# BFP843

## Robust low noise broadband pre-matched RF bipolar transistor

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## Product description

The BFP843 is a robust low noise broadband pre-matched RF heterojunction bipolar transistor (HBT).


## Feature list

- Unique combination of high end RF performance and robustness: 20 dBm maximum RF input power, 1.5 kV HBM ESD hardness
- High transition frequency enables best in class noise performance at high frequencies: $NF_{min}$ = 1.2 dB at 5.5 GHz, 1.8 V, 8 mA
- High gain $G_{ma}$ = 17 dB at 5.5 GHz, 1.8 V, 15 mA
- $OIP_3$ = 19.5 dBm at 5.5 GHz, 1.8 V, 15 mA
- Suitable for low voltage applications e.g. $V_{CC}$ = 1.2 V and 1.8 V (2.85 V, 3.3 V, 3.6 V require a corresponding collector resistor)

## Product validation

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

## Potential applications

- WLAN, WiMAX and UWB
- Satellite communication systems: satellite radio (SDARs, DAB) and navigation systems (e.g. GPS, GLONASS, BeiDou, Galileo)

## Device information

**Table 1 Part information**

| Product name / Ordering code | Package | Pin configuration | | | | Marking | Pieces / Reel |
|---|---|---|---|---|---|---|---|
| BFP843 / BFP843H6327XTSA1 | SOT343 | 1 = B | 2 = E | 3 = C | 4 = E | T2s | 3000 |

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

# Table of contents

# 1 Absolute maximum ratings

**Table 2 Absolute maximum ratings at $T_A$ = 25 °C (unless otherwise specified)**

| Parameter | Symbol | Values | | Unit | Note or test condition |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Collector emitter voltage | $V_{CEO}$ | – | 2.25 | V | Open base |
| | | | 2.0 | | $T_A$ = -55 °C, open base |
| Collector emitter voltage [1] | $V_{CES}$ | | 2.25 | | E-B short circuited |
| | | | 2.0 | | $T_A$ = -55 °C, E-B short circuited |
| Collector base voltage [2] | $V_{CBO}$ | | 2.9 | | Open emitter |
| | | | 2.6 | | $T_A$ = -55 °C, open emitter |
| Base current | $I_B$ | -5 | 5 | mA | – |
| Collector current | $I_C$ | – | 55 | | |
| 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 | $T_S \leq 99$ °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 $V_{CES}$ is similar 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.

# 2 Thermal characteristics

**Table 3 Thermal resistance**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Junction - soldering point | $R_{thJS}$ | – | 405 | – | K/W | – |

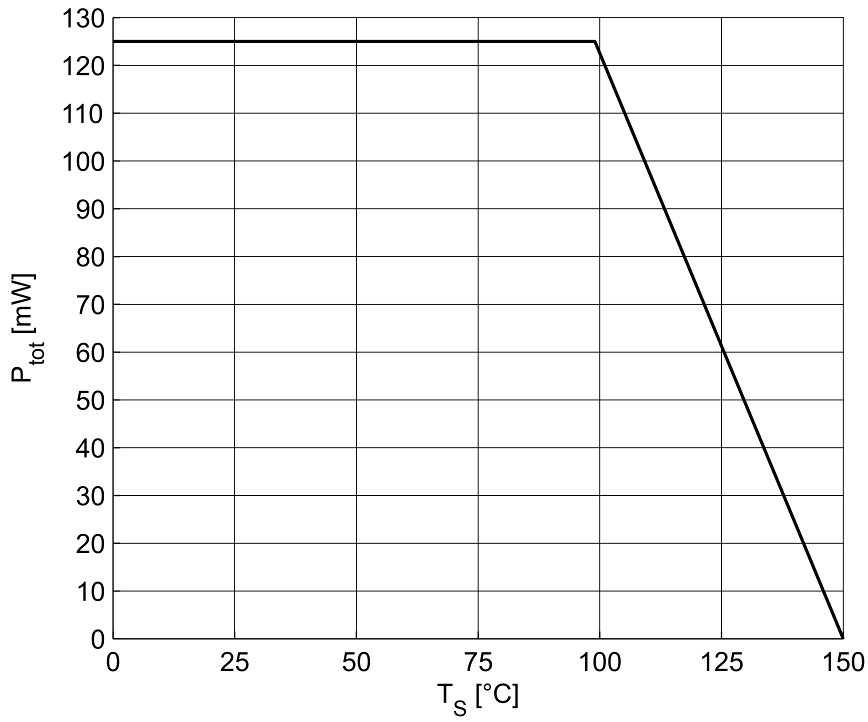


**Figure 1 Total power dissipation $P_{tot}$ = f($T_S$)**

# 3 Electrical characteristics

## 3.1 DC characteristics

**Table 4** **DC characteristics at $T_A = 25$ °C**

| Parameter | Symbol | Values | | | Unit | Note or 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 [1] | nA | $V_{CE} = 1.5$ V, $V_{BE} = 0$, E-B short circuited |
| Collector base leakage current | $I_{CBO}$ | | | 400 [1] | | $V_{CB} = 1.5$ V, $I_E = 0$, open emitter |
| Emitter base leakage current | $I_{EBO}$ | | | 10 [1] | µA | $V_{EB} = 0.5$ V, $I_C = 0$, open collector |
| DC current gain | $h_{FE}$ | 150 | 260 | 450 | – | $V_{CE} = 1.8$ V, $I_C = 15$ mA, pulse measured |

## 3.2 General AC characteristics

**Table 5** **General AC characteristics at $T_A = 25$ °C**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Collector base capacitance [2] | $C_{CB}$ | – | 5.23<br>0.06 | – | pF | $f = 1$ MHz,<br>$f = 1$ GHz,<br>$V_{CB} = 1.8$ V, $V_{BE} = 0$, emitter grounded |
| Collector emitter capacitance | $C_{CE}$ | | 0.5 | | | $f = 1$ MHz,<br>$V_{CE} = 1.8$ V, $V_{BE} = 0$, base grounded |
| Emitter base capacitance | $C_{EB}$ | | 0.73 | | | $f = 1$ MHz,<br>$V_{EB} = 0.4$ V, $V_{CB} = 0$, collector grounded |

1 Maximum values not limited by the device but by the short cycle time of the 100% test
2 Including integrated feedback capacitance

## 3.3 Frequency dependent AC characteristics

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

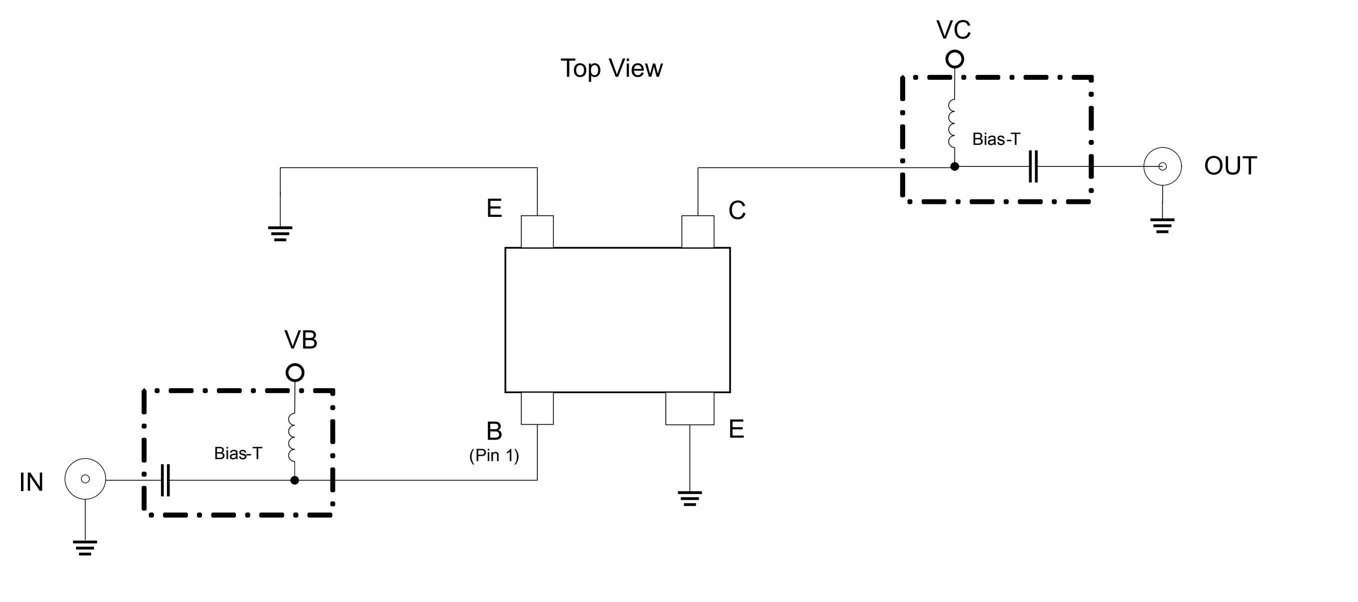


**Figure 2** **Testing circuit**

**Table 6** **AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 450 MHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 24.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 24.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.9 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 22 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 24 | | | $I_C$ = 15 mA, $Z_S$ = $Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 7 | | | |

## Electrical characteristics

**Table 7 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 900 MHz**

| Parameter | Symbol | Values Min. | Values Typ. | Values Max. | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 24 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 24 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.9 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 22 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 23.5 | | | $I_C$ = 15 mA, $Z_S$ = $Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 8 | | | |

**Table 8 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 1.5 GHz**

| Parameter | Symbol | Values Min. | Values Typ. | Values Max. | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 23.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 23 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.95 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 21 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 22.5 | | | $I_C$ = 15 mA, $Z_S$ = $Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 6 | | | |

**Table 9 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 1.9 GHz**

| Parameter | Symbol | Values Min. | Values Typ. | Values Max. | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 22.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 22 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 0.95 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 20 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 24 | | | $I_C$ = 15 mA, $Z_S$ = $Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 8.5 | | | |

**Table 10 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 2.4 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 21.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 21 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.0 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 19.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 22 | | | $I_C$ = 15 mA, $Z_S = Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 6.5 | | | |

**Table 11 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 3.5 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 19.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 19 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.1 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 17.5 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 22.5 | | | $I_C$ = 15 mA, $Z_S = Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 7 | | | |

**Table 12 AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 5.5 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 17 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 15.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.2 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 15 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 19.5 | | | $I_C$ = 15 mA, $Z_S = Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 4 | | | |

**Table 13** **AC characteristics, $V_{CE}$ = 1.8 V, $f$ = 10 GHz**

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | – | | – | dB | |
| • Maximum power gain | $G_{ma}$ | | 13.5 | | | $I_C$ = 15 mA |
| • Transducer gain | $\|S_{21}\|^2$ | | 8.5 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | $NF_{min}$ | | 1.85 | | | $I_C$ = 8 mA |
| • Associated gain | $G_{ass}$ | | 9 | | | |
| Linearity | | | | | dBm | |
| • 3rd order intercept point at output | $OIP_3$ | | 16 | | | $I_C$ = 15 mA, $Z_S$ = $Z_L$ = 50 Ω |
| • 1 dB gain compression point at output | $OP_{1dB}$ | | 0 | | | |

*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 Ω from 0.2 MHz to 12 GHz.*

## 3.4 Characteristic DC diagrams

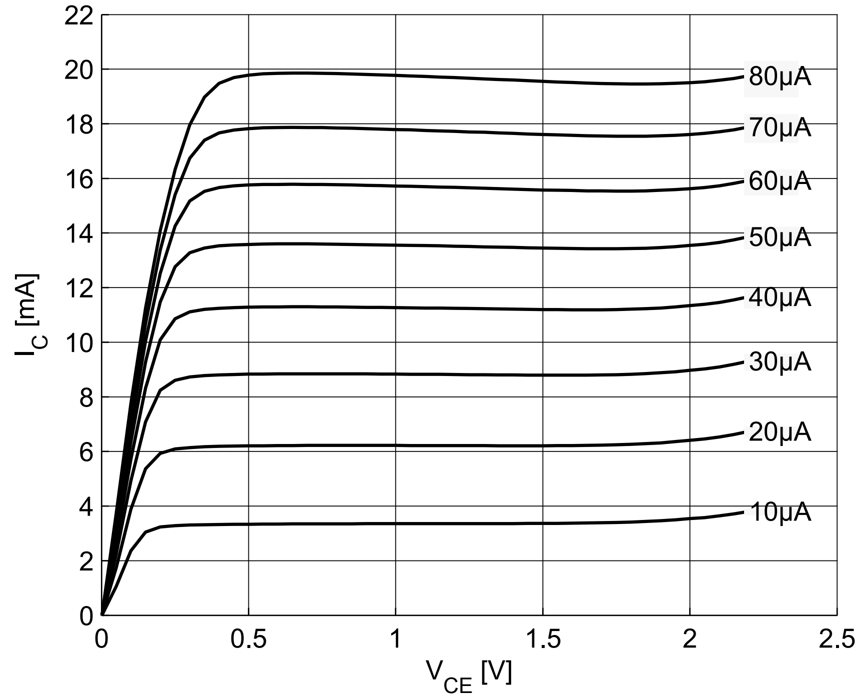


**Figure 3** **Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, $I_B$ = parameter**

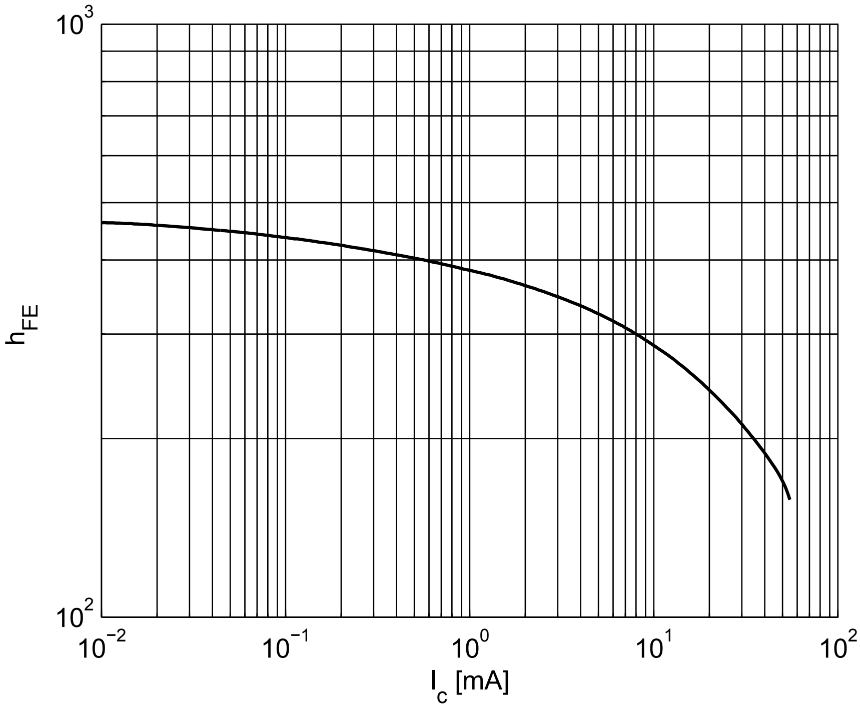


**Figure 4** **DC current gain $h_{FE} = f(I_C)$, $V_{CE}$ = 1.8 V**

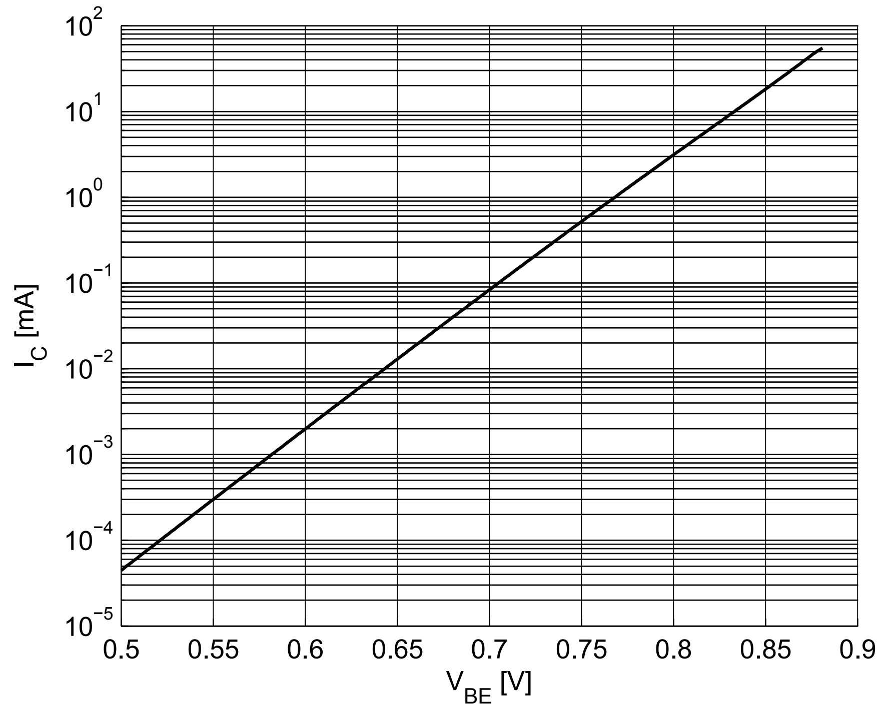


**Figure 5** **Collector current vs. base emitter forward voltage $I_C = f(V_{BE})$, $V_{CE} = 1.8$ V**

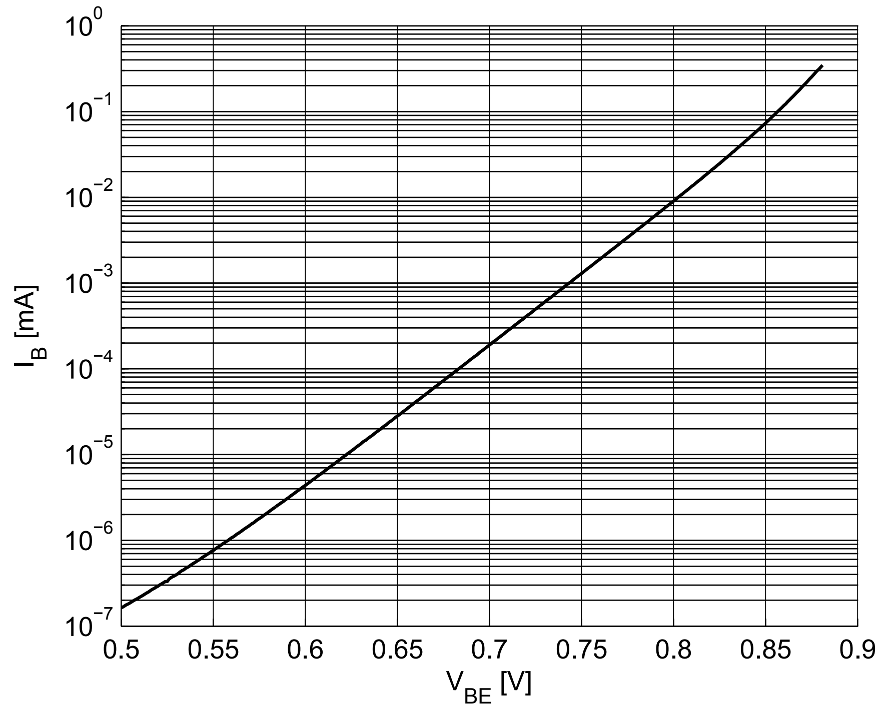


**Figure 6** **Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 1.8$ V**

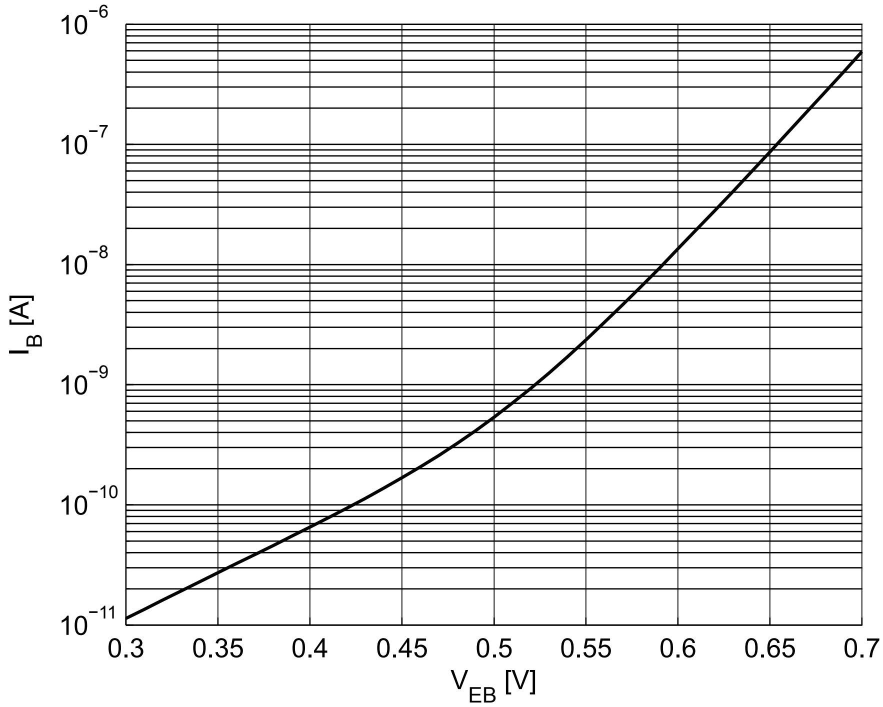


**Figure 7** **Base current vs. base emitter reverse voltage $I_B = f(V_{EB})$, $V_{CE} = 1.8$ V**

## 3.5 Characteristic AC diagrams

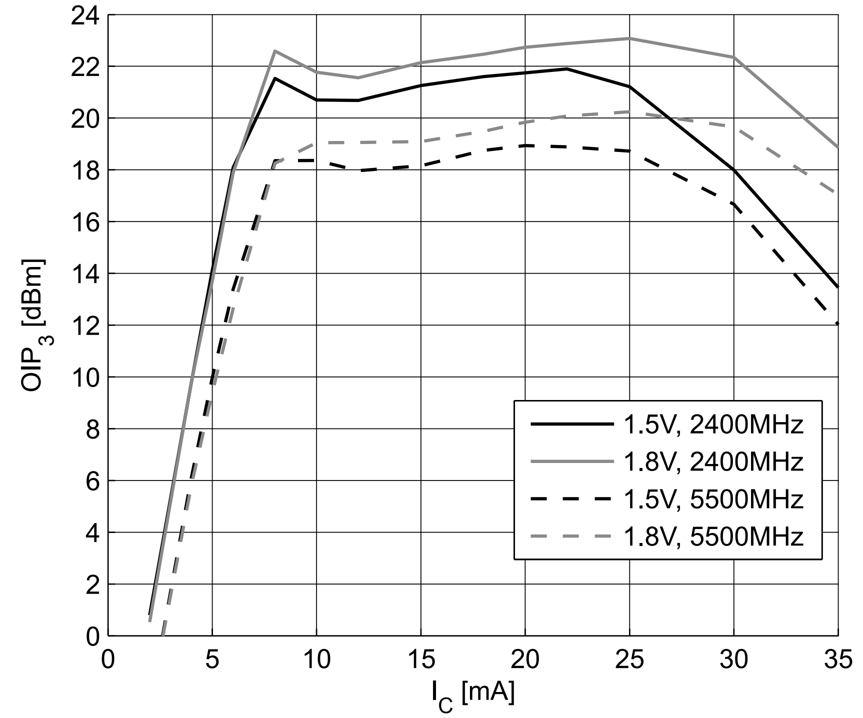


**Figure 8** 3rd order intercept point at output $OIP_3 = f(I_C)$, $Z_S = Z_L = 50\ \Omega$, $V_{CE}$, $f$ = parameters

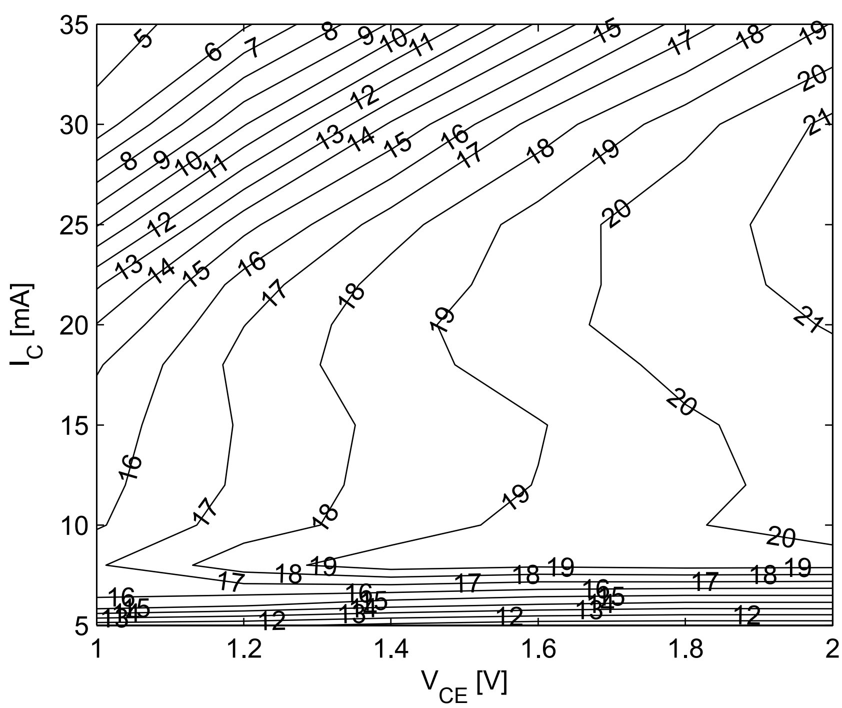


**Figure 9** 3rd order intercept point at output $OIP_3$ [dBm] = $f(I_C, V_{CE})$, $Z_S = Z_L = 50\ \Omega$, $f$ = 5.5 GHz

## Electrical characteristics

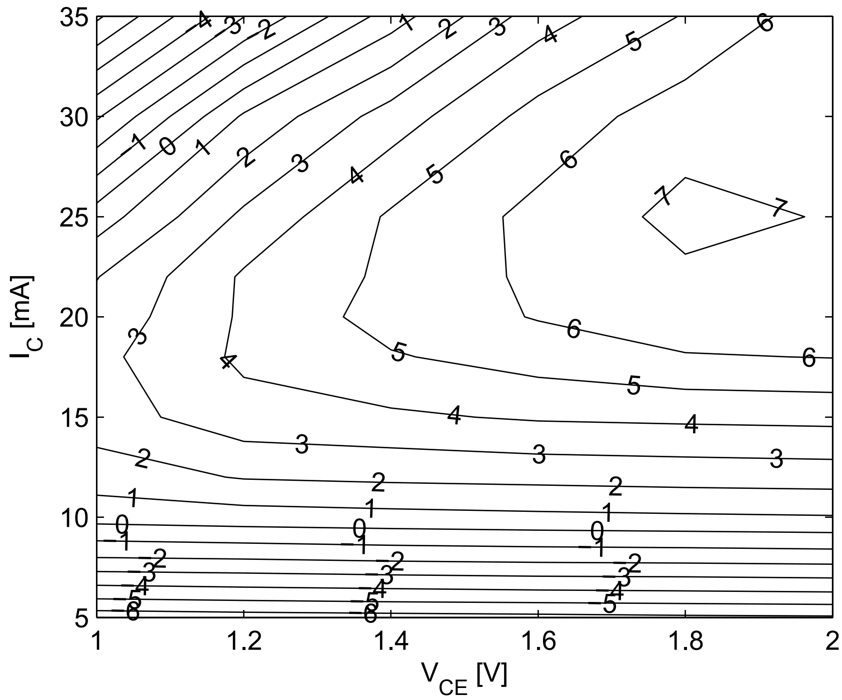


**Figure 10** **Compression point at output $OP_{1dB}$ [dBm] = f($I_C$, $V_{CE}$), $Z_S$ = $Z_L$ = 50 Ω, $f$ = 5.5 GHz**

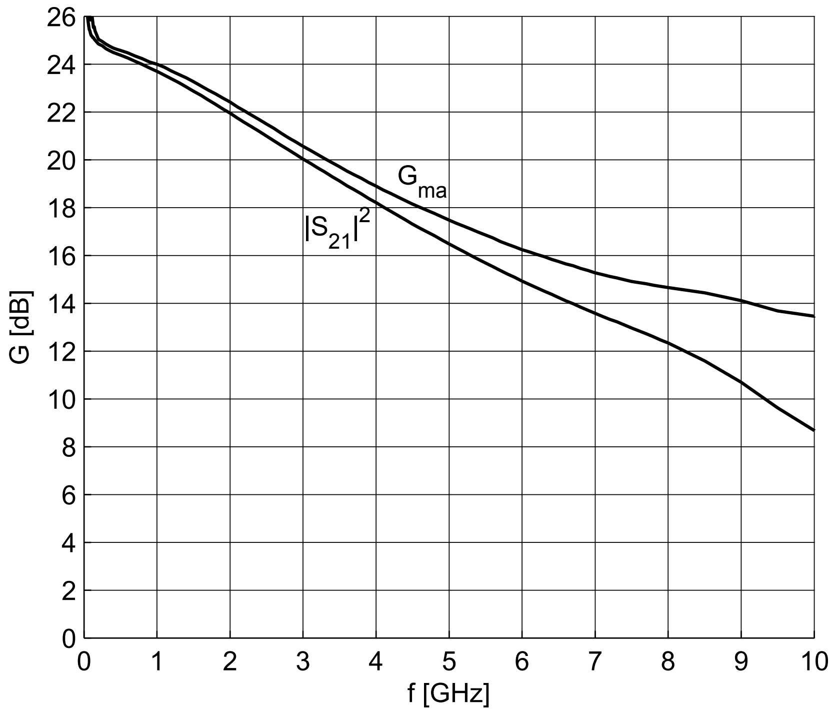


**Figure 11** **Gain $G_{ma}$, $|S_{21}|^2$ = f($f$), $V_{CE}$ = 1.8 V, $I_C$ = 15 mA**

## Electrical characteristics

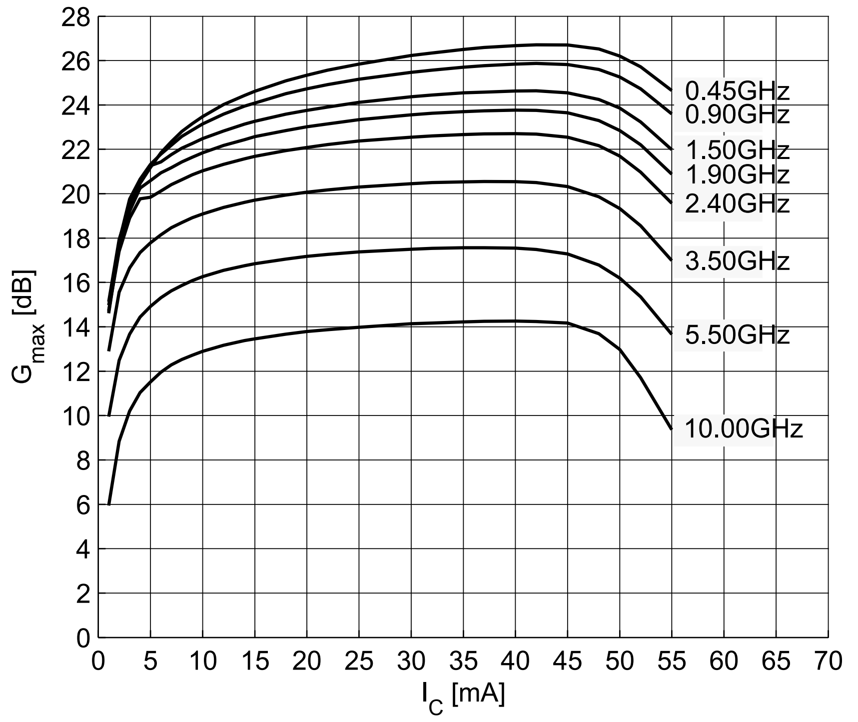


**Figure 12** **Maximum power gain $G_{max}$ = f($I_C$), $V_{CE}$ = 1.8 V, *f* = parameter in GHz**

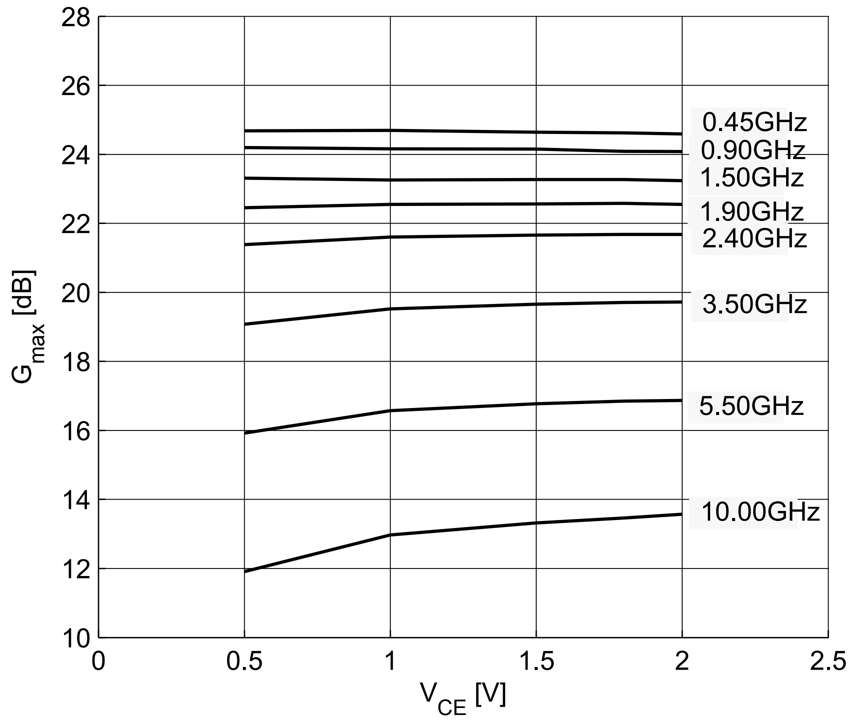


**Figure 13** **Maximum power gain $G_{max}$ = f($V_{CE}$), $I_C$ = 15 mA, *f* = parameter in GHz**

## Electrical characteristics

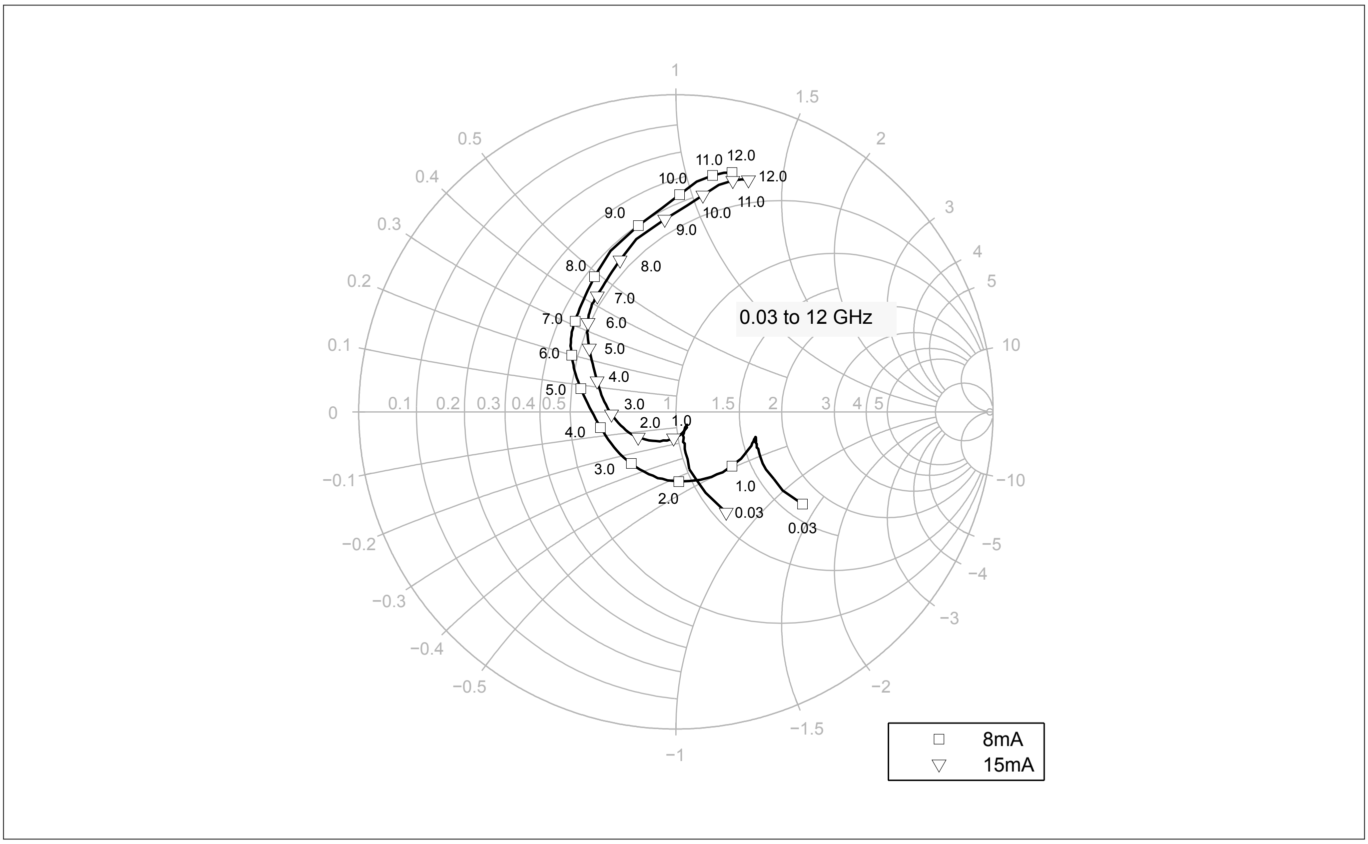


**Figure 14** **Input reflection coefficient $S_{11}$ = f($f$), $V_{CE}$ = 1.8 V, $I_C$ = 8 / 15 mA**

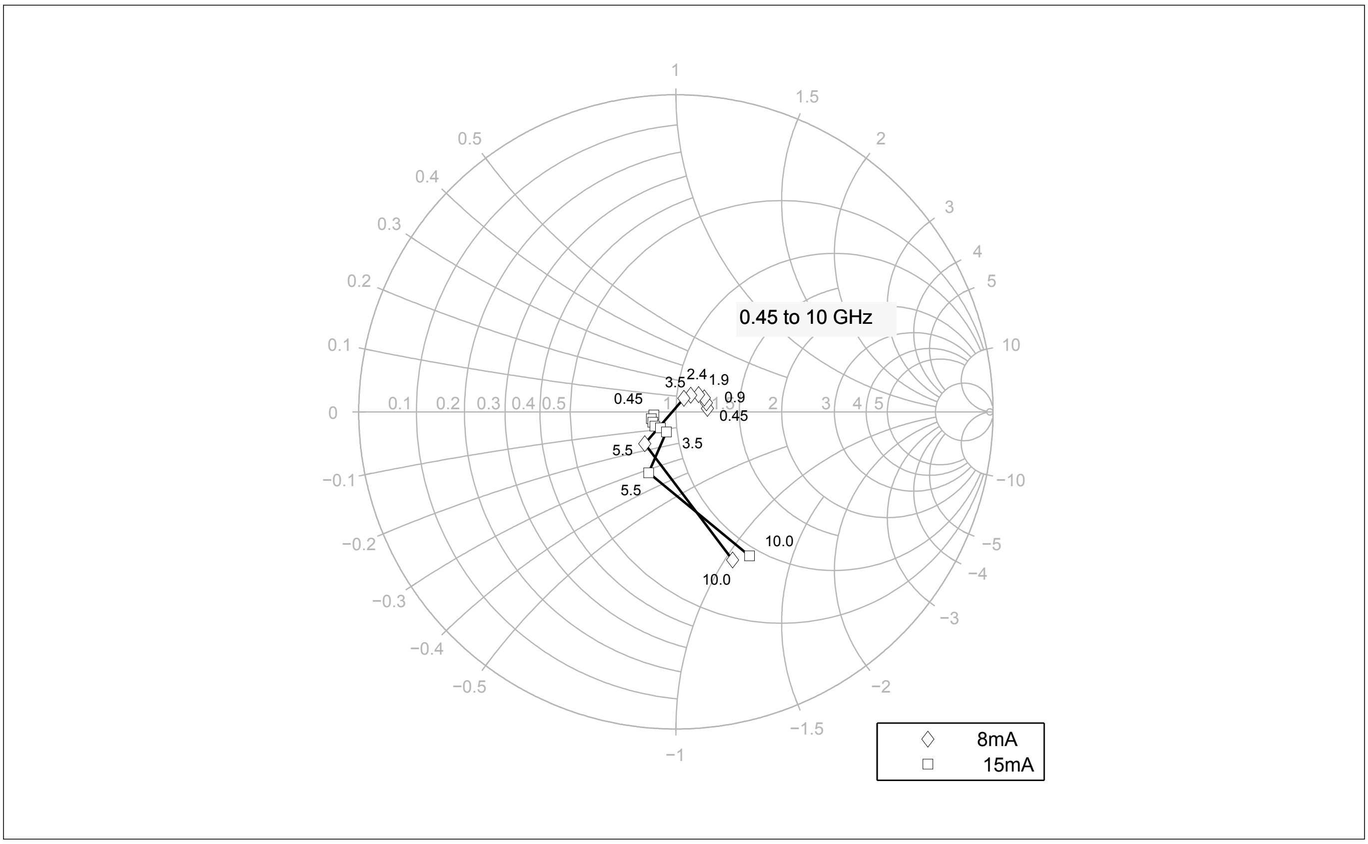


**Figure 15** **Source impedance for minimum noise figure $Z_{S,opt}$ = f($f$), $V_{CE}$ = 1.8 V, $I_C$ = 8 / 15 mA**

## Electrical characteristics

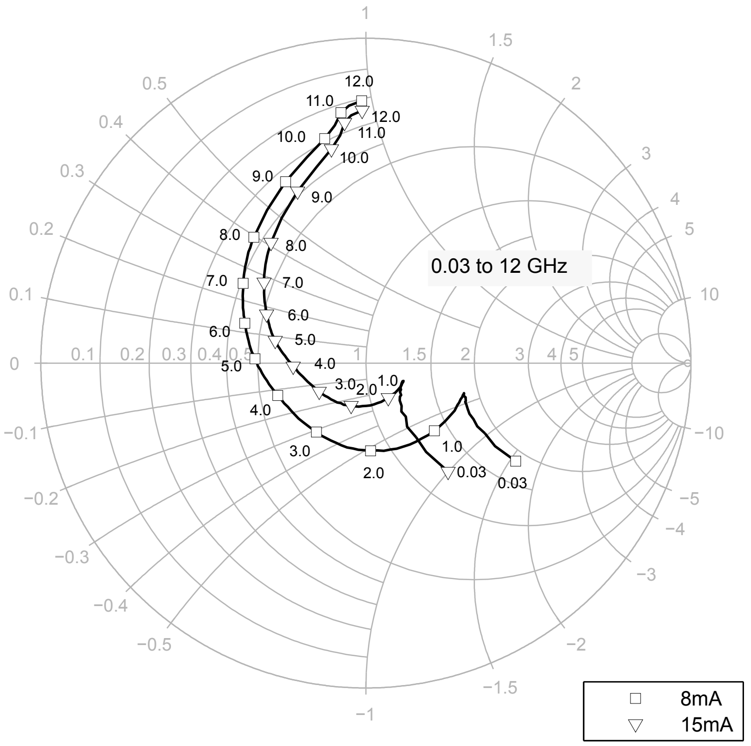


**Figure 16** **Output reflection coefficient $S_{22} = f(f)$, $V_{CE} = 1.8$ V, $I_C = 8 / 15$ mA**

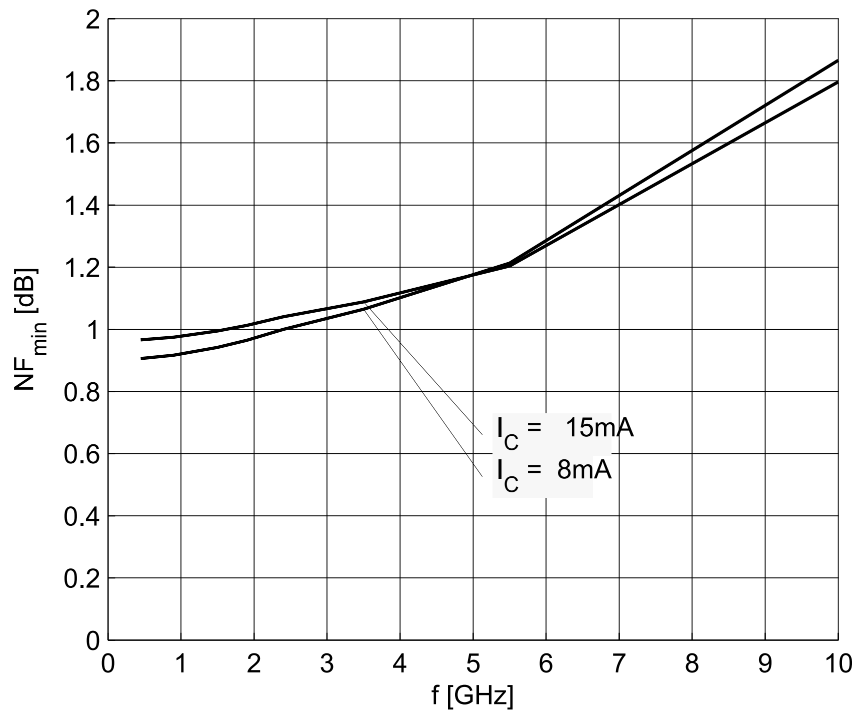


**Figure 17** **Noise figure $NF_{min} = f(f)$, $V_{CE} = 1.8$ V, $Z_S = Z_{S,opt}$, $I_C = 8 / 15$ mA**

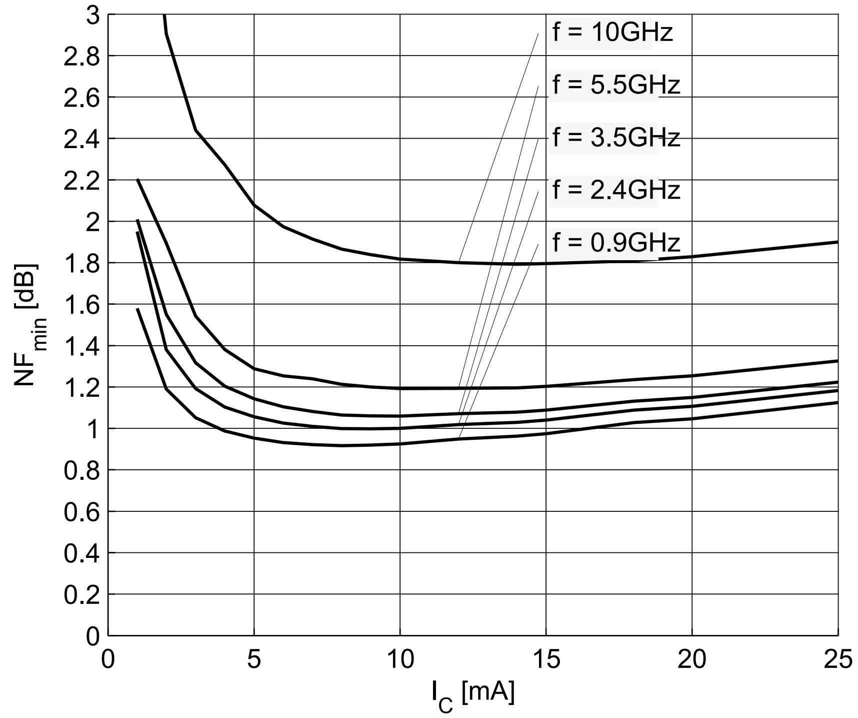


**Figure 18** Noise figure $NF_{min}$ = f($I_C$), $V_{CE}$ = 1.8 V, $Z_S$ = $Z_{S,opt}$, $f$ = parameter in GHz

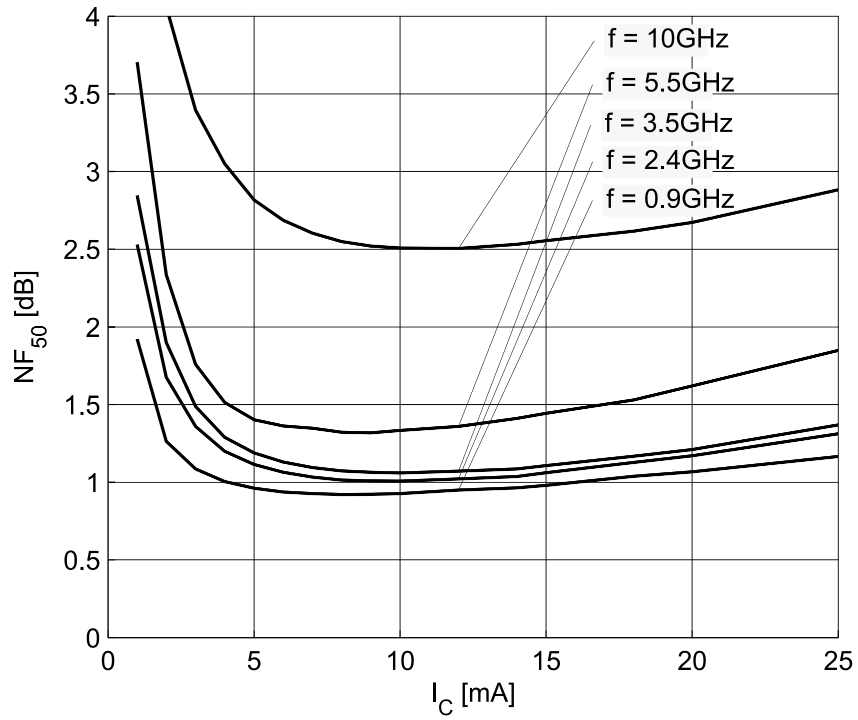


**Figure 19** Noise figure $NF_{50}$ = f($I_C$), $V_{CE}$ = 1.8 V, $Z_S$ = 50 Ω, $f$ = parameter in GHz

*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.

# 4 Package information SOT343

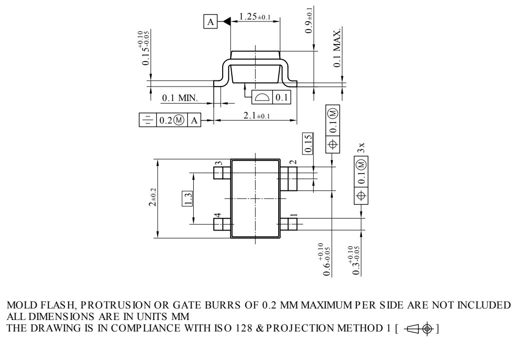


**Figure 20 Package outline**

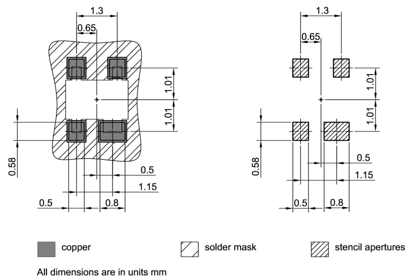


**Figure 21 Foot print**

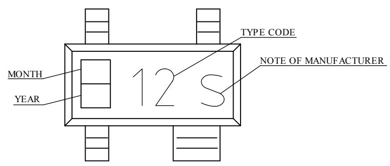


**Figure 22 Marking layout example**

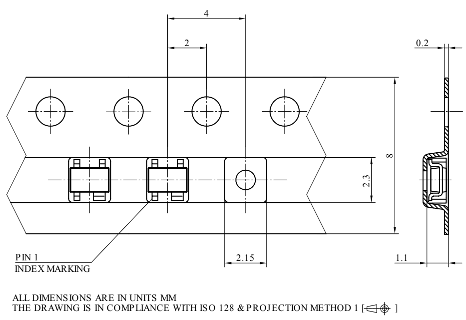


**Figure 23 Tape dimensions**

# Revision history

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

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