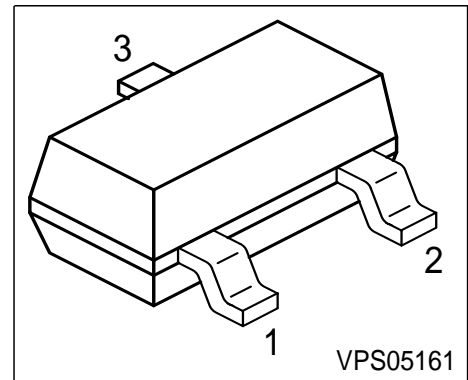


NPN Silicon RF Transistor

- For low-noise, high-gain broadband amplifiers at collector currents from 2 mA to 30 mA



ESD: Electrostatic discharge sensitive device, observe handling precaution!

| Type | Marking | Pin Configuration | | | Package |
|--------|---------|-------------------|-------|-------|---------|
| BFR93A | R2s | 1 = B | 2 = E | 3 = C | SOT23 |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|-----------|-------------|------------------|
| Collector-emitter voltage | V_{CEO} | 12 | V |
| Collector-emitter voltage | V_{CES} | 20 | |
| Collector-base voltage | V_{CBO} | 20 | |
| Emitter-base voltage | V_{EBO} | 2 | |
| Collector current | I_C | 50 | mA |
| Base current | I_B | 6 | |
| Total power dissipation, $T_S \leq 63 \text{ }^\circ\text{C}$ ¹⁾ | P_{tot} | 300 | mW |
| Junction temperature | T_j | 150 | $^\circ\text{C}$ |
| Ambient temperature | T_A | -65 ... 150 | |
| Storage temperature | T_{stg} | -65 ... 150 | |

Thermal Resistance

| | | | |
|--|------------|------------|-----|
| Junction - soldering point ²⁾ | R_{thJS} | ≤ 290 | K/W |
|--|------------|------------|-----|

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

²For 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 $I_C = 1 \text{ mA}, I_B = 0$ | $V_{(BR)CEO}$ | 12 | - | - | V |
| Collector-emitter cutoff current $V_{CE} = 20 \text{ V}, V_{BE} = 0$ | I_{CES} | - | - | 100 | μA |
| Collector-base cutoff current $V_{CB} = 10 \text{ V}, I_E = 0$ | I_{CBO} | - | - | 100 | nA |
| Emitter-base cutoff current $V_{EB} = 2 \text{ V}, I_C = 0$ | I_{EBO} | - | - | 10 | μA |
| DC current gain $I_C = 30 \text{ mA}, V_{CE} = 8 \text{ V}$ | h_{FE} | 50 | 100 | 200 | - |

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

| Parameter | Symbol | Values | | | Unit |
|---|---------------|--------|-------------|------|------|
| | | min. | typ. | max. | |
| AC characteristics (verified by random sampling) | | | | | |
| Transition frequency $I_C = 30\text{ mA}$, $V_{CE} = 8\text{ V}$, $f = 500\text{ MHz}$ | f_T | 4.5 | 6 | - | GHz |
| Collector-base capacitance $V_{CB} = 10\text{ V}$, $f = 1\text{ MHz}$ | C_{cb} | - | 0.58 | 0.9 | pF |
| Collector-emitter capacitance $V_{CE} = 10\text{ V}$, $f = 1\text{ MHz}$ | C_{ce} | - | 0.23 | - | |
| Emitter-base capacitance $V_{EB} = 0.5\text{ V}$, $f = 1\text{ MHz}$ | C_{eb} | - | 1.7 | - | |
| Noise figure $I_C = 5\text{ mA}$, $V_{CE} = 8\text{ V}$, $Z_S = Z_{Sopt}$, $f = 900\text{ MHz}$ $f = 1.8\text{ GHz}$ | F | - | 2 3.3 | - | dB |
| Power gain, maximum available ¹⁾ $I_C = 30\text{ mA}$, $V_{CE} = 8\text{ V}$, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$, $f = 900\text{ MHz}$ $f = 1.8\text{ GHz}$ | G_{ma} | - | 13.5 8.5 | - | |
| Transducer gain $I_C = 30\text{ mA}$, $V_{CE} = 8\text{ V}$, $Z_S = Z_L = 50\Omega$, $f = 900\text{ MHz}$ $f = 1.8\text{ GHz}$ | $ S_{21e} ^2$ | - | 12 6.5 | - | |

$$^1G_{ma} = |S_{21} / S_{12}| (k - (k^2 - 1)^{1/2})$$

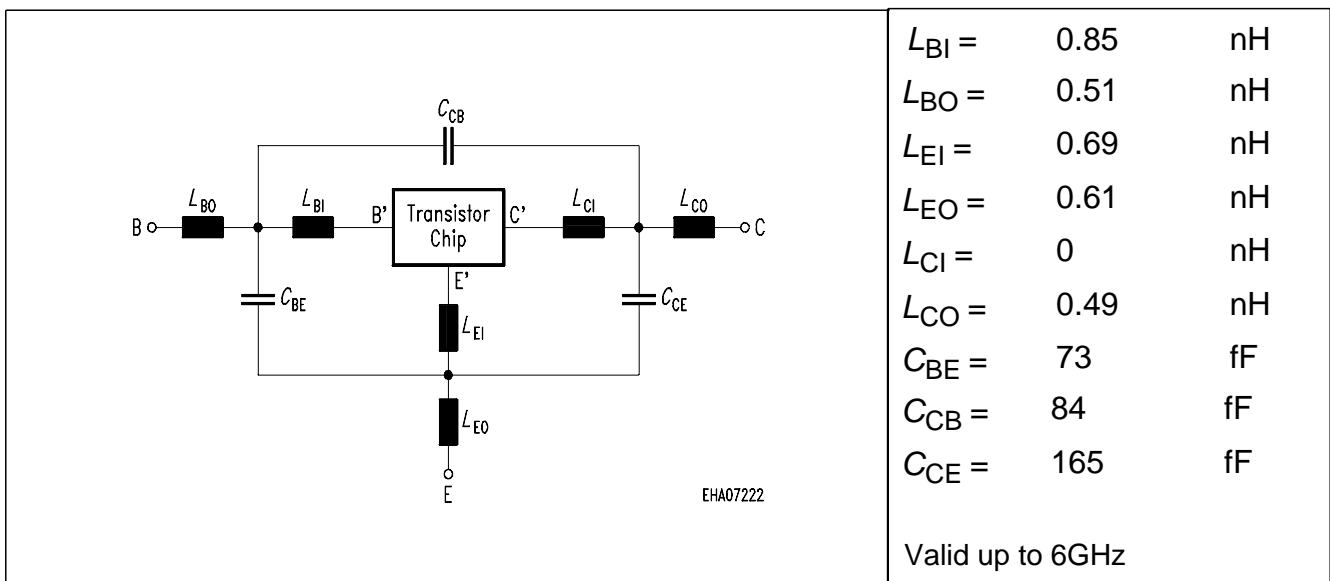
SPICE Parameters (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax) :

Transistor Chip Data

| | | | | | | | | |
|-------|---------|----------|-------|----------|----------|--------|----------|----------|
| IS = | 8.6752 | fA | BF = | 137.63 | - | NF = | 0.93633 | - |
| VAF = | 20.011 | V | IKF = | 0.33395 | A | ISE = | 2619.3 | fA |
| NE = | 1.5466 | - | BR = | 59 | - | NR = | 0.88761 | - |
| VAR = | 26.834 | V | IKR = | 0.015129 | A | ISC = | 0.70823 | fA |
| NC = | 1.95 | - | RB = | 7.2326 | Ω | IRB = | 0.043806 | mA |
| RBM = | 3.4649 | Ω | RE = | 1.0075 | | RC = | 0.13193 | Ω |
| CJE = | 3.1538 | fF | VJE = | 0.70393 | V | MJE = | 0.5071 | - |
| TF = | 33.388 | ps | XTF = | 0.28319 | - | VTF = | 0.17765 | V |
| ITF = | 2.5184 | mA | PTF = | 0 | deg | CJC = | 1039.5 | fF |
| VJC = | 0.72744 | V | MJC = | 0.34565 | - | XCJC = | 0.21422 | - |
| TR = | 1.1061 | ns | CJS = | 0 | fF | VJS = | 0.75 | V |
| MJS = | 0 | - | XTB = | 0 | - | EG = | 1.11 | eV |
| XTI = | 3 | - | FC = | 0.75935 | - | TNOM | 300 | K |

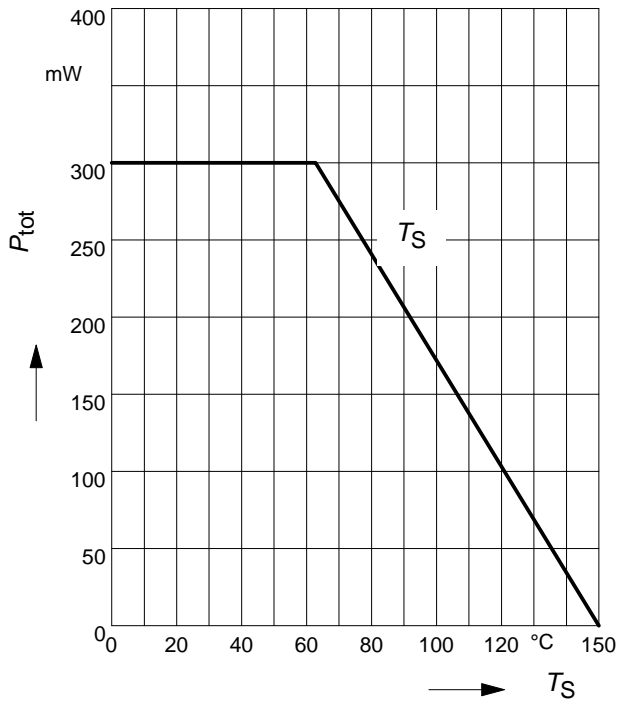
All parameters are ready to use, no scaling is necessary.
 Extracted on behalf of Infineon Technologies AG by:
 Institut für Mobil-und Satellitentechnik (IMST)

Package Equivalent Circuit:

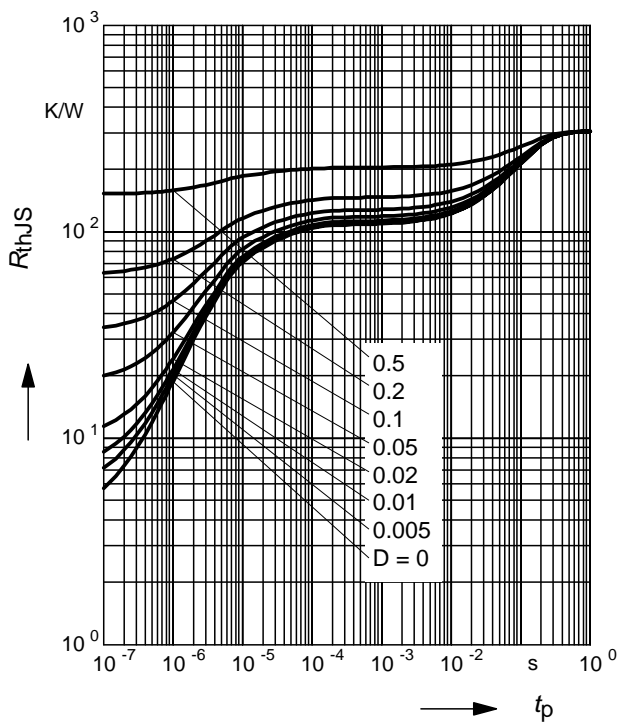


For examples and ready to use parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies CD-ROM or see Internet: <http://www.infineon.com/products/discrete/index.htm>

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

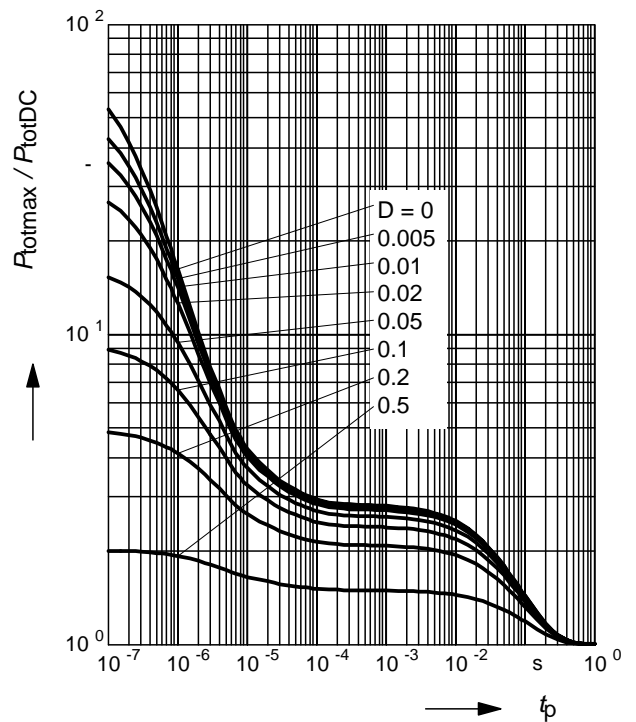


Permissible Pulse Load $R_{thJS} = f(t_p)$



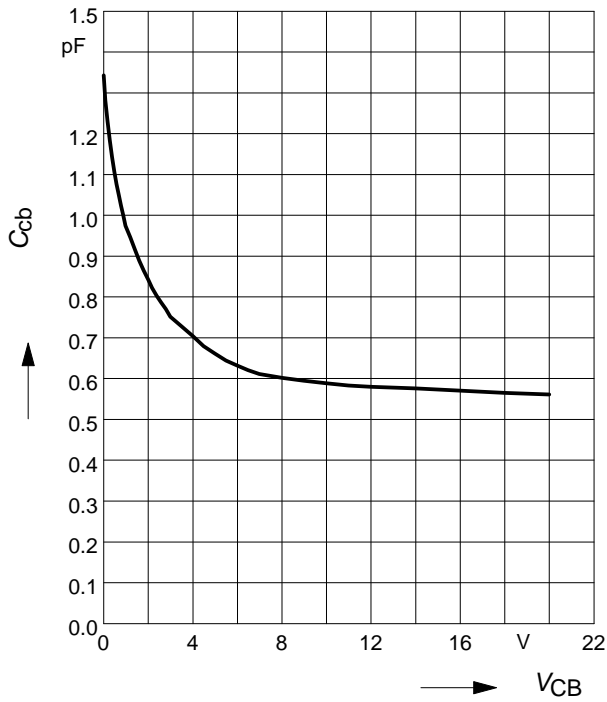
Permissible Pulse Load

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



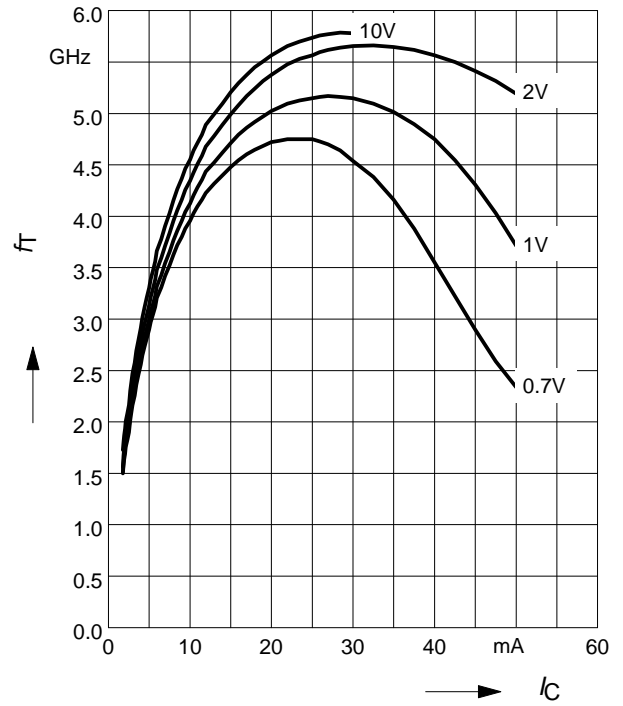
Collector-base capacitance $C_{cb} = f(V_{CB})$

$f = 1\text{MHz}$



Transition frequency $f_T = f(I_C)$

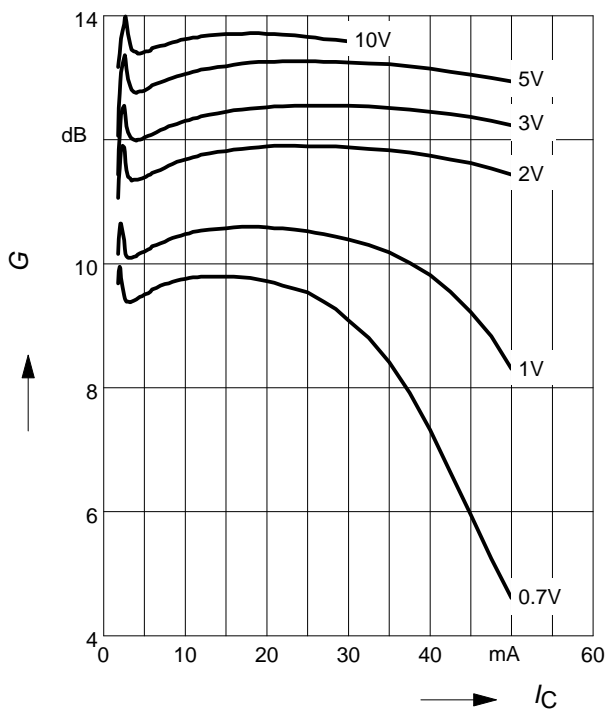
$V_{CE} = \text{Parameter}$



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

$f = 0.9\text{GHz}$

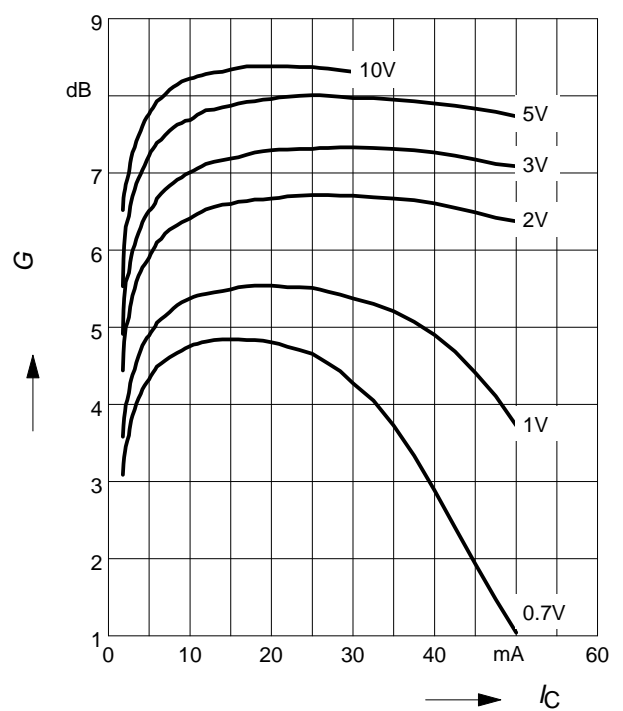
$V_{CE} = \text{Parameter}$



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

$f = 1.8\text{GHz}$

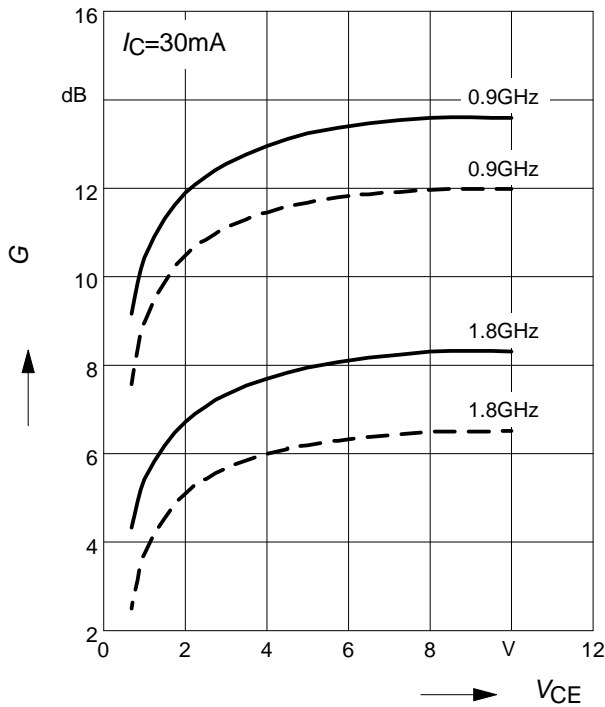
$V_{CE} = \text{Parameter}$



Power Gain $G_{ma}, G_{ms} = f(V_{CE})$: _____

$|S_{21}|^2 = f(V_{CE})$: -----

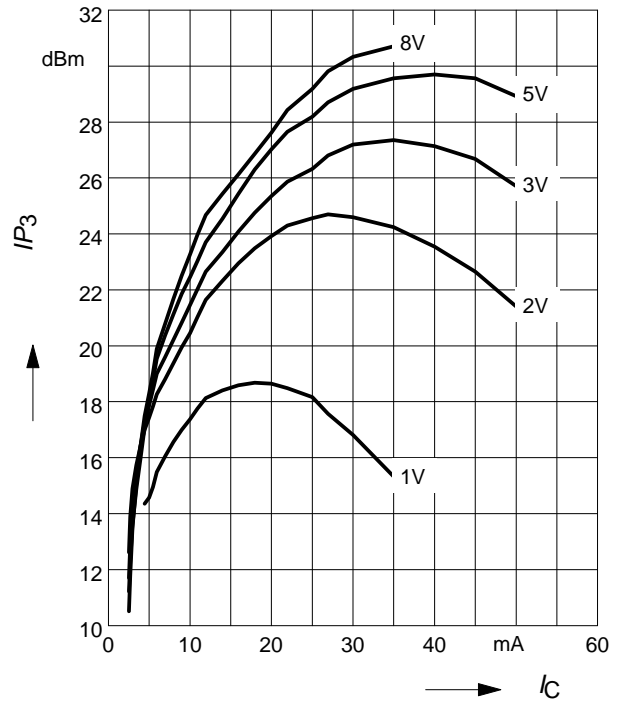
f = Parameter



Intermodulation Intercept Point $IP_3 = f(I_C)$

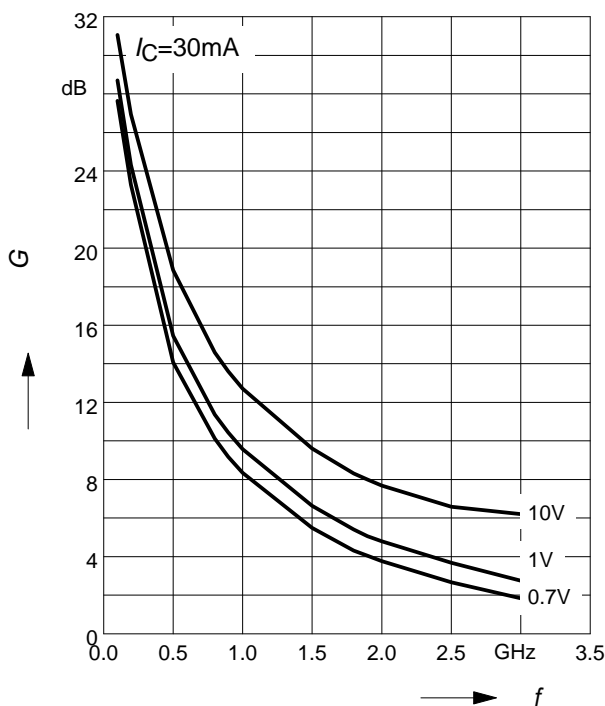
(3rd order, Output, $Z_S = Z_L = 50\Omega$)

V_{CE} = Parameter, $f = 900\text{MHz}$



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

V_{CE} = Parameter



Power Gain $|S_{21}|^2 = f(f)$

V_{CE} = Parameter

