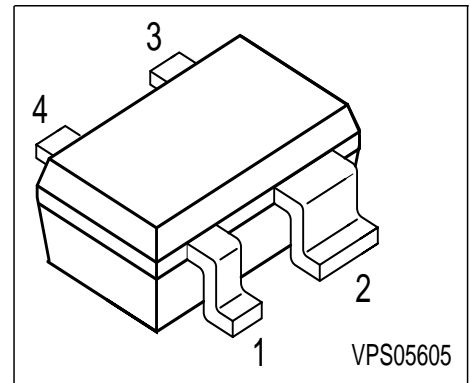


NPN Silicon RF Transistor

- For low current applications
- For oscillators up to 12 GHz
- Noise figure $F = 1.25$ dB at 1.8 GHz
outstanding $G_{ms} = 23$ dB at 1.8 GHz
- Transition frequency $f_T = 25$ GHz
- Gold metallization for high reliability
- **SIEGET® 25 GHz f_T - Line**



ESD: Electrostatic discharge sensitive device, observe handling precaution!

| Type | Marking | Pin Configuration | | | | Package |
|--------|---------|-------------------|-----|-----|-----|---------|
| BFP405 | ALs | 1=B | 2=E | 3=C | 4=E | SOT343 |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|-----------|-------------|------|
| Collector-emitter voltage | V_{CEO} | 4.5 | V |
| Collector-base voltage | V_{CBO} | 15 | |
| Emitter-base voltage | V_{EBO} | 1.5 | |
| Collector current | I_C | 12 | mA |
| Base current | I_B | 1 | |
| Total power dissipation $T_S \leq 120^\circ\text{C}$ ¹⁾ | P_{tot} | 55 | mW |
| Junction temperature | T_j | 150 | °C |
| Ambient temperature | T_A | -65 ... 150 | |
| Storage temperature | T_{stg} | -65 ... 150 | |

Thermal Resistance

| | | | |
|--|------------|------------|-----|
| Junction - soldering point ²⁾ | R_{thJS} | ≤ 520 | K/W |
|--|------------|------------|-----|

¹ T_S is measured on the emitter lead at the soldering point to the pcb

² For calculation of R_{thJA} please refer to Application Note Thermal Resistance

Electrical Characteristics at $T_A = 25^\circ\text{C}$, unless otherwise specified.

| Parameter | Symbol | Values | | | Unit |
|--|---------------|--------|------|------|---------------|
| | | min. | typ. | max. | |
| DC characteristics | | | | | |
| Collector-emitter breakdown voltage $I_C = 1 \text{ mA}, I_B = 0$ | $V_{(BR)CEO}$ | 4.5 | 5 | - | V |
| Collector-base cutoff current $V_{CB} = 5 \text{ V}, I_E = 0$ | I_{CBO} | - | - | 150 | nA |
| Emitter-base cutoff current $V_{EB} = 1.5 \text{ V}, I_C = 0$ | I_{EBO} | - | - | 15 | μA |
| DC current gain $I_C = 5 \text{ mA}, V_{CE} = 4 \text{ V}$ | h_{FE} | 50 | 90 | 150 | - |
| AC characteristics (verified by random sampling) | | | | | |
| Transition frequency $I_C = 10 \text{ mA}, V_{CE} = 3 \text{ V}, f = 2 \text{ GHz}$ | f_T | 18 | 25 | - | GHz |
| Collector-base capacitance $V_{CB} = 2 \text{ V}, f = 1 \text{ MHz}$ | C_{cb} | - | 0.05 | 0.1 | pF |
| Collector-emitter capacitance $V_{CE} = 2 \text{ V}, f = 1 \text{ MHz}$ | C_{ce} | - | 0.24 | - | |
| Emitter-base capacitance $V_{EB} = 0.5 \text{ V}, f = 1 \text{ MHz}$ | C_{eb} | - | 0.29 | - | |
| Noise figure $I_C = 2 \text{ mA}, V_{CE} = 2 \text{ V}, Z_S = Z_{Sopt}, f = 1.8 \text{ GHz}$ | F | - | 1.25 | - | dB |
| Power gain ¹⁾ $I_C = 5 \text{ mA}, V_{CE} = 2 \text{ V}, Z_S = Z_{Sopt}, Z_L = Z_{Lopt}, f = 1.8 \text{ GHz}$ | G_{ms} | - | 23 | - | |
| Insertion power gain $I_C = 5 \text{ mA}, V_{CE} = 2 \text{ V}, f = 1.8 \text{ MHz}, Z_S = Z_L = 50\Omega$ | $ S_{21} ^2$ | 14 | 18 | - | |
| Third order intercept point $I_C = 5 \text{ mA}, V_{CE} = 2 \text{ V}, Z_S = Z_{Sopt}, Z_L = Z_{Lopt}, f = 1.8 \text{ GHz}$ | IP_3 | - | 15 | - | dBm |
| 1dB Compression point $I_C = 5 \text{ mA}, V_{CE} = 2 \text{ V}, f = 1.8 \text{ GHz}, Z_S = Z_{Sopt}, Z_L = Z_{Lopt}$ | P_{-1dB} | - | 5 | - | |

$$^1G_{ms} = |S_{21} / S_{12}|$$

SPICE Parameters (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax) :

Transistor Chip Data

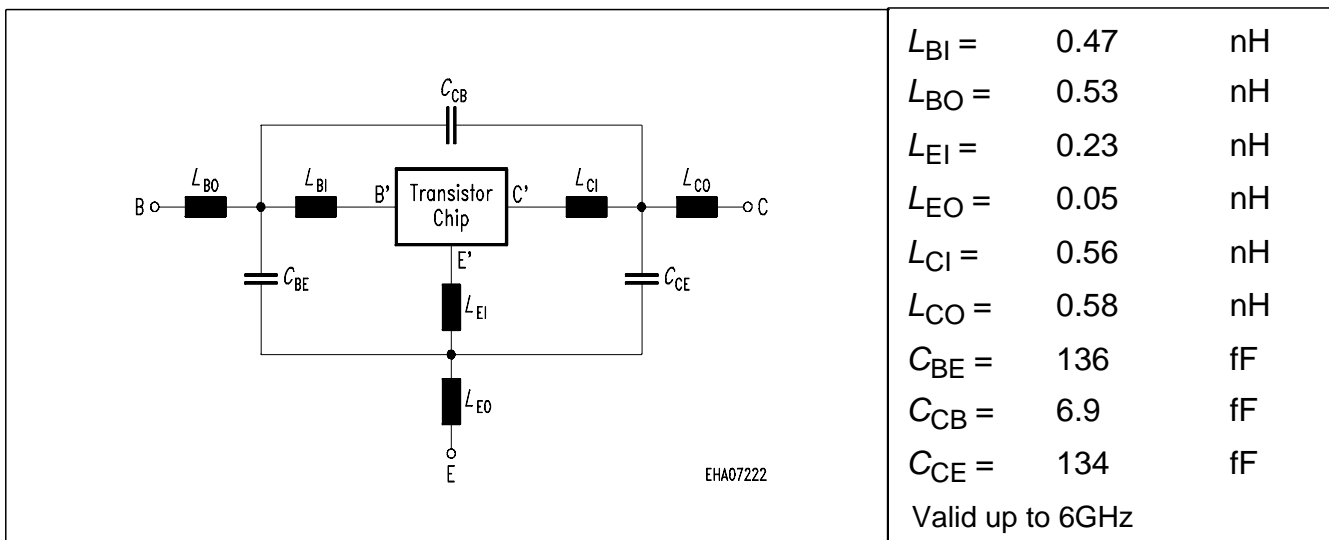
| | | | | | | | | |
|-------|---------|----|-------|---------|-----|--------|----------|----|
| IS = | 0.21024 | fA | BF = | 83.23 | - | NF = | 1.0405 | - |
| VAF = | 39.251 | V | IKF = | 0.16493 | A | ISE = | 15.761 | fA |
| NE = | 1.7763 | - | BR = | 10.526 | - | NR = | 0.96647 | - |
| VAR = | 34.368 | V | IKR = | 0.25052 | A | ISC = | 0.037223 | fA |
| NC = | 1.3152 | - | RB = | 15 | Ω | IRB = | 0.21215 | mA |
| RBM = | 1.3491 | Ω | RE = | 1.9289 | | RC = | 0.12691 | Ω |
| CJE = | 3.7265 | fF | VJE = | 0.70367 | V | MJE = | 0.37747 | - |
| TF = | 4.5899 | ps | XTF = | 0.3641 | - | VTF = | 0.19762 | V |
| ITF = | 1.3364 | mA | PTF = | 0 | deg | CJC = | 96.941 | fF |
| VJC = | 0.99532 | V | MJC = | 0.48652 | - | XCJC = | 0.08161 | - |
| TR = | 1.4935 | ns | CJS = | 0 | fF | VJS = | 0.75 | V |
| MJS = | 0 | - | XTB = | 0 | - | EG = | 1.11 | eV |
| XTI = | 3 | - | FC = | 0.99469 | - | TNOM | 300 | K |

C'-E'-Diode Data (Berkley-SPICE 2G.6 Syntax) :

| | | | | | | | | |
|------|---|----|-----|------|---|------|----|---|
| IS = | 2 | fA | N = | 1.02 | - | RS = | 20 | Ω |
|------|---|----|-----|------|---|------|----|---|

All parameters are ready to use, no scaling is necessary

Package Equivalent Circuit:



The SOT-343 package has two emitter leads. To avoid high complexity of the package equivalent circuit, both leads are combined in one electrical connection.

Extracted on behalf of Infineon Technologies AG by:
Institut für Mobil-und Satellitentechnik (IMST)

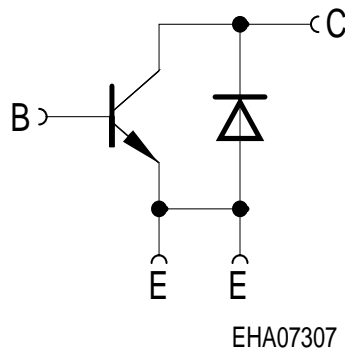
For examples and ready to use parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies CD-ROM or see Internet:
<http://www.infineon.com/silicondiscretes>

For non-linear simulation:

- Use transistor chip parameters in Berkeley SPICE 2G.6 syntax for all simulators.
- If you need simulation of the reverse characteristics, add the diode with the C'-E'- diode data between collector and emitter.
- Simulation of package is not necessary for frequencies < 100MHz.
For higher frequencies add the wiring of package equivalent circuit around the non-linear transistor and diode model.

Note:

- This transistor is constructed in a common emitter configuration. This feature causes an additional reverse biased diode between emitter and collector, which does not effect normal operation.



Transistor Schematic Diagram

The common emitter configuration shows the following advantages:

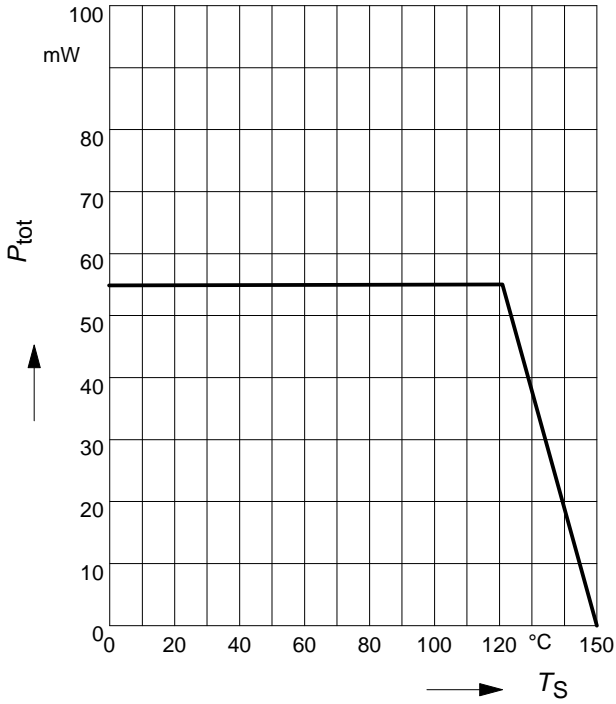
- Higher gain because of lower emitter inductance.
- Power is dissipated via the grounded emitter leads, because the chip is mounted on copper emitter leadframe.

Please note, that the broadest lead is the emitter lead.

Common Emitter S- and Noise-parameter

For detailed S- and Noise-parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies Application Notes CD-ROM or see Internet: <http://www.infineon.com/silicondiscretes>

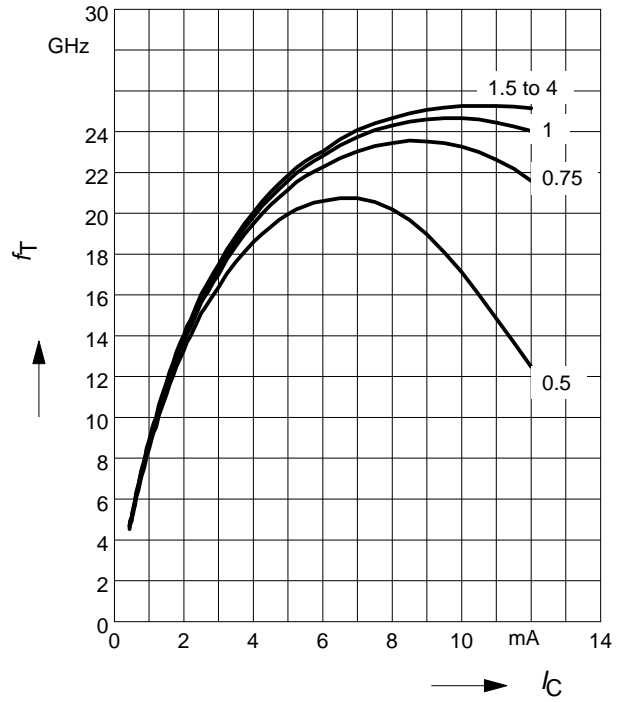
Total power dissipation $P_{tot} = f(T_S)$



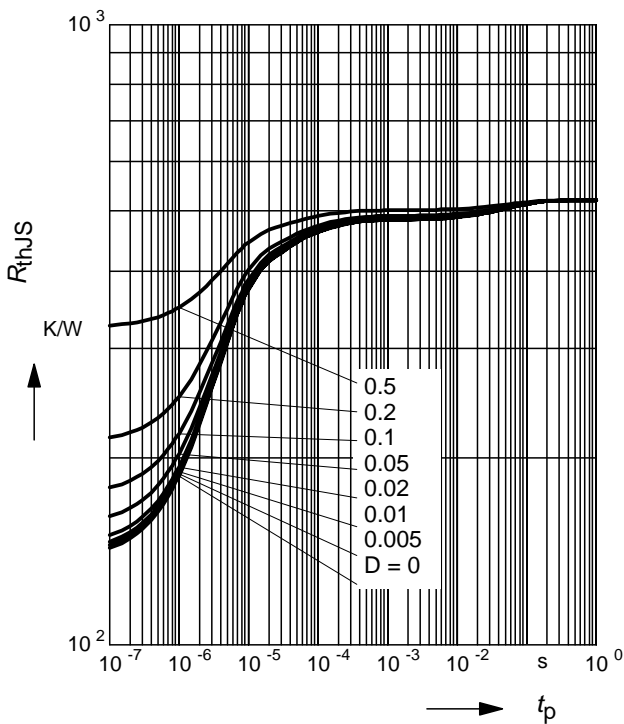
Transition frequency $f_T = f(I_C)$

$f = 2$ GHz

$V_{CE} =$ parameter in V

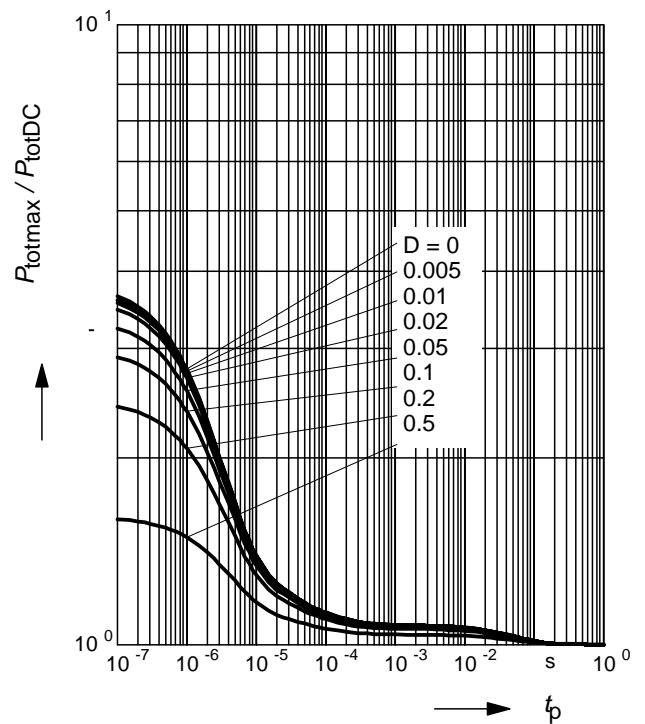


Permissible Pulse Load $R_{thJS} = f(t_p)$



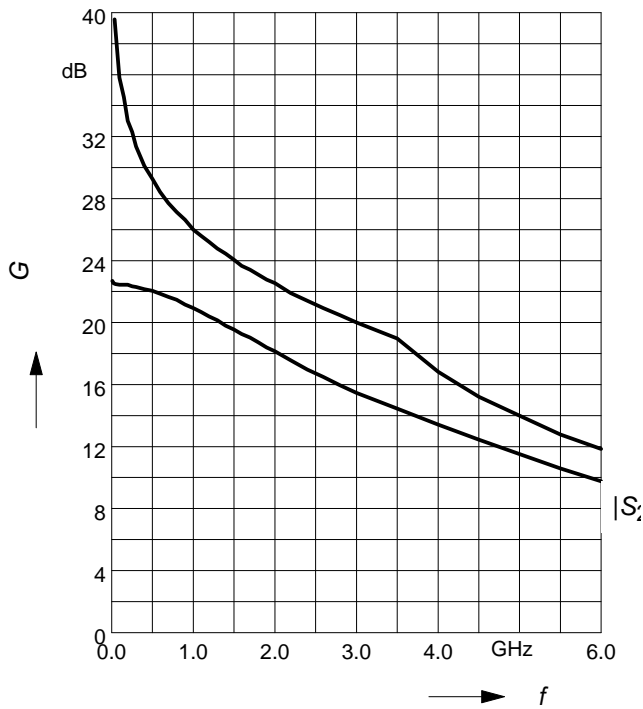
Permissible Pulse Load

$P_{totmax}/P_{totDC} = f(t_p)$



Power gain G_{ma} , G_{ms} , $|S_{21}|^2 = f(f)$

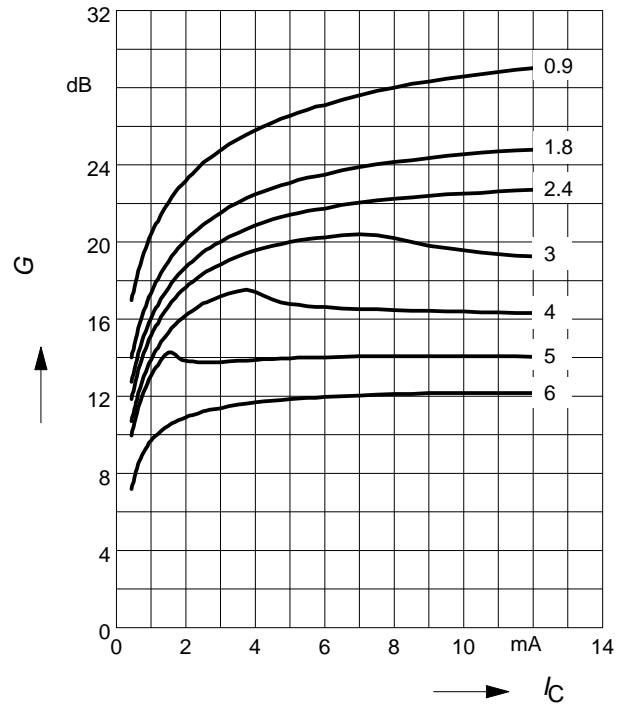
$V_{CE} = 2\text{ V}$, $I_C = 5\text{ mA}$



Power gain G_{ma} , $G_{ms} = f(I_C)$

$V_{CE} = 2\text{ V}$

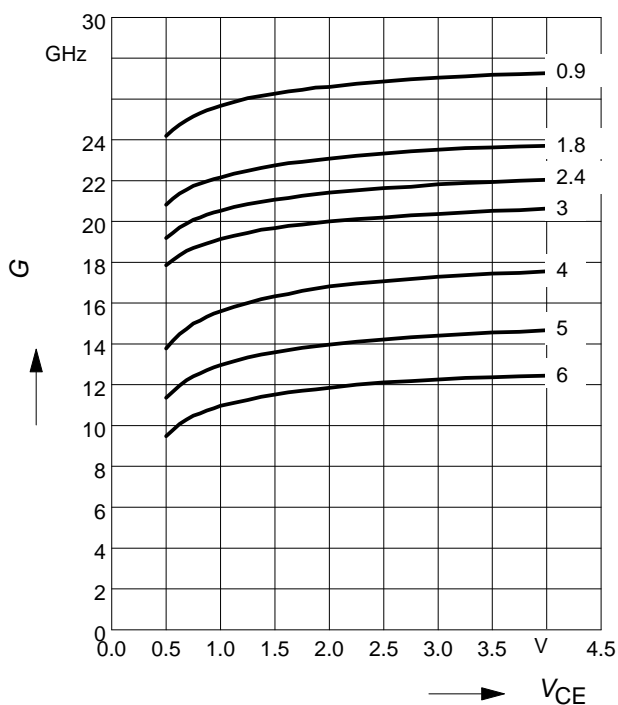
$f = \text{parameter in GHz}$



Power gain G_{ma} , $G_{ms} = f(V_{CE})$

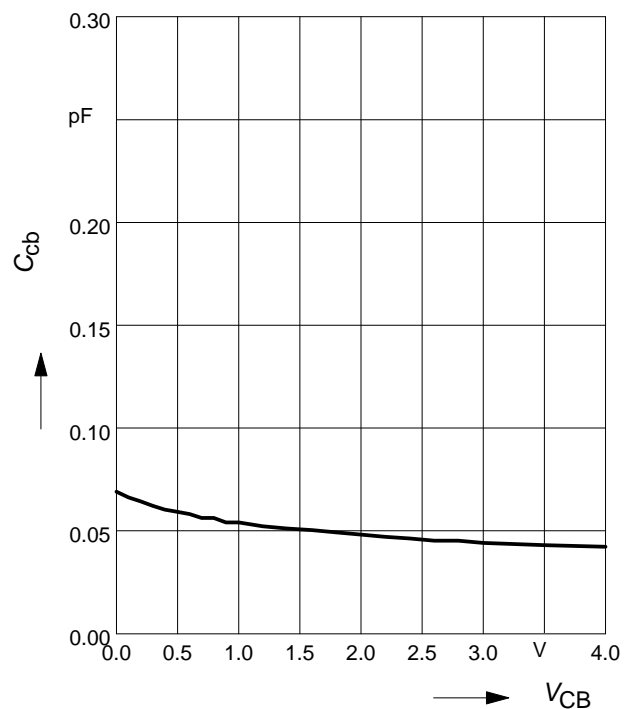
$I_C = 5\text{ mA}$

$f = \text{parameter in GHz}$



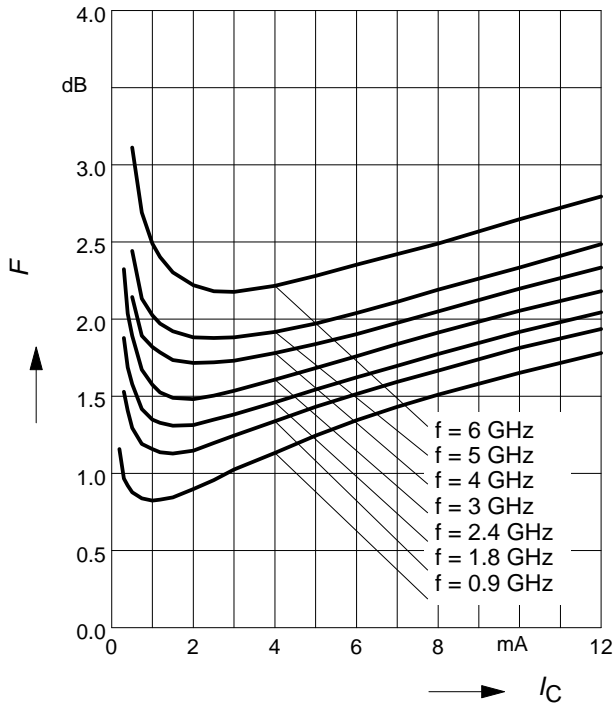
Collector-base capacitance $C_{cb} = f(V_{CB})$

$f = 1\text{ MHz}$



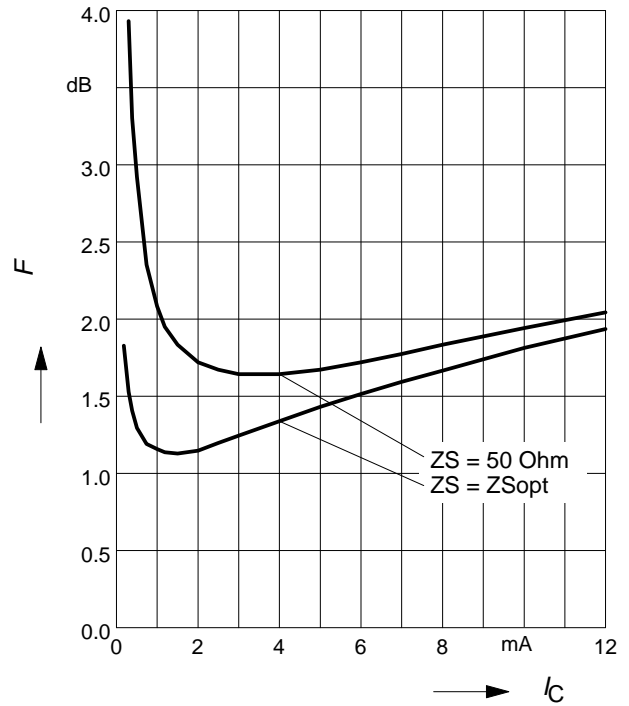
Noise figure $F = f(I_C)$

$V_{CE} = 2\text{ V}$, $Z_S = Z_{Sopt}$



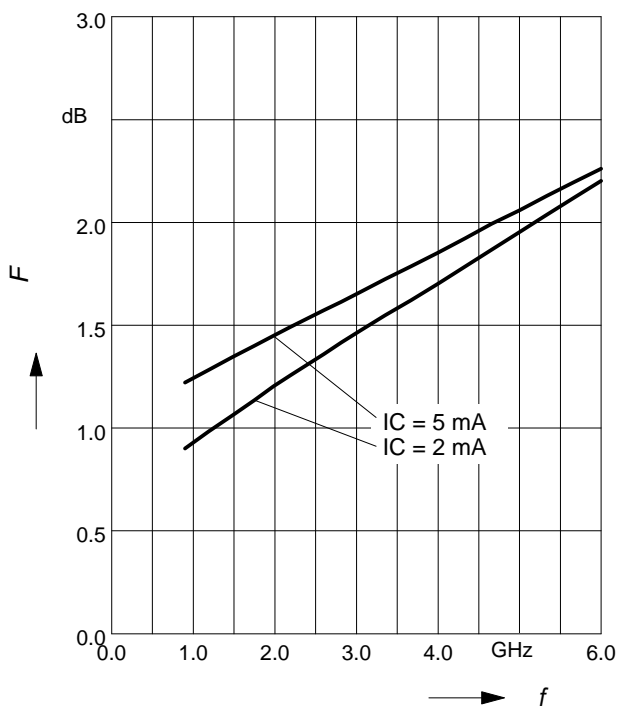
Noise figure $F = f(I_C)$

$V_{CE} = 2\text{ V}$, $f = 1.8\text{ GHz}$



Noise figure $F = f(f)$

$V_{CE} = 2\text{ V}$, $Z_S = Z_{Sopt}$



Source impedance for min.

Noise Figure versus Frequency

$V_{CE} = 2\text{ V}$, $I_C = 2\text{ mA} / 5\text{ mA}$

