

BFR360F

Low profile silicon NPN RF bipolar transistor



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Technical documents



Simulation



Support

Product description

The BFR360F is a low noise device based on Si that is part of Infineon's established third generation RF bipolar transistor family. Its low current and low voltage characteristics make the device suitable for low current amplifiers. It remains cost competitive without compromising on ease of use.



Feature list

- Minimum noise figure $NF_{min} = 1$ dB at 1.8 GHz, 3 V, 3 mA
- High gain $G_{ma} = 15.5$ dB at 1.8 GHz, 3 V, 15 mA
- $OIP_3 = 24$ dBm at 1.8 GHz, 3 V, 15 mA

Product validation

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

Potential applications

- Low noise amplifiers (LNAs) for FM and AM radio
- LNAs for sub-1 GHz ISM band applications

Device information

Table 1 Part information

| Product name / Ordering code | Package | Pin configuration | | | Marking | Pieces / Reel |
|------------------------------|----------|-------------------|-------|-------|---------|---------------|
| BFR360F / BFR360FH6327XTSA1 | TSFP-3-1 | 1 = B | 2 = E | 3 = C | FBs | 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} | - | 6 | V | Open base |
| Collector emitter voltage | V_{CES} | | 15 | | E-B short circuited |
| Collector base voltage | V_{CBO} | | 15 | | Open emitter |
| Emitter base voltage | V_{EBO} | | 2 | | Open collector |
| Base current | I_B | | 4 | mA | - |
| Collector current | I_C | | 35 | | |
| Total power dissipation ¹⁾ | P_{tot} | | 210 | mW | $T_S \leq 98\text{ °C}$ |
| 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 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} | - | 250 | - | K/W | - |

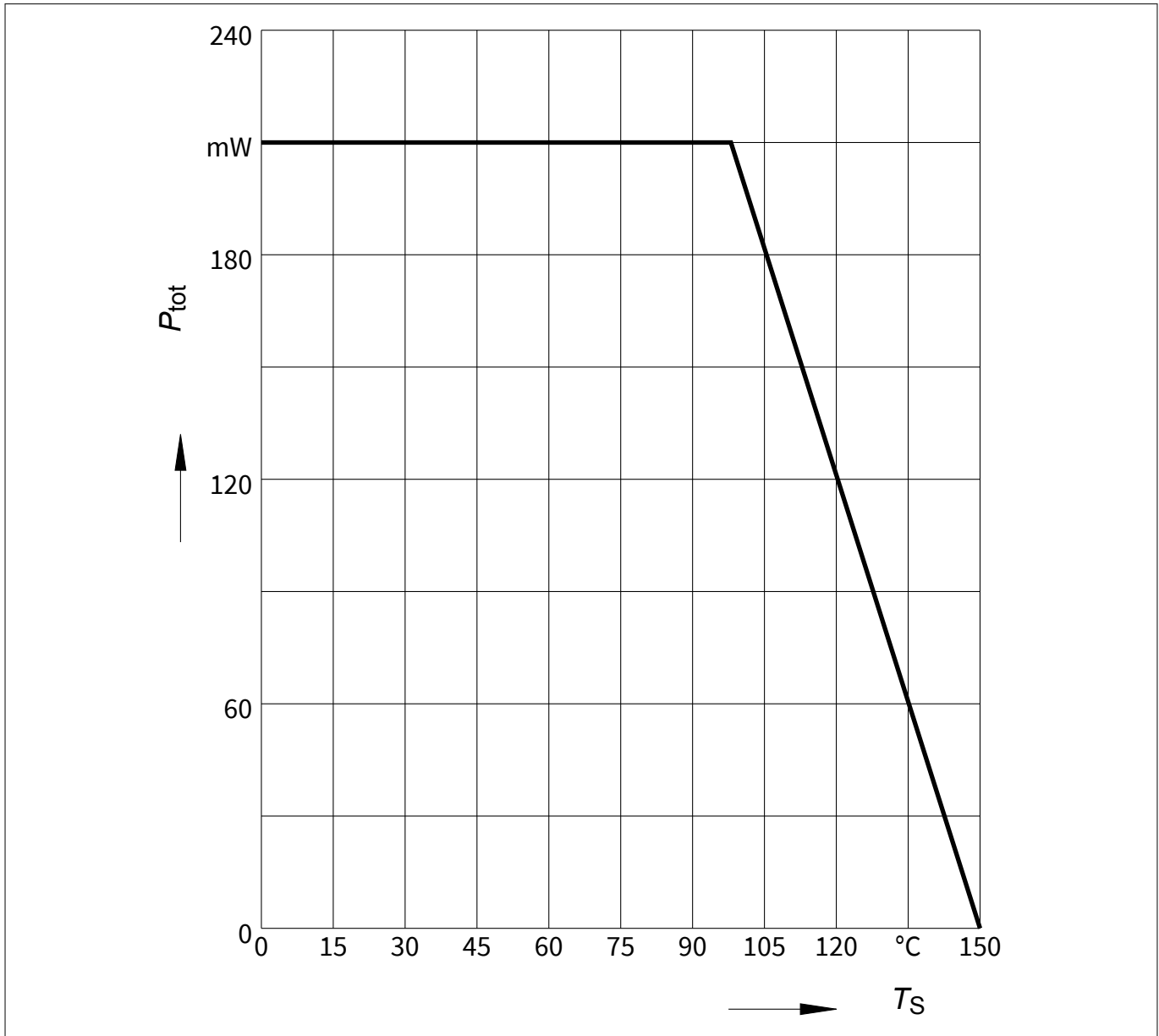


Figure 1 Total power dissipation $P_{tot} = f(T_S)$

Electrical characteristics

3 Electrical characteristics

3.1 DC characteristics

Table 4 DC characteristics at $T_A = 25\text{ °C}$ (unless otherwise specified)

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|-------------------------------------|---------------|--------|------|-------------------|------|--|
| | | Min. | Typ. | Max. | | |
| Collector emitter breakdown voltage | $V_{(BR)CEO}$ | 6 | 9 | – | V | $I_C = 1\text{ mA}$, $I_B = 0$, open base |
| Collector emitter leakage current | I_{CES} | – | 1 | 30 ²⁾ | nA | $V_{CE} = 4\text{ V}$, $V_{BE} = 0$, E-B short circuited |
| | | | 2 | 50 ²⁾ | | $V_{CE} = 10\text{ V}$, $V_{BE} = 0$, $T_A = 85\text{ °C}$, E-B short circuited |
| Collector base leakage current | I_{CBO} | | 1 | 30 ²⁾ | | $V_{CB} = 4\text{ V}$, $I_E = 0$, open emitter |
| Emitter base leakage current | I_{EBO} | | 1 | 500 ²⁾ | | $V_{EB} = 1\text{ V}$, $I_C = 0$, open collector |
| DC current gain | h_{FE} | 90 | 120 | 160 | | $V_{CE} = 3\text{ V}$, $I_C = 15\text{ mA}$, 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 | 11 | 14 | – | GHz | $V_{CE} = 3\text{ V}$, $I_C = 15\text{ mA}$, $f = 1\text{ GHz}$ |
| Collector base capacitance | C_{CB} | – | 0.32 | 0.5 | pF | $V_{CB} = 5\text{ V}$, $V_{BE} = 0$, $f = 1\text{ MHz}$, emitter grounded |
| Collector emitter capacitance | C_{CE} | | 0.2 | – | | $V_{CE} = 5\text{ V}$, $V_{BE} = 0$, $f = 1\text{ MHz}$, base grounded |
| Emitter base capacitance | C_{EB} | | 0.4 | | | $V_{EB} = 0.5\text{ V}$, $V_{CB} = 0$, $f = 1\text{ MHz}$, collector grounded |

² 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, $T_A = 25\text{ °C}$.

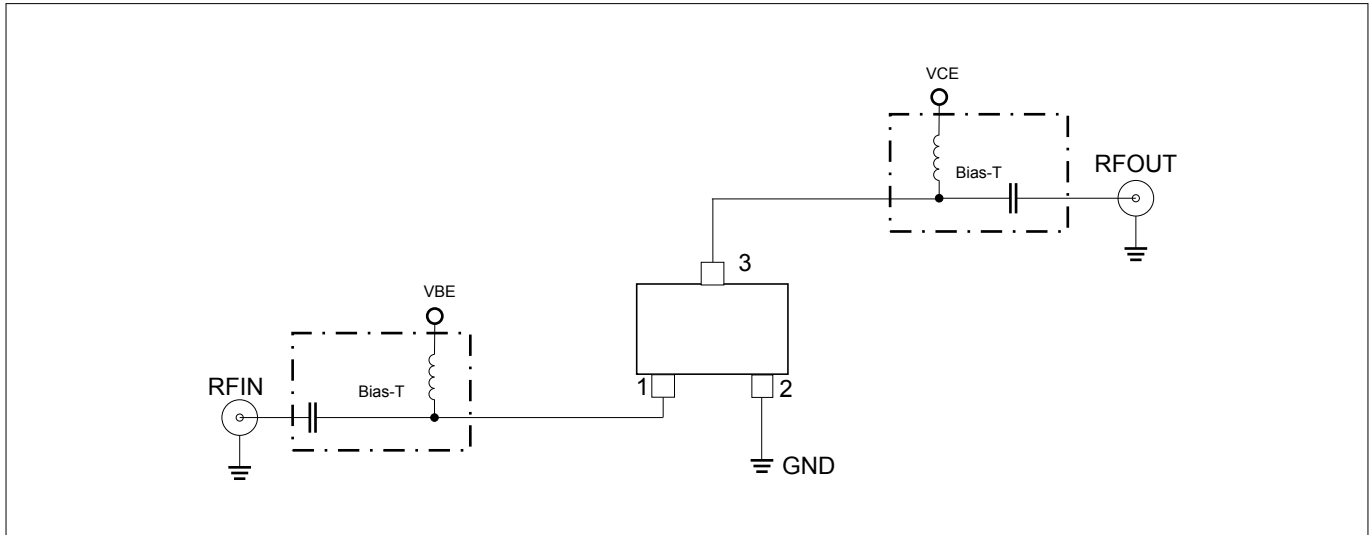


Figure 2 Testing circuit

Table 6 AC characteristics, $V_{CE} = 3\text{ V}$, $f = 1.8\text{ GHz}$

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|---|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Power gain | | - | | - | dB | $I_C = 15\text{ mA}$ |
| • Maximum power gain | G_{ma} | | 15.5 | | | |
| • Transducer gain | $ S_{21} ^2$ | | 13 | | | |
| Noise figure | | | | | | |
| • Minimum noise figure | NF_{min} | | 1 | | | $I_C = 3\text{ mA}$ |
| Linearity | | | | | dBm | $I_C = 15\text{ mA}$, $Z_S = Z_L = 50\text{ }\Omega$ |
| • 3rd order intercept point at output | OIP_3 | | 24 | | | |
| • 1 dB gain compression point at output | OP_{1dB} | | 9 | | | |

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

| Parameter | Symbol | Values | | | Unit | Note or test condition |
|----------------------|--------------|--------|------|------|------|------------------------|
| | | Min. | Typ. | Max. | | |
| Power gain | | - | | - | dB | $I_C = 15\text{ mA}$ |
| • Maximum power gain | G_{ma} | | 11 | | | |
| • Transducer gain | $ S_{21} ^2$ | | 9 | | | |

Note: $G_{ms} = |S_{21} / S_{12}|$ for $k < 1$; $G_{ma} = |S_{21} / S_{12}| \sqrt{k - (k^2 - 1)^{1/2}}$ 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 0.1 MHz to 6 GHz.

Electrical characteristics

3.4 Characteristic AC diagrams

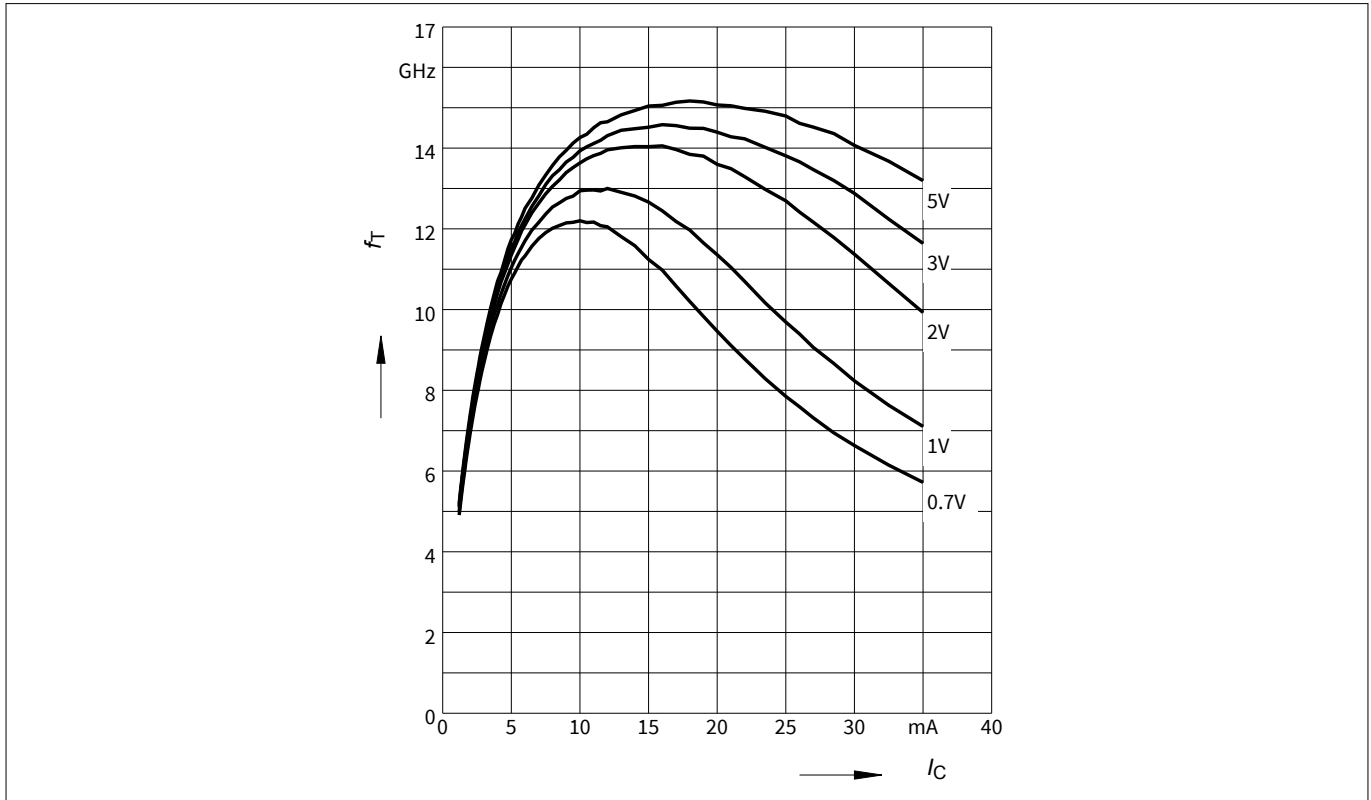


Figure 3 Transition frequency $f_T = f(I_C)$, $f = 1 \text{ GHz}$, $V_{CE} = \text{parameter}$

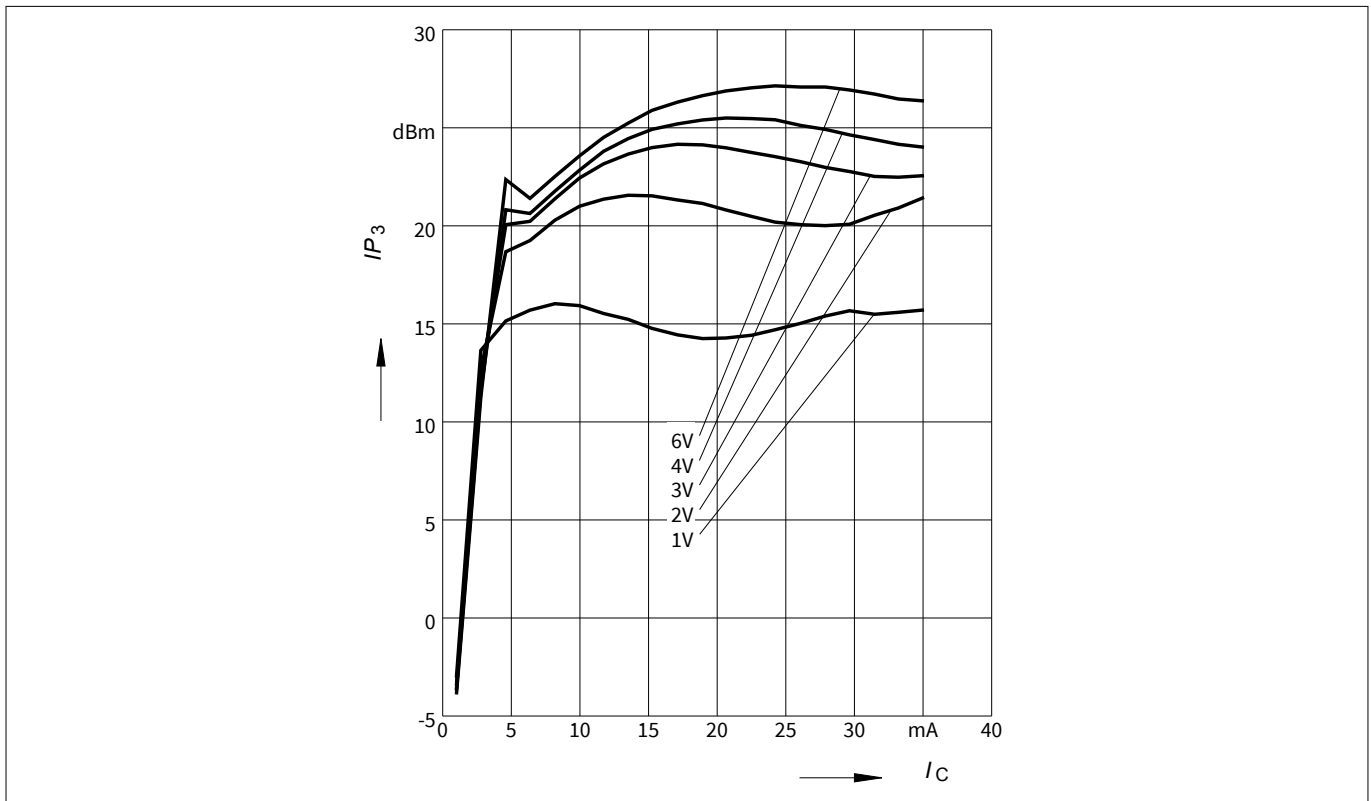


Figure 4 3rd order intercept point $OIP_3 = f(I_C)$, $Z_S = Z_L = 50 \Omega$, V_{CE} , $f = 1.8 \text{ GHz}$, $V_{CE} = \text{parameter}$

Electrical characteristics

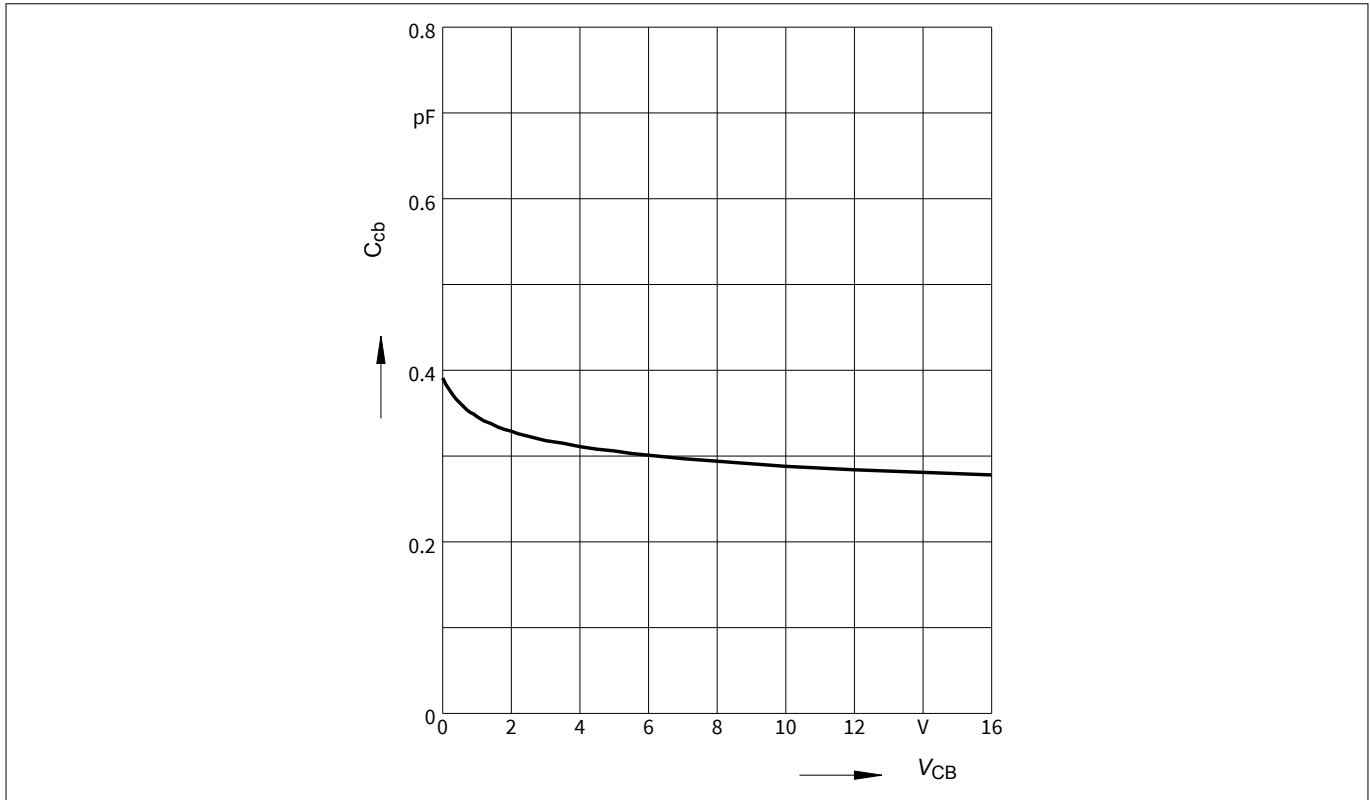


Figure 5 Collector base capacitance $C_{CB} = f(V_{CB}), f = 1 \text{ MHz}$

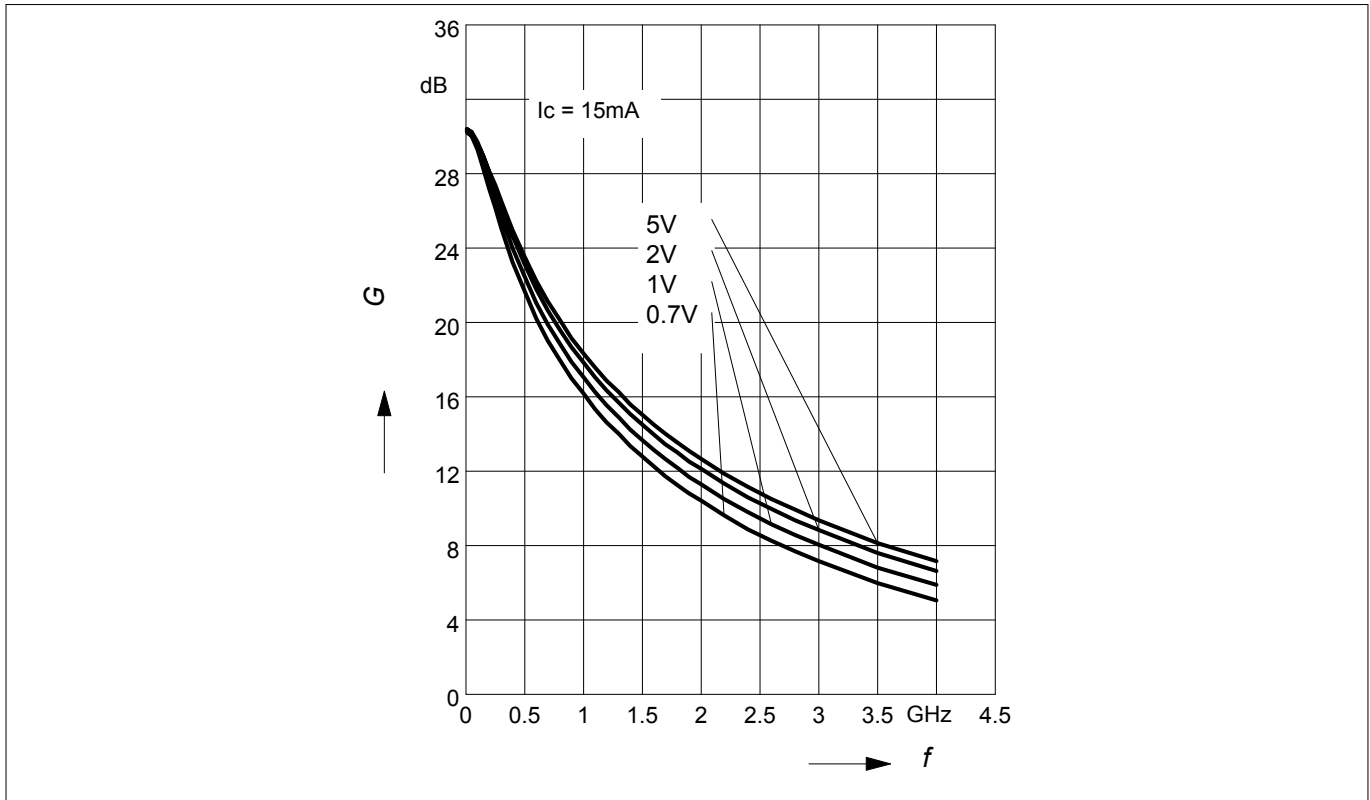


Figure 6 Transducer Gain $IS_{21}I^2 = f(f), I_C = 15 \text{ mA}, V_{CE} = \text{parameter}$

Electrical characteristics

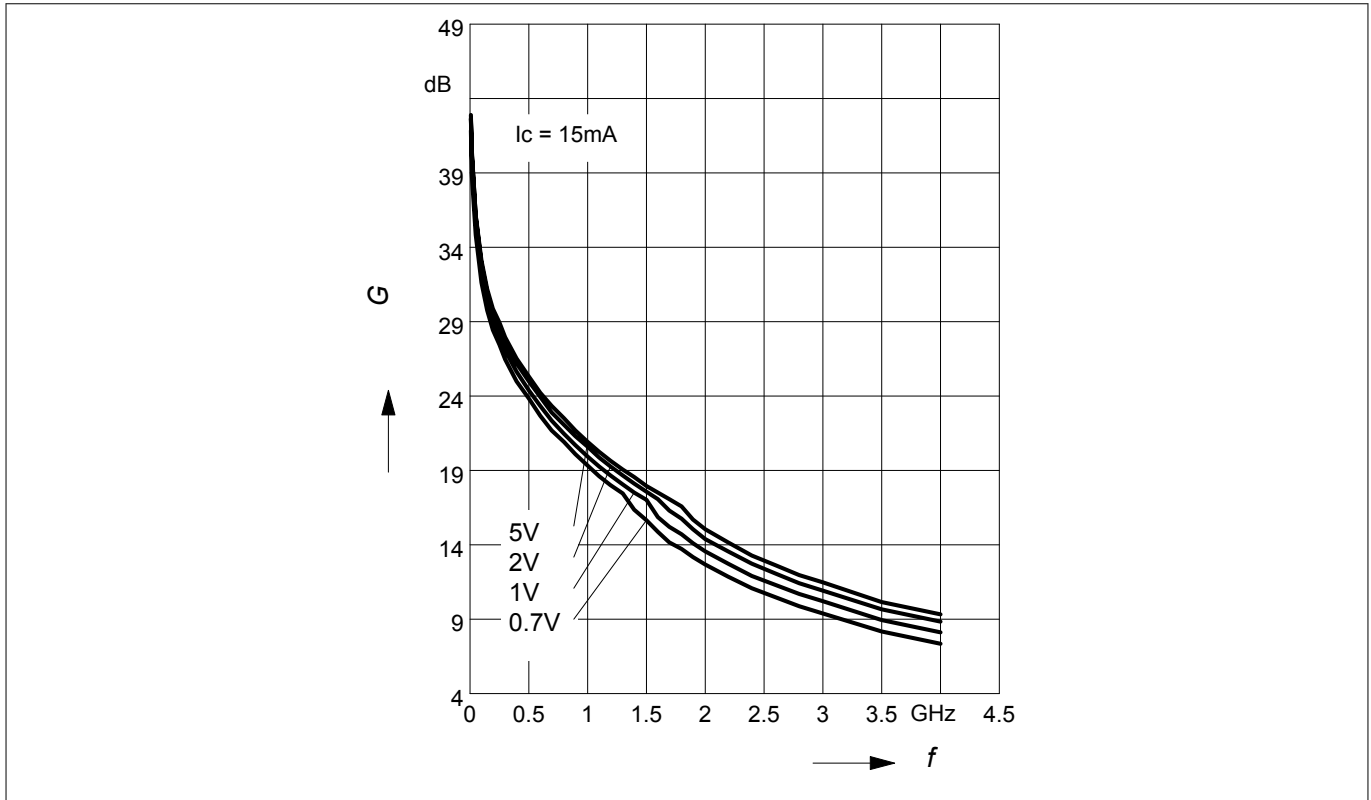


Figure 7 Gain $G_{ma}, G_{ms} = f(f), I_C = 15\text{ mA}, V_{CE} = \text{parameter}$

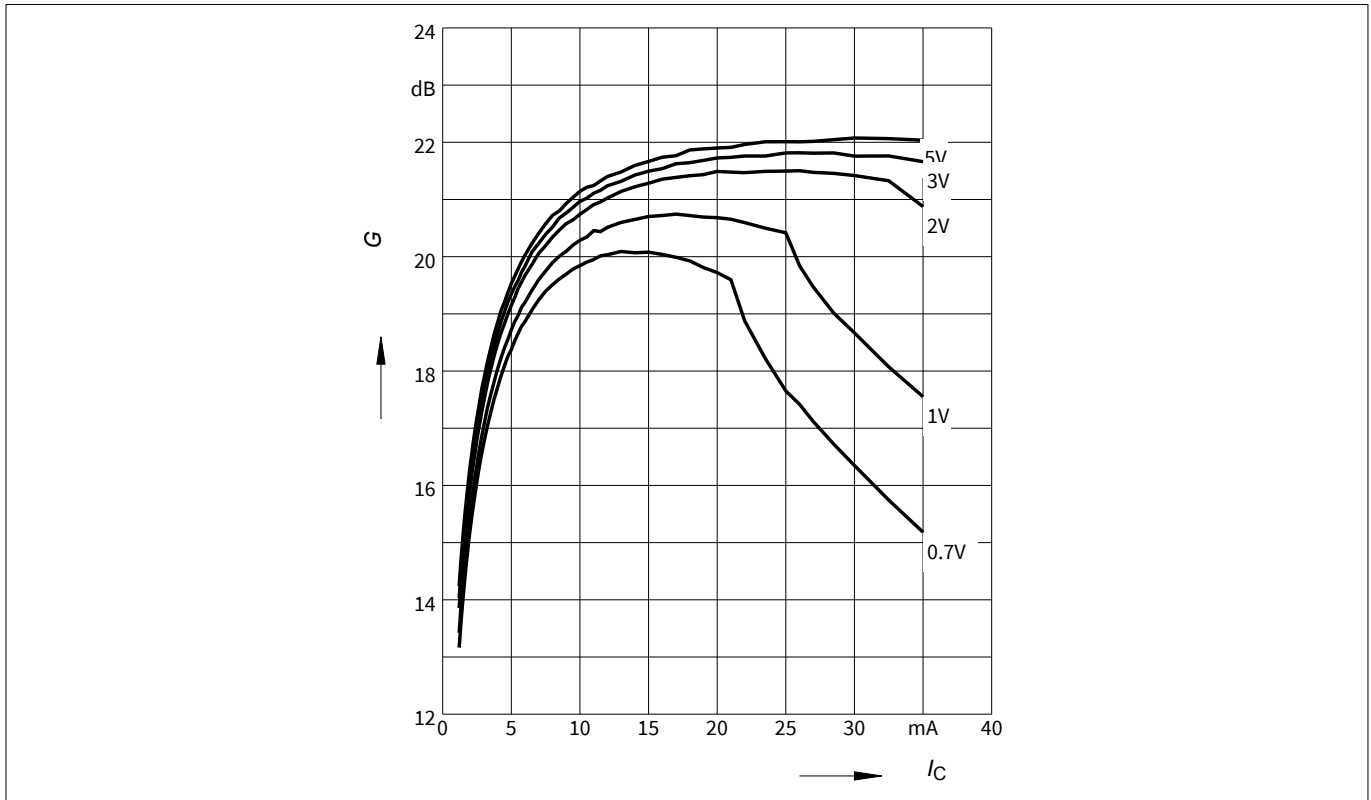


Figure 8 Gain $G_{ma}, G_{ms} = f(I_C), f = 900\text{ MHz}, V_{CE} = \text{parameter}$

Electrical characteristics

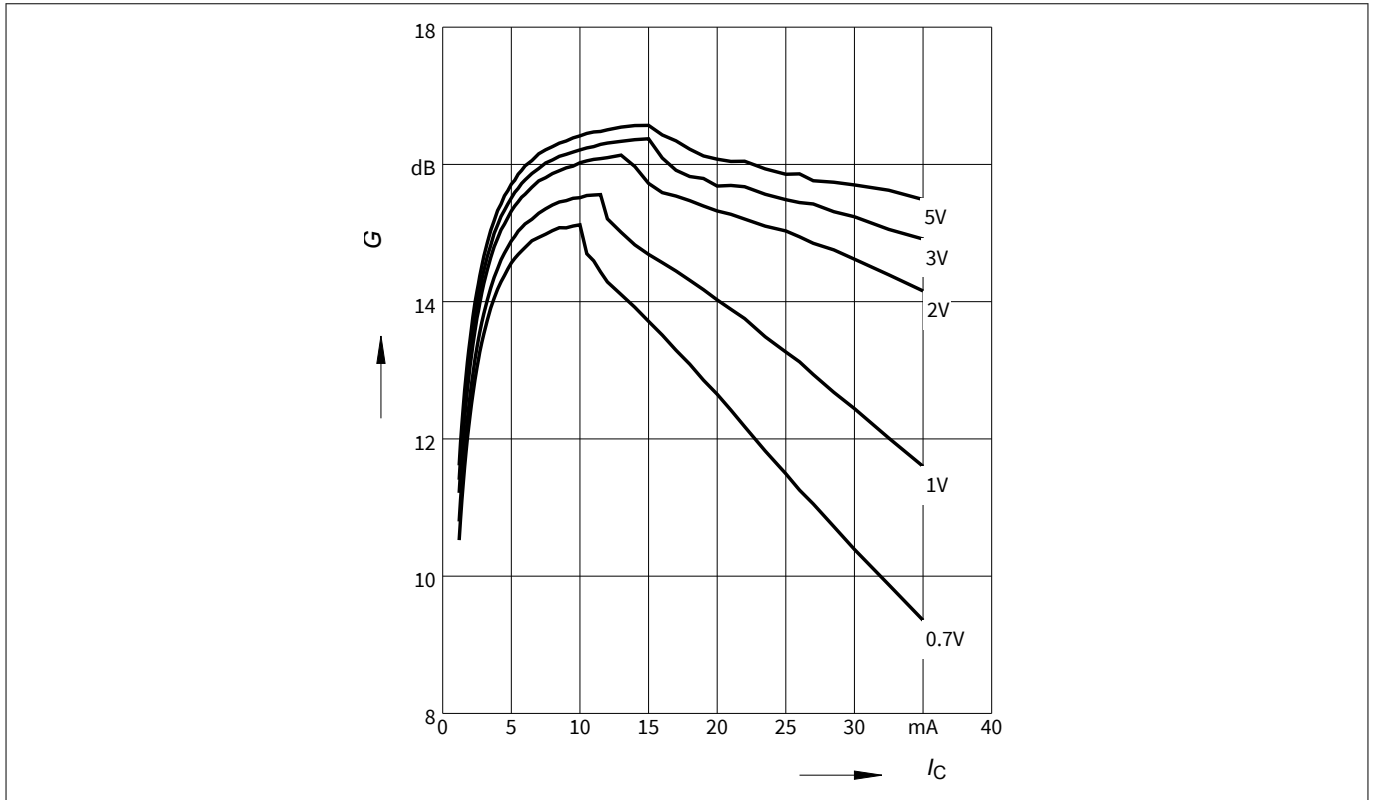


Figure 9 Gain $G_{ma}, G_{ms} = f(I_C), f = 1.8 \text{ GHz}, V_{CE} = \text{parameter}$

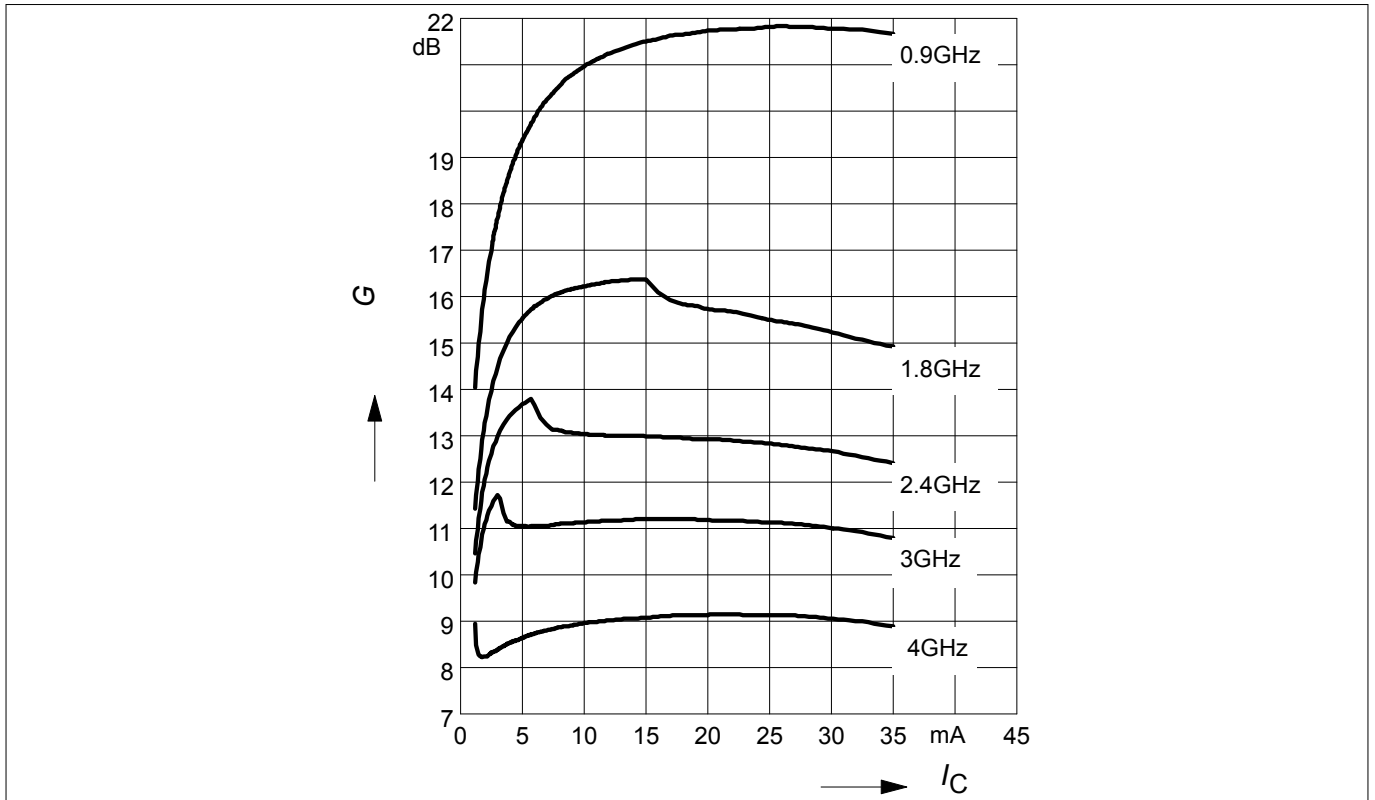


Figure 10 Maximum power gain $G_{max} = f(I_C), V_{CE} = 3 \text{ V}, f = \text{parameter in GHz}$

Electrical characteristics

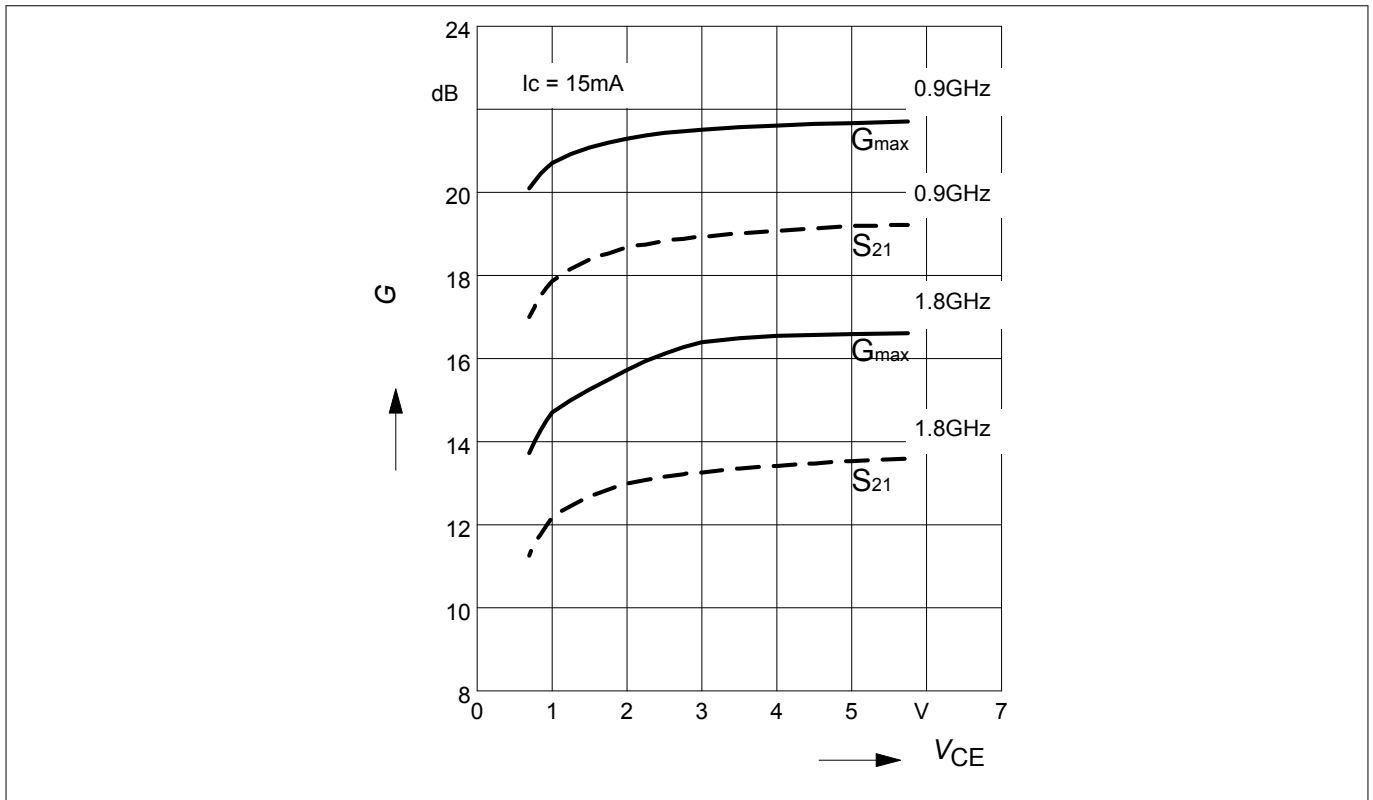


Figure 11 Maximum power gain $G_{max} = f(V_{CE})$, transducer gain $|S_{21}|^2 = f(V_{CE})$, $I_C = 15\text{ mA}$, $f =$ parameter in GHz

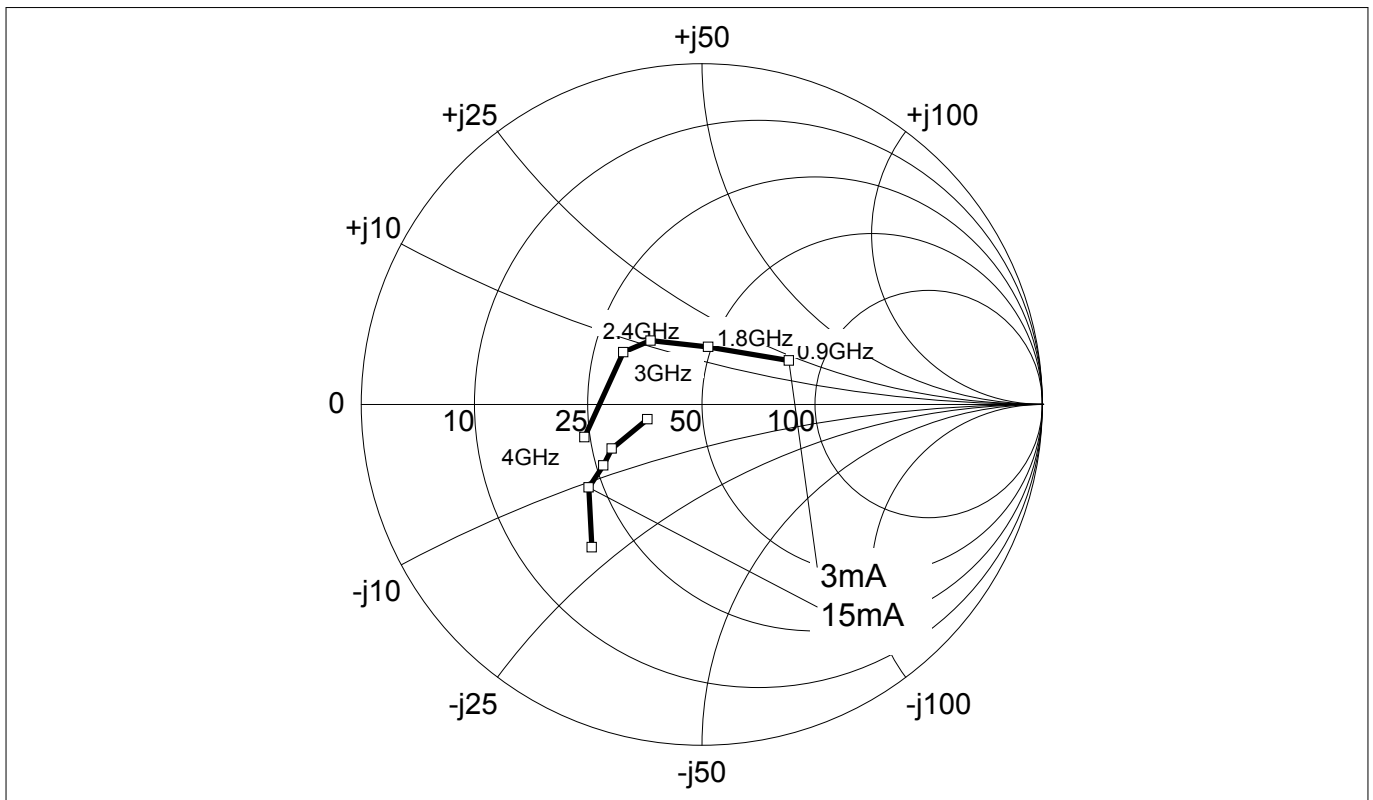


Figure 12 Source impedance for minimum noise figure $Z_{s,opt} = f(f)$, $V_{CE} = 3\text{ V}$, $I_C = 3 / 15\text{ mA}$

Electrical characteristics

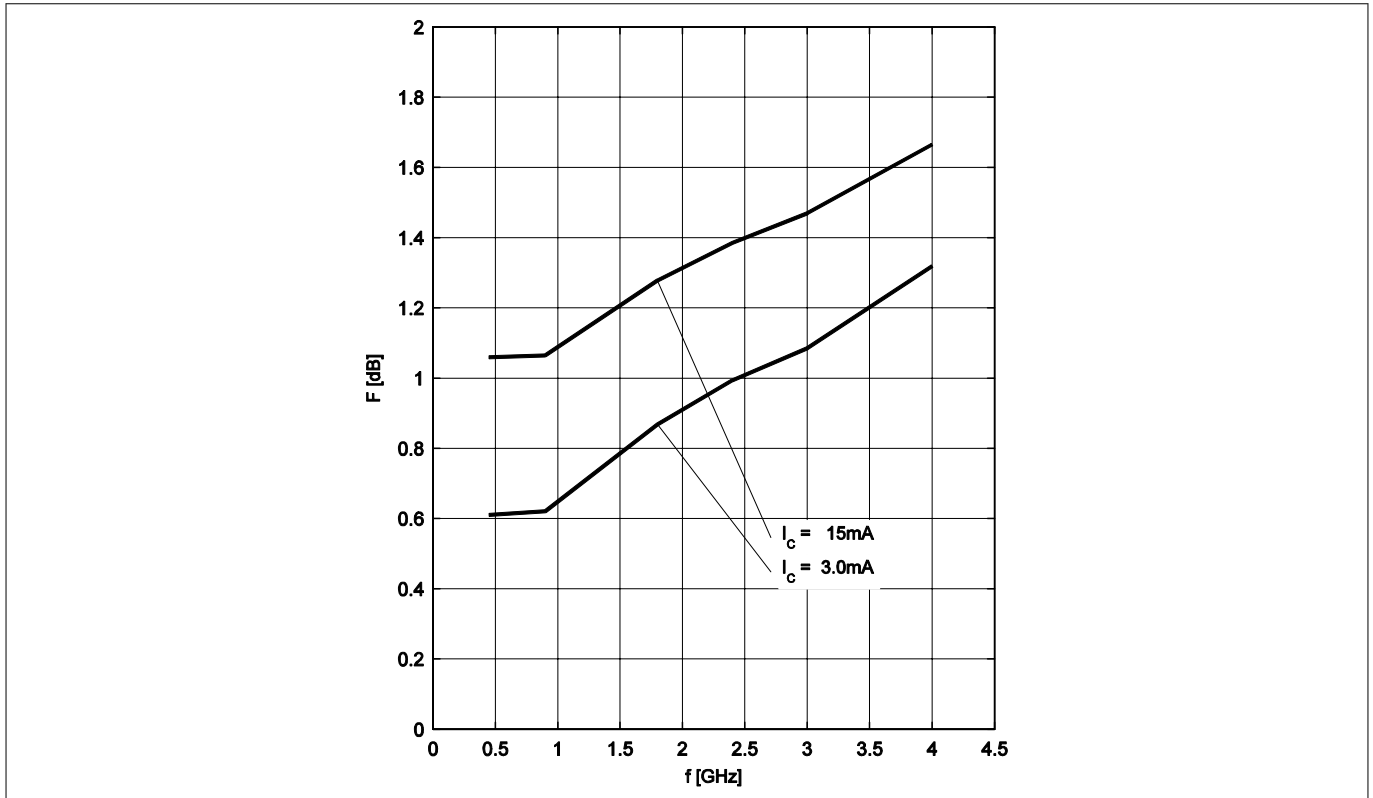


Figure 13 Minimum noise figure $NF_{min} = f(f)$, $V_{CE} = 3\text{ V}$, $Z_S = Z_{S,opt}$, $I_C = 3 / 15\text{ mA}$

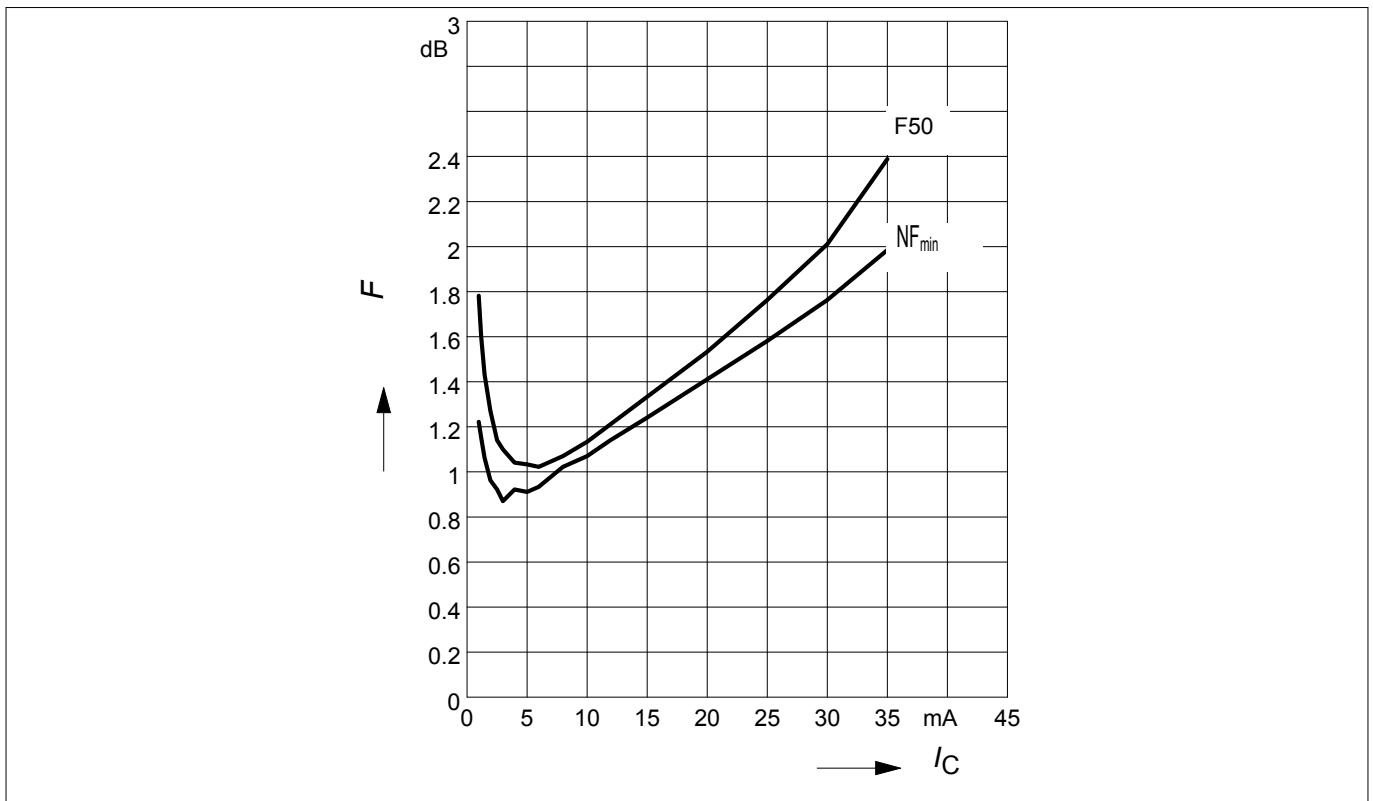


Figure 14 Noise figure $NF_{min} = f(I_C)$, $Z_S = Z_{S,opt}$, $NF_{50} = f(I_C)$, $Z_S = 50\ \Omega$, $V_{CE} = 3\text{ V}$, $f = 1.8\text{ GHz}$

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 TSFP-3-1

4 Package information TSFP-3-1

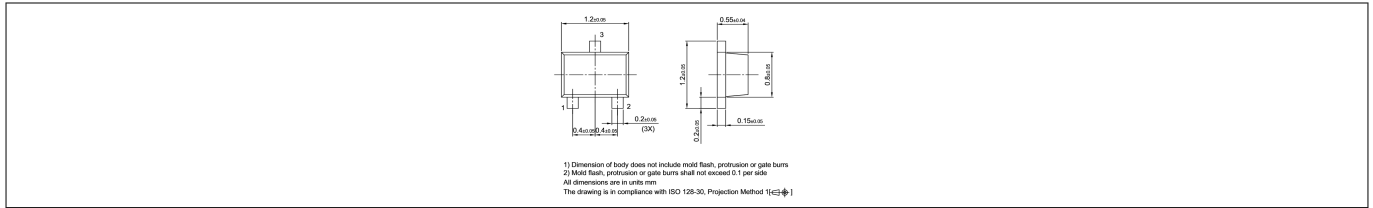


Figure 15 Package outline

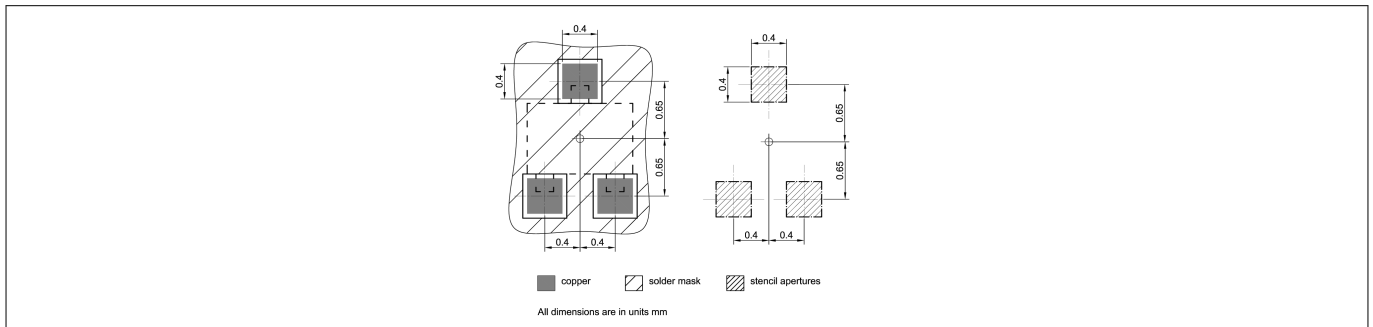


Figure 16 Foot print

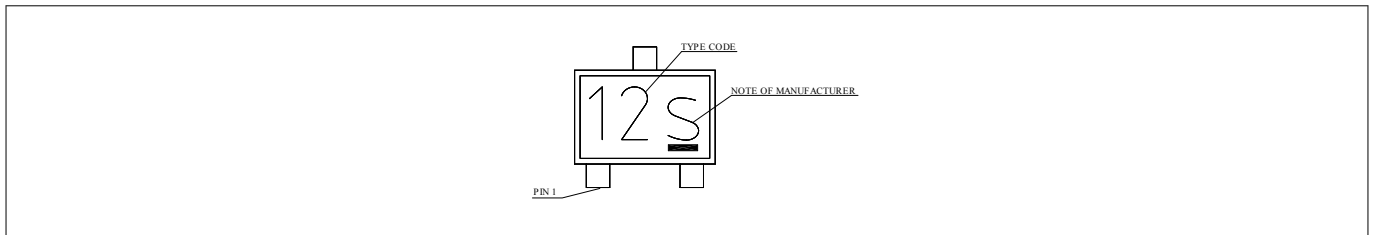


Figure 17 Marking layout example

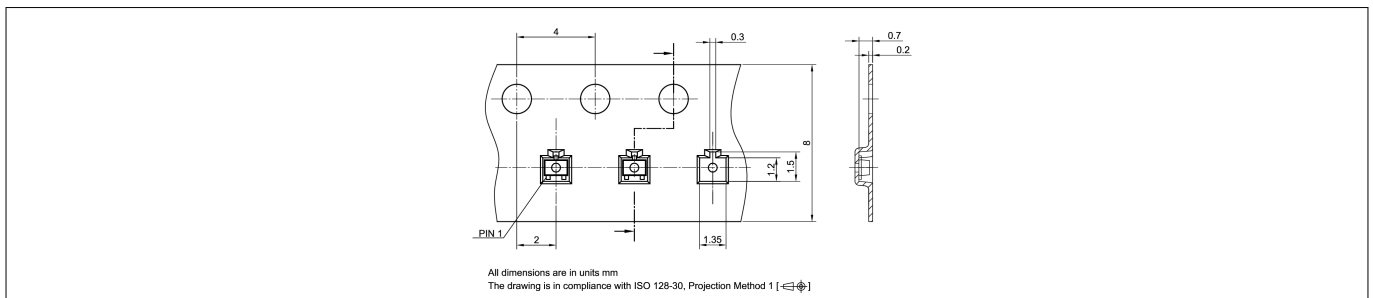


Figure 18 Tape information

Revision history

Revision history

| Document version | Date of release | Description of changes |
|------------------|-----------------|------------------------|
| Revision 2.0 | 2019-01-25 | New datasheet layout. |

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