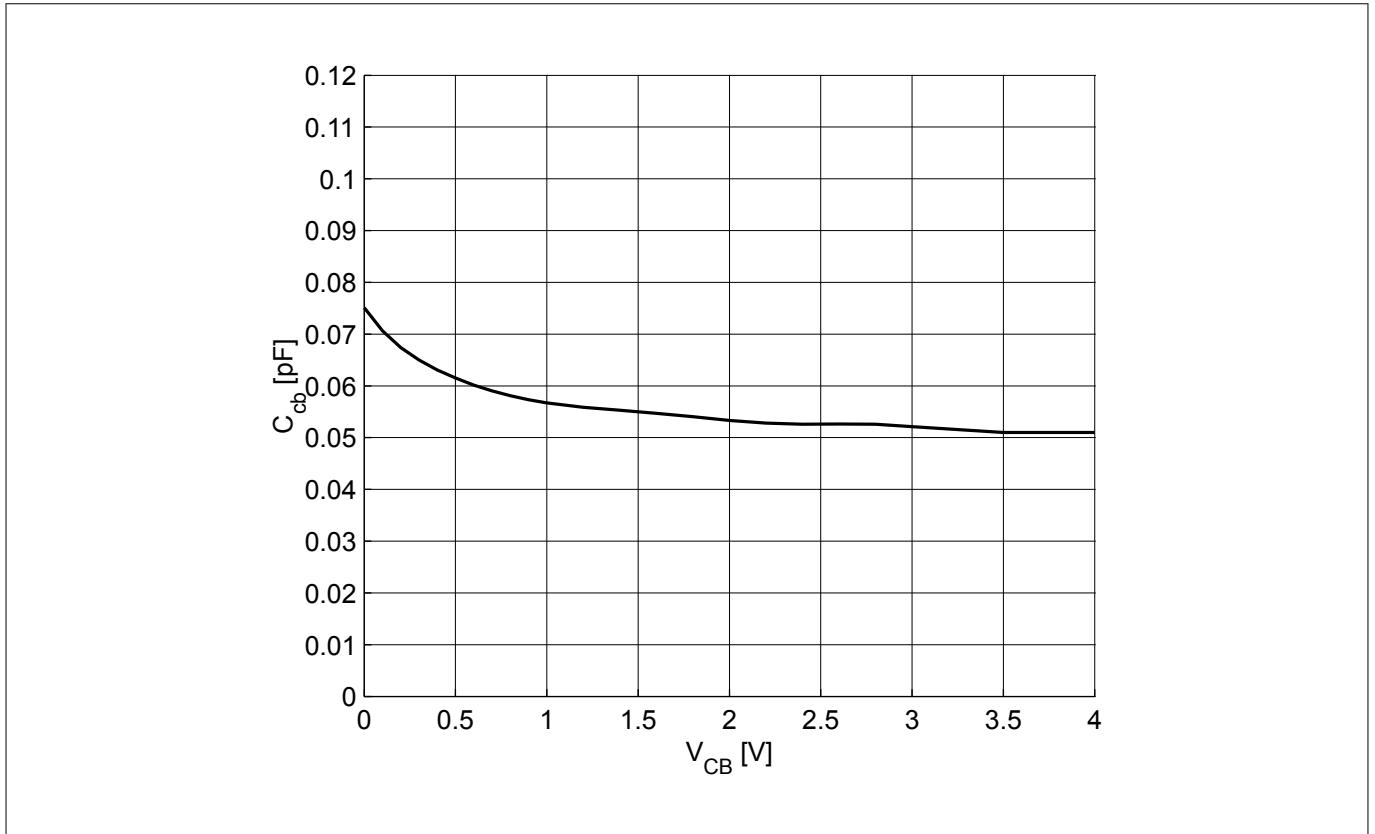


Figure 10 Collector base capacitance $C_{CB} = f(V_{CB})$, $f = 1$ MHz

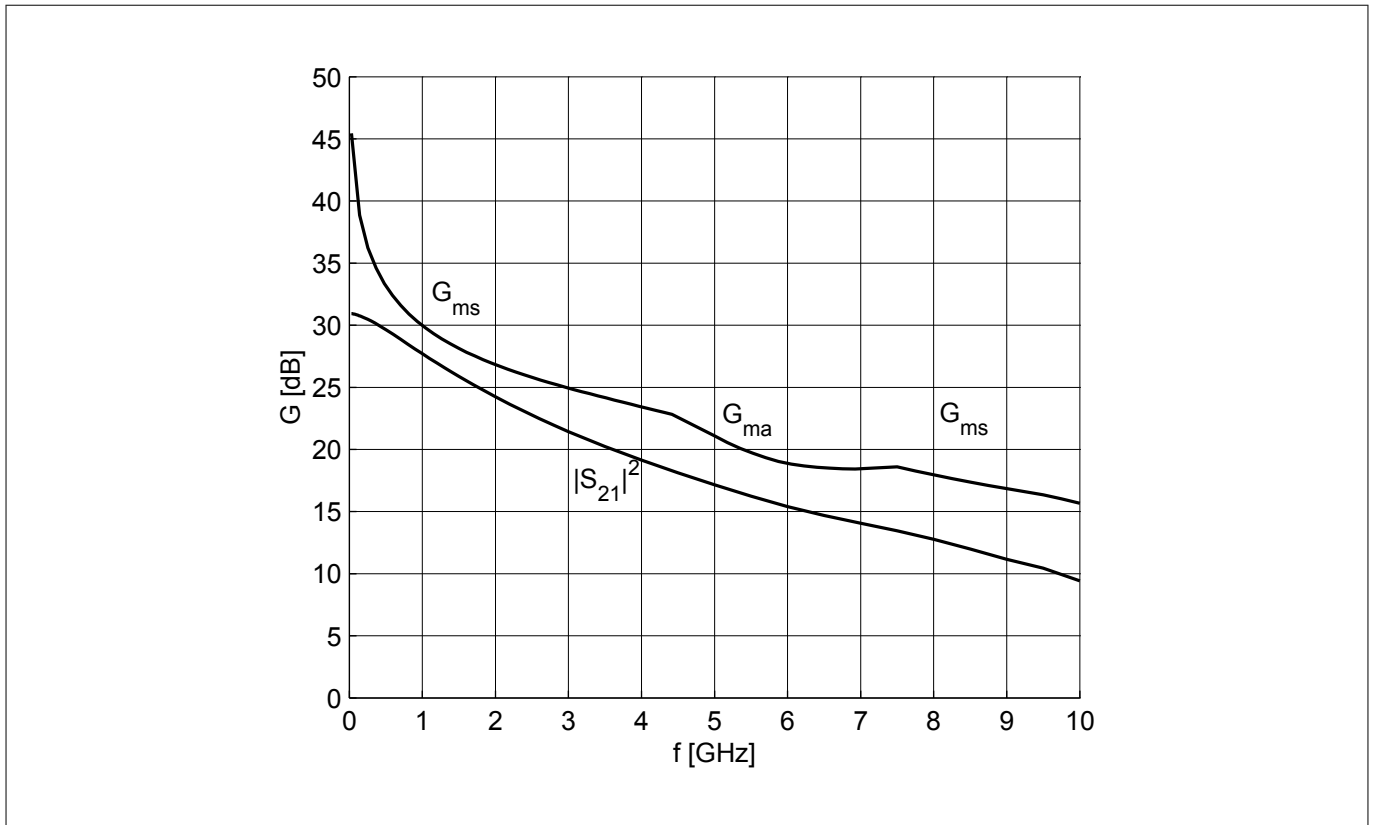


Figure 11 Gain G_{ma} , G_{ms} , $|S_{21}|^2 = f(f)$, $V_{CE} = 3$ V, $I_C = 15$ mA

Electrical characteristics

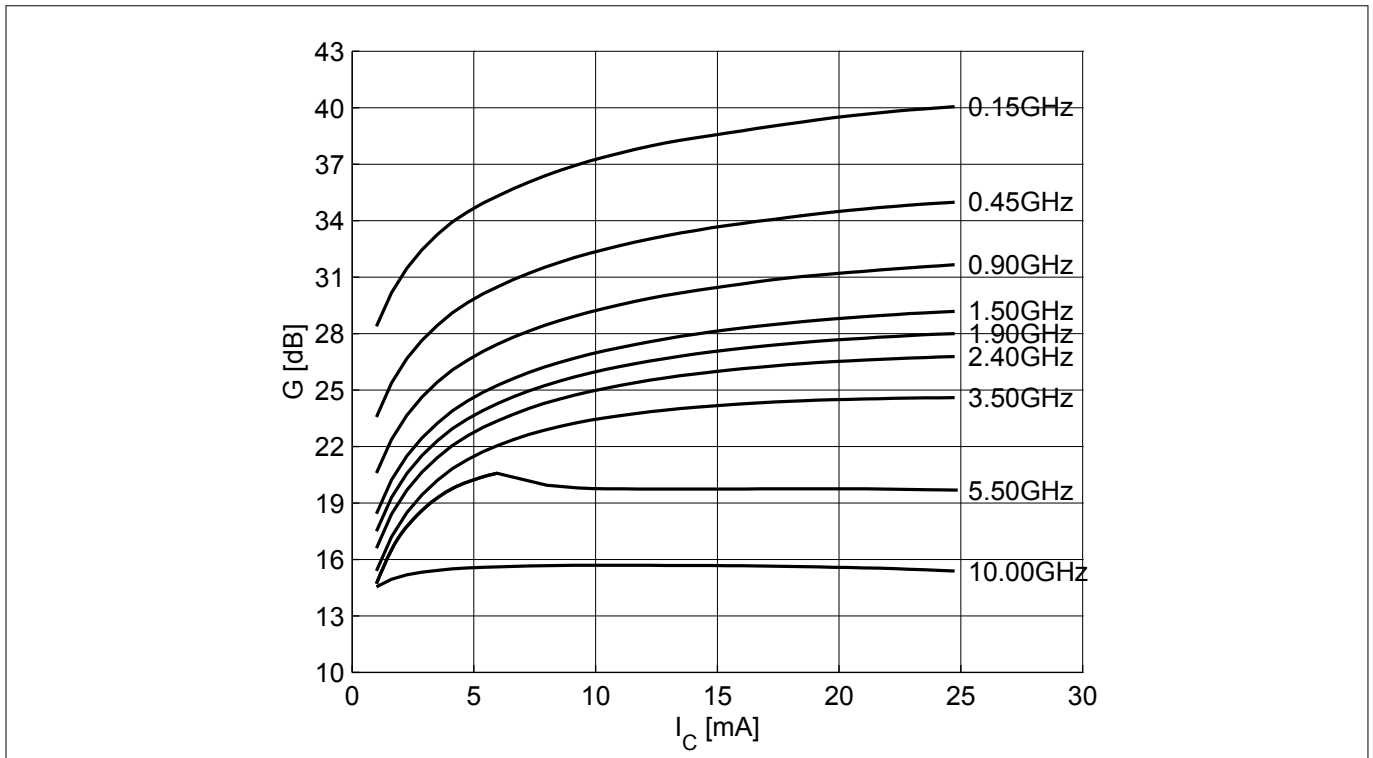


Figure 12 Maximum power gain $G_{max} = f(I_C)$, $V_{CE} = 3\text{ V}$, $f =$ parameter in GHz

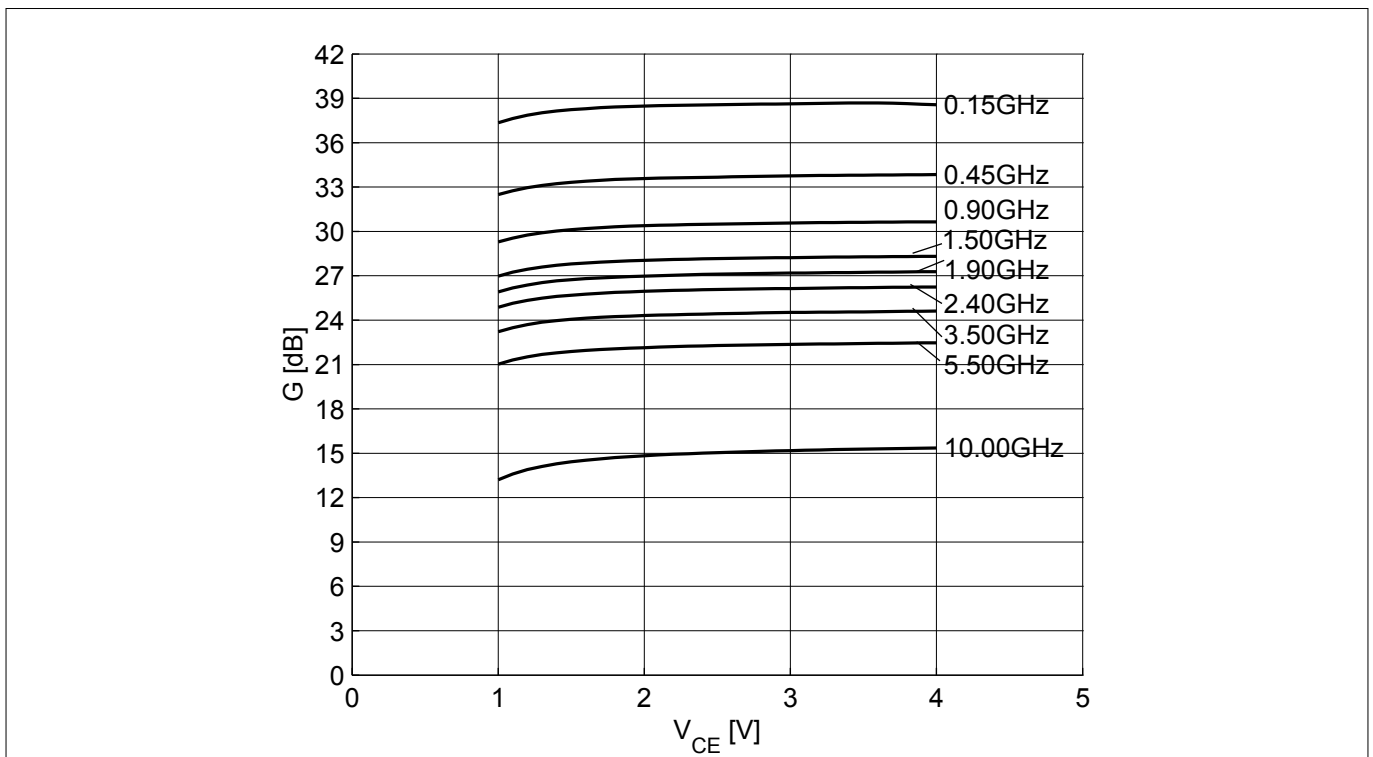


Figure 13 Maximum power gain $G_{max} = f(V_{CE})$, $I_C = 15\text{ mA}$, $f =$ parameter in GHz

Electrical characteristics

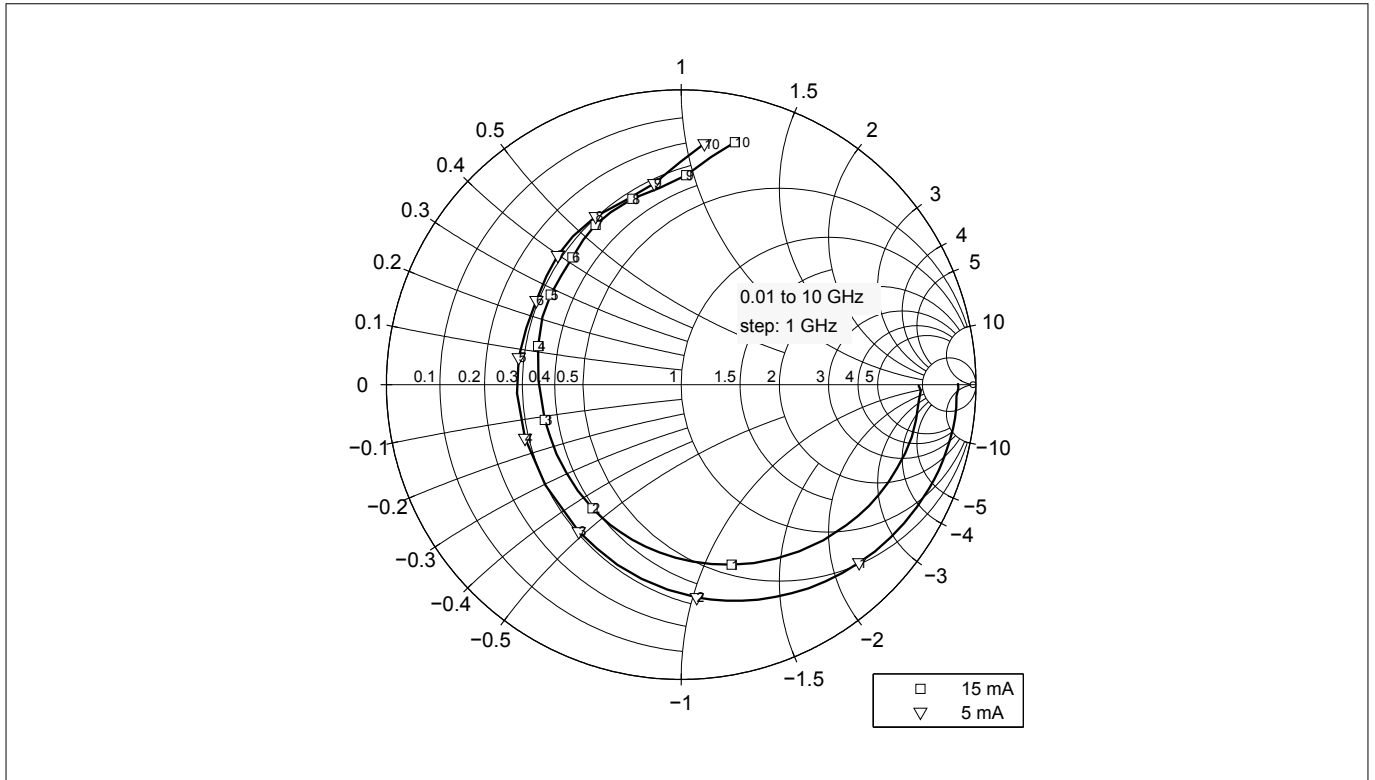


Figure 14 Input reflection coefficient $S_{11} = f(f)$, $V_{CE} = 3 \text{ V}$, $I_C = 5 / 15 \text{ mA}$

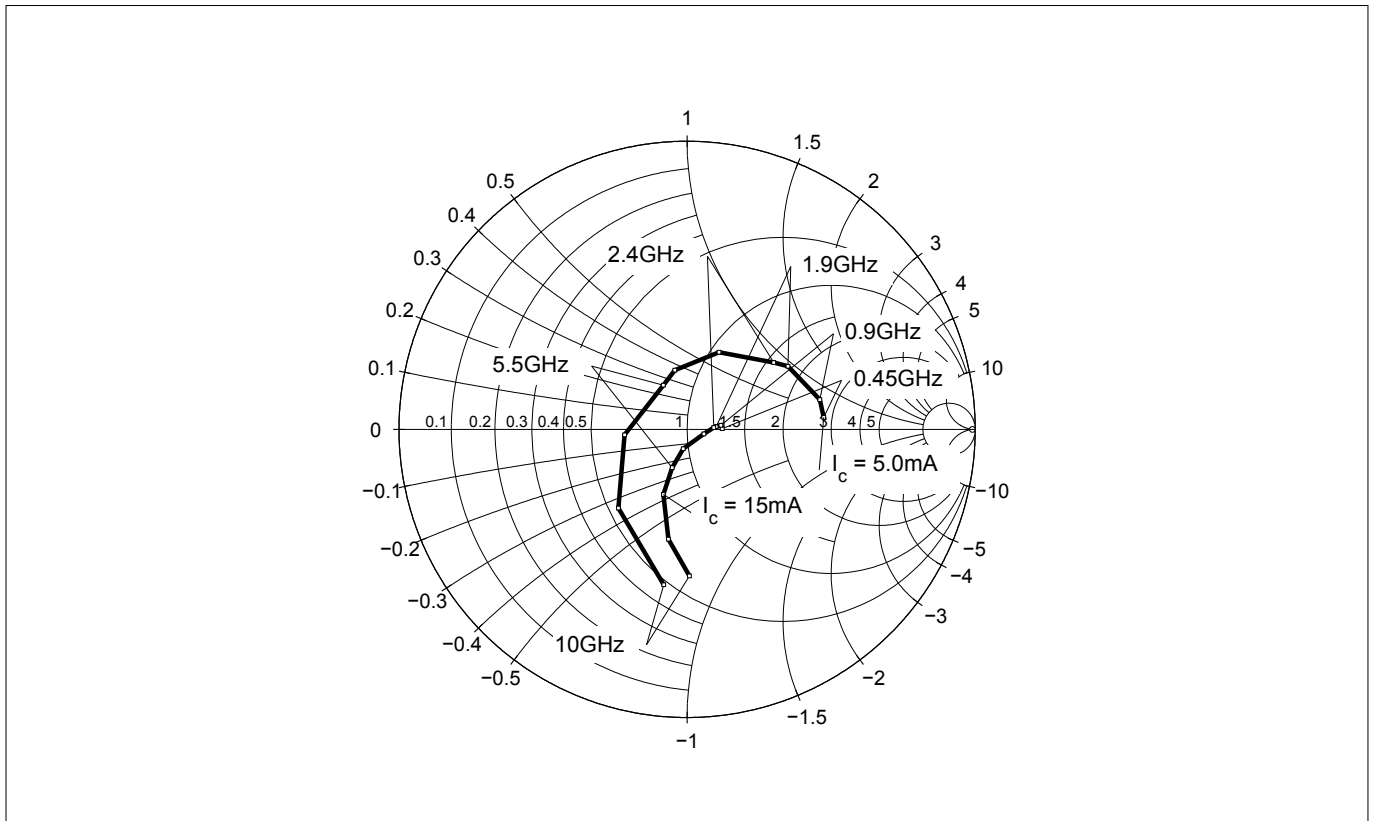


Figure 15 Source impedance for minimum noise figure $Z_{S,opt} = f(f)$, $V_{CE} = 3 \text{ V}$, $I_C = 5 / 15 \text{ mA}$

Electrical characteristics

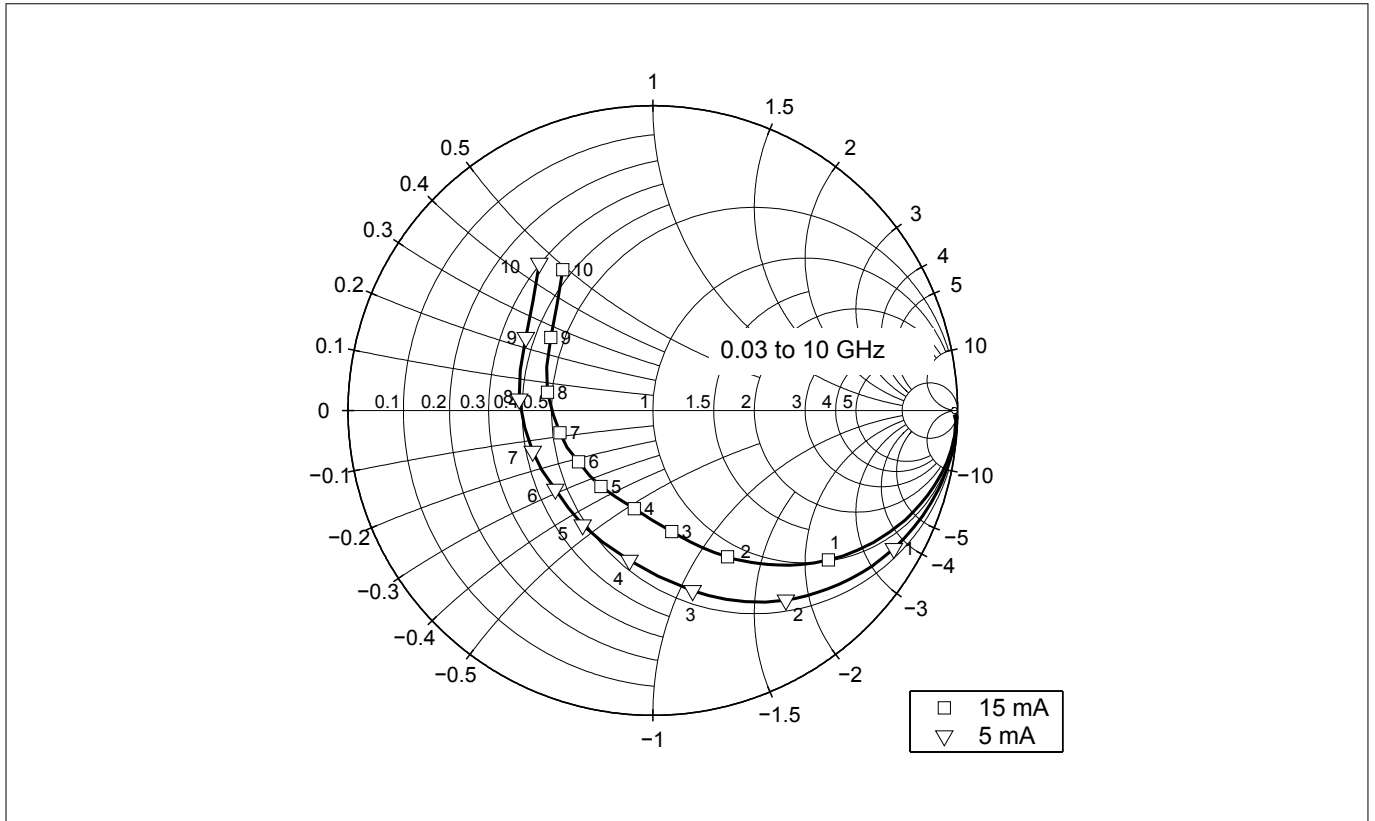


Figure 16 Output reflection coefficient $S_{22} = f(f)$, $V_{CE} = 3 \text{ V}$, $I_C = 5 / 15 \text{ mA}$

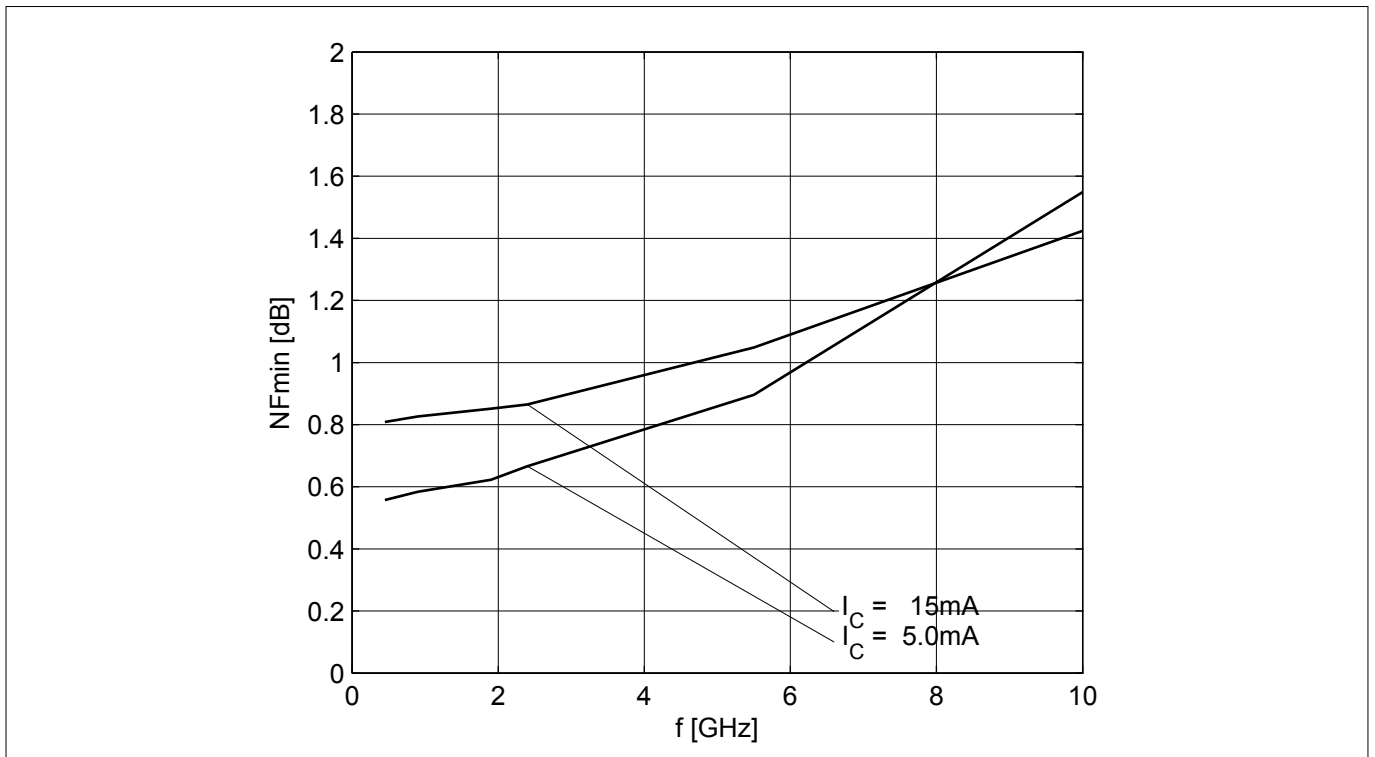


Figure 17 Noise figure $NF_{min} = f(f)$, $V_{CE} = 3 \text{ V}$, $Z_S = Z_{S,opt}$, $I_C = 5 / 15 \text{ mA}$

Electrical characteristics

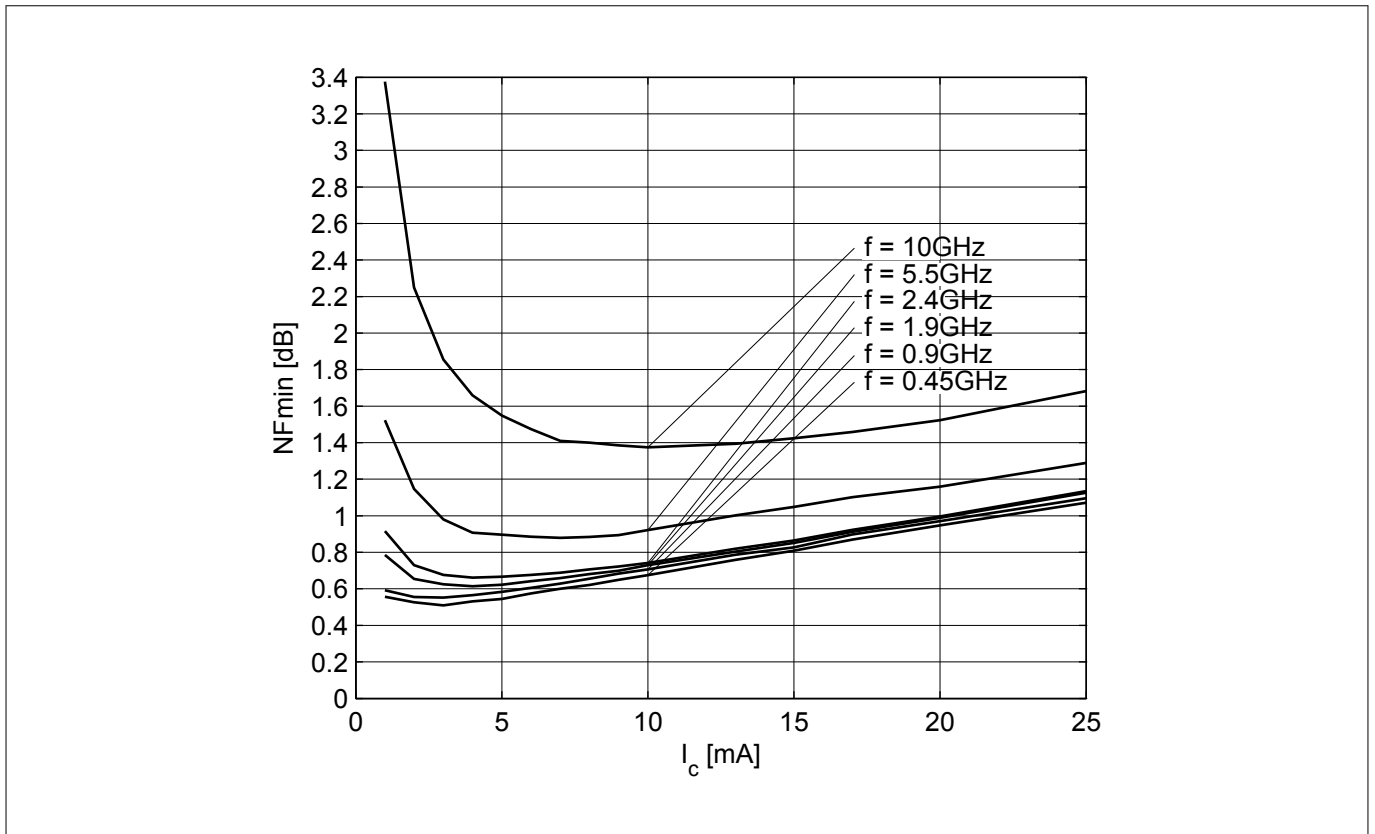


Figure 18 Noise figure $NF_{min} = f(I_C)$, $V_{CE} = 3\text{ V}$, $Z_S = Z_{S,opt}$, $f =$ parameter in GHz

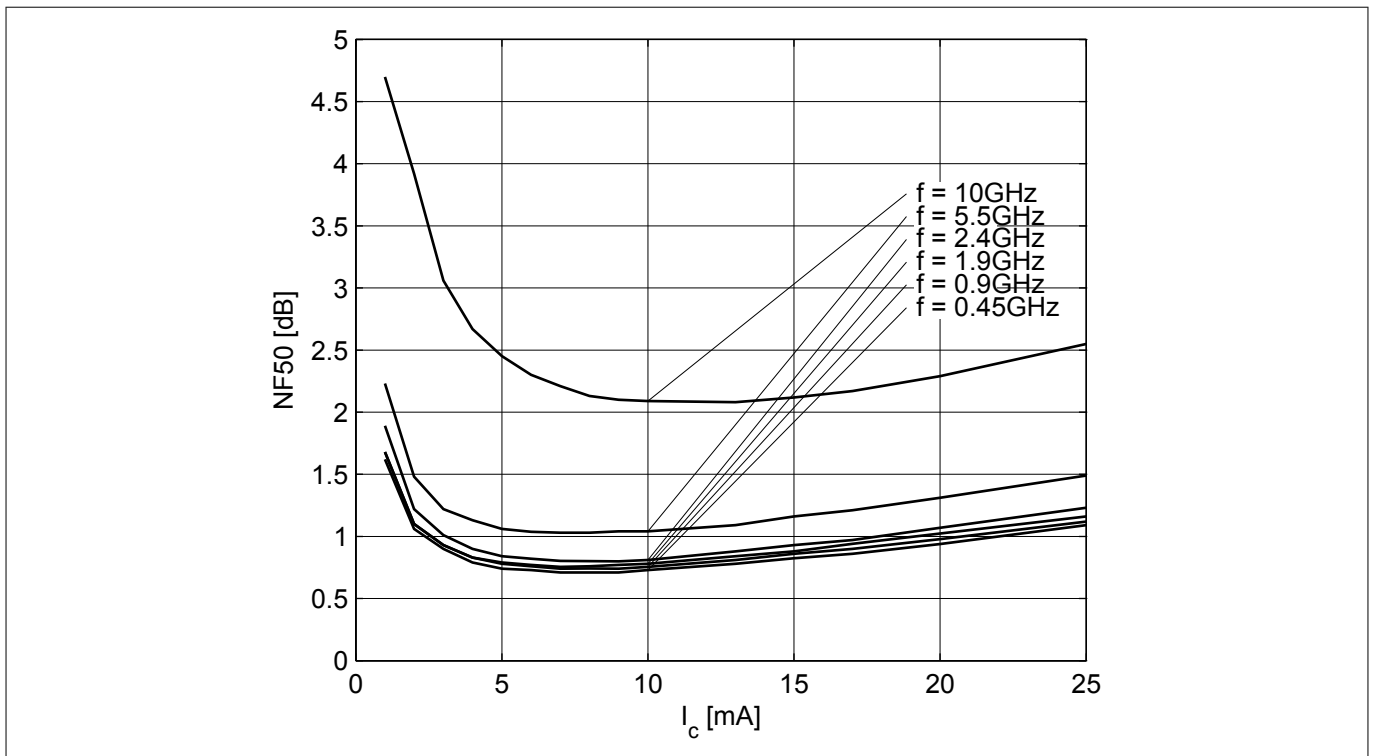


Figure 19 Noise figure $NF_{50} = f(I_C)$, $V_{CE} = 3\text{ V}$, $Z_S = 50\ \Omega$, $f =$ parameter in GHz

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

Package information SOT343

4 Package information SOT343

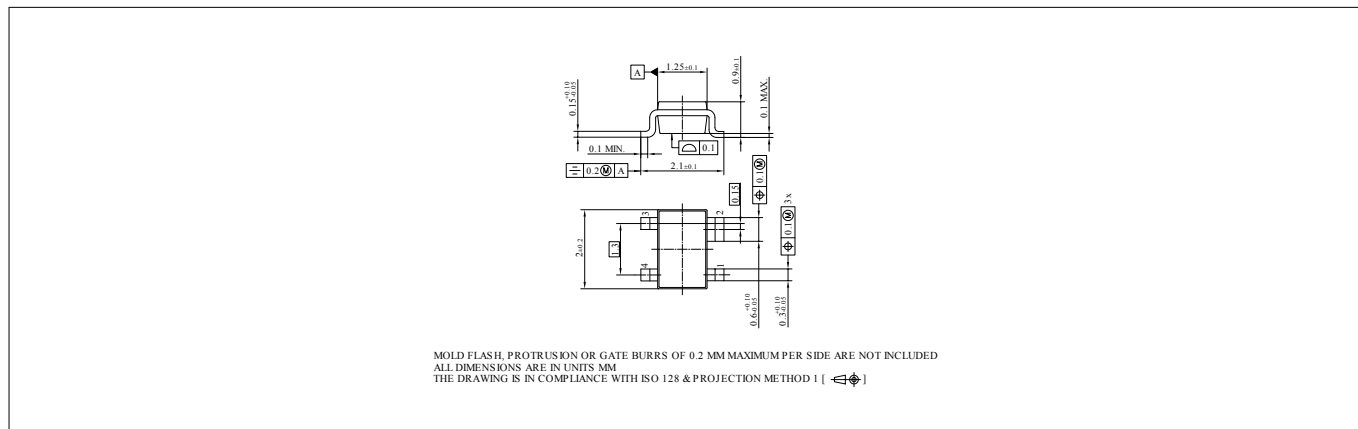


Figure 20 Package outline

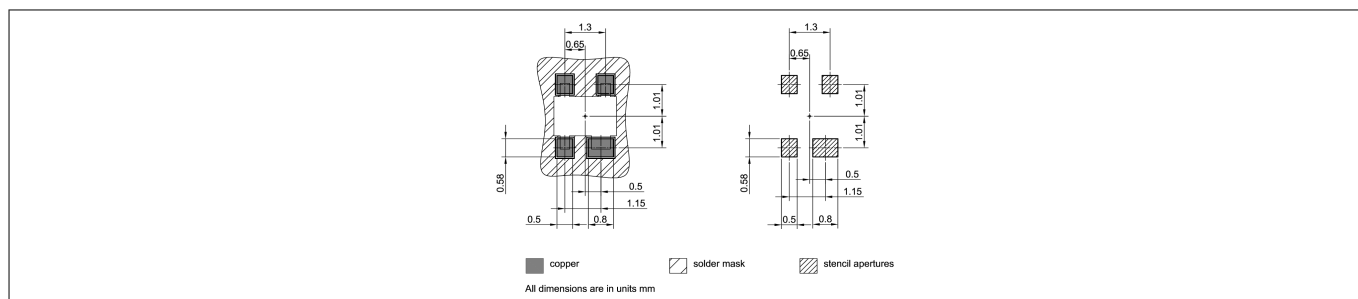


Figure 21 Foot print

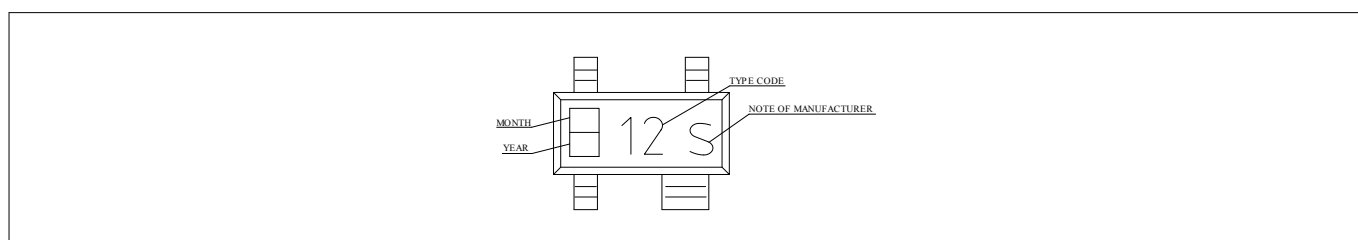


Figure 22 Marking layout example

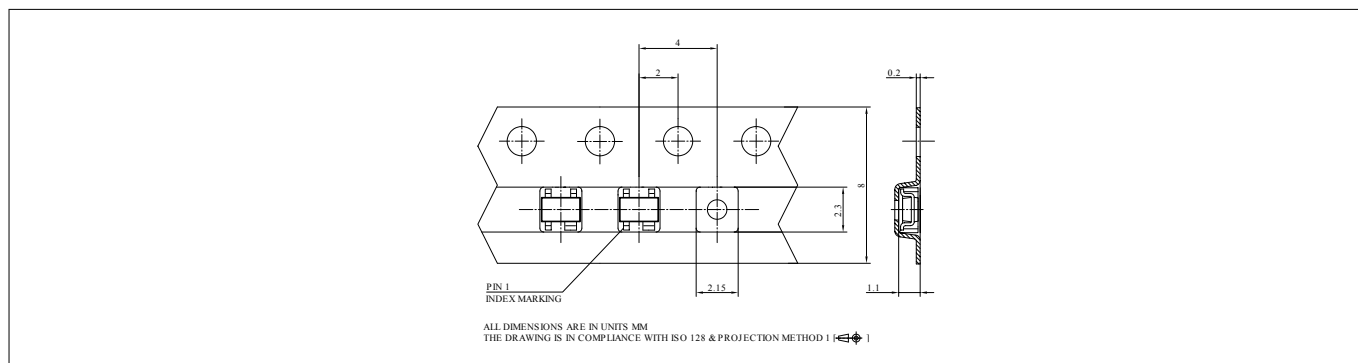


Figure 23 Tape dimensions

Revision history

Revision history

| Document version | Date of release | Description of changes |
|------------------|-----------------|------------------------|
| 2.0 | 2018-09-26 | New datasheet layout. |

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