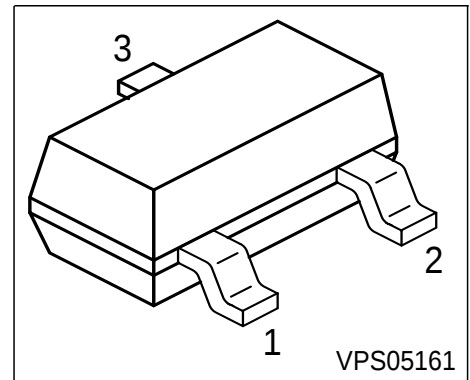


## NPN Silicon RF Transistor

- For low noise, high-gain broadband amplifiers at collector currents from 0.5 mA to 12 mA
- $f_T = 8 \text{ GHz}$   
 $F = 1.45 \text{ dB at } 900 \text{ MHz}$



**ESD:** Electrostatic discharge sensitive device, observe handling precaution!

| Type   | Marking | Pin Configuration |       |       | Package |
|--------|---------|-------------------|-------|-------|---------|
| BFR181 | RFs     | 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                                        | $I_C$     | 20          | mA   |
| Base current                                             | $I_B$     | 2           |      |
| Total power dissipation<br>$T_S \leq 91 \text{ °C } ^1)$ | $P_{tot}$ | 175         | mW   |
| Junction temperature                                     | $T_j$     | 150         | °C   |
| Ambient temperature                                      | $T_A$     | -65 ... 150 |      |
| Storage temperature                                      | $T_{stg}$ | -65 ... 150 |      |

### Thermal Resistance

|                                          |            |            |     |
|------------------------------------------|------------|------------|-----|
| Junction - soldering point <sup>2)</sup> | $R_{thJS}$ | $\leq 335$ | K/W |
|------------------------------------------|------------|------------|-----|

<sup>1</sup> $T_S$  is measured on the collector lead at the soldering point to the pcb

<sup>2</sup>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<br>$I_C = 1\text{ mA}, I_B = 0$    | $V_{(BR)CEO}$ | 12     | -    | -    | V             |
| Collector-emitter cutoff current<br>$V_{CE} = 20\text{ V}, V_{BE} = 0$ | $I_{CES}$     | -      | -    | 100  | $\mu\text{A}$ |
| Collector-base cutoff current<br>$V_{CB} = 10\text{ V}, I_E = 0$       | $I_{CBO}$     | -      | -    | 100  | nA            |
| Emitter-base cutoff current<br>$V_{EB} = 1\text{ V}, I_C = 0$          | $I_{EBO}$     | -      | -    | 1    | $\mu\text{A}$ |
| DC current gain<br>$I_C = 5\text{ mA}, V_{CE} = 8\text{ V}$            | $h_{FE}$      | 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<br>$I_C = 10\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 500\text{ MHz}$                                                                | $f_T$         | 6      | 8           | -      | GHz  |
| Collector-base capacitance<br>$V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$                                                                                  | $C_{cb}$      | -      | 0.26        | 0.45   | pF   |
| Collector-emitter capacitance<br>$V_{CE} = 10\text{ V}$ , $f = 1\text{ MHz}$                                                                               | $C_{ce}$      | -      | 0.18        | -      |      |
| Emitter-base capacitance<br>$V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$                                                                                   | $C_{eb}$      | -      | 0.3         | -      |      |
| Noise figure<br>$I_C = 2\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_{Sopt}$ ,<br>$f = 900\text{ MHz}$<br>$f = 1.8\text{ GHz}$                           | $F$           | -<br>- | 1.45<br>1.8 | -<br>- | dB   |
| Power gain, maximum stable <sup>1)</sup><br>$I_C = 5\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ ,<br>$f = 900\text{ MHz}$    | $G_{ms}$      | -      | 18          | -      |      |
| Power gain, maximum available <sup>2)</sup><br>$I_C = 5\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ ,<br>$f = 1.8\text{ GHz}$ | $G_{ma}$      | -      | 11.5        | -      |      |
| Transducer gain<br>$I_C = 5\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_L = 50\Omega$ ,<br>$f = 900\text{ MHz}$<br>$f = 1.8\text{ GHz}$                  | $ S_{21e} ^2$ | -<br>- | 14<br>9     | -<br>- |      |

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

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

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

### Transistor Chip Data

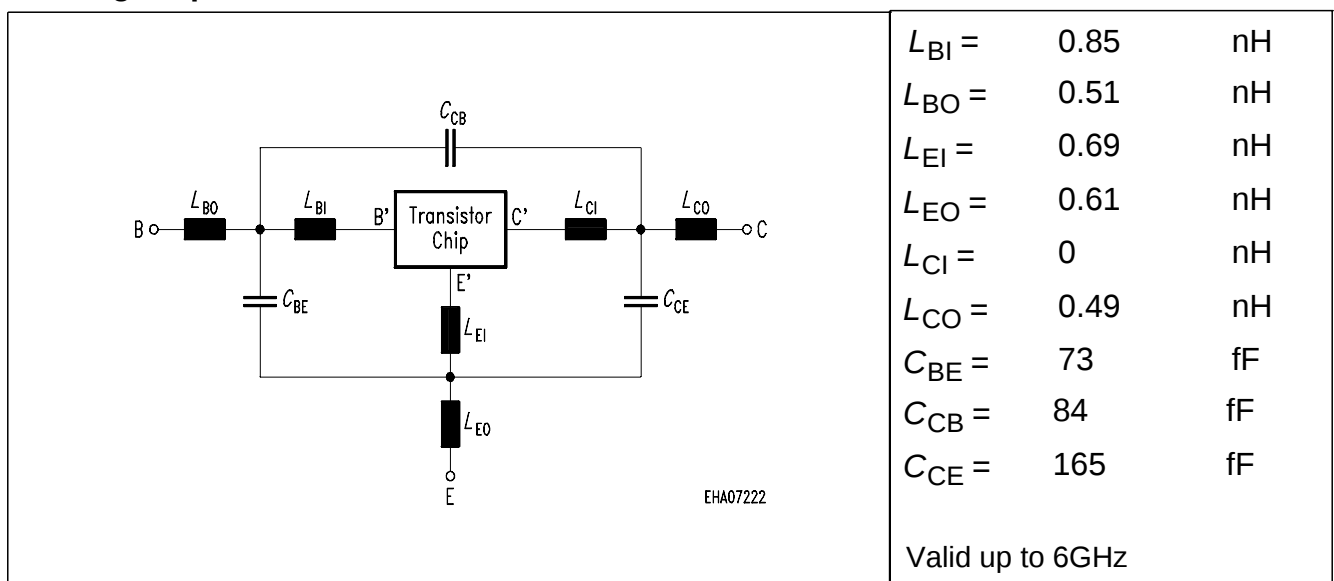
|       |           |          |       |         |          |        |          |          |
|-------|-----------|----------|-------|---------|----------|--------|----------|----------|
| IS =  | 0.0010519 | fA       | BF =  | 96.461  | -        | NF =   | 0.90617  | -        |
| VAF = | 22.403    | V        | IKF = | 0.12146 | A        | ISE =  | 12.603   | fA       |
| NE =  | 1.7631    | -        | BR =  | 16.504  | -        | NR =   | 0.87757  | -        |
| VAR = | 5.1127    | V        | IKR = | 0.24951 | A        | ISC =  | 0.01195  | fA       |
| NC =  | 1.6528    | -        | RB =  | 9.9037  | $\Omega$ | IRB =  | 0.69278  | mA       |
| RBM = | 6.6315    | $\Omega$ | RE =  | 2.1372  |          | RC =   | 2.2171   | $\Omega$ |
| CJE = | 1.8168    | fF       | VJE = | 0.73155 | V        | MJE =  | 0.43619  | -        |
| TF =  | 17.028    | ps       | XTF = | 0.33814 | -        | VTF =  | 0.12571  | V        |
| ITF = | 1.0549    | mA       | PTF = | 0       | deg      | CJC =  | 319.69   | fF       |
| VJC = | 1.1633    | V        | MJC = | 0.30013 | -        | XCJC = | 0.082903 | -        |
| TR =  | 2.7449    | ns       | CJS = | 0       | fF       | VJS =  | 0.75     | V        |
| MJS = | 0         | -        | XTB = | 0       | -        | EG =   | 1.11     | eV       |
| XTI = | 3         | -        | FC =  | 0.99768 | -        | TNOM   | 300      | K        |

All parameters are ready to use, no scaling is necessary.

Extracted on behalf of Infineon Technologies AG by:

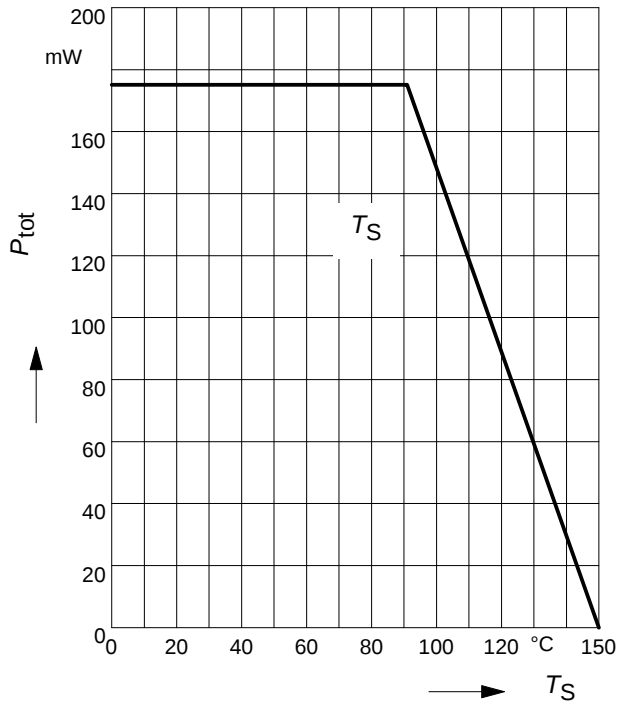
Institut für Mobil-und Satellitentechnik (IMST)

### Package Equivalent Circuit:

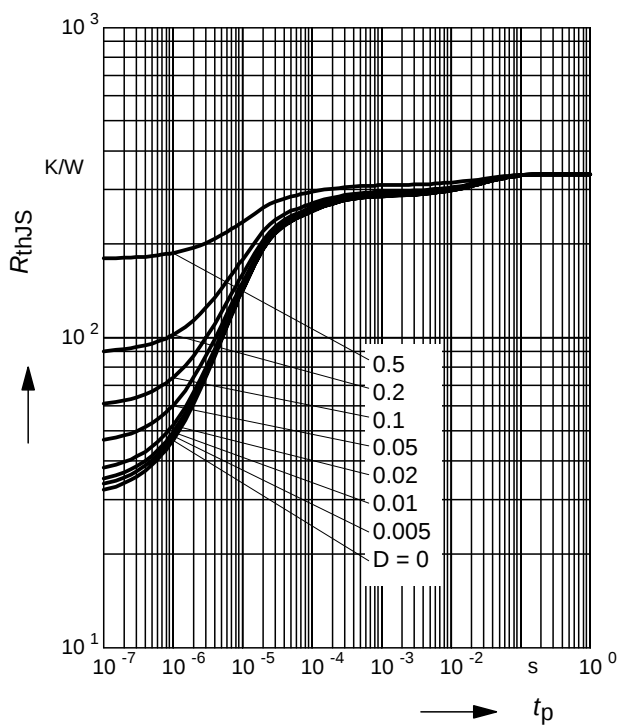


For examples and ready to use parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies CD-ROM or see Internet: <http://www.infineon.com/silicondiscretes>

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

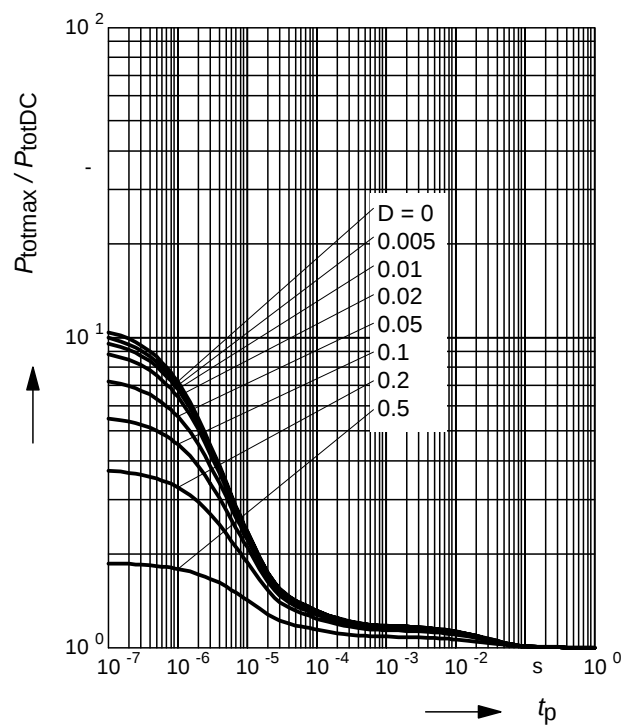


Permissible Pulse Load  $R_{\text{thJS}} = f(t_p)$



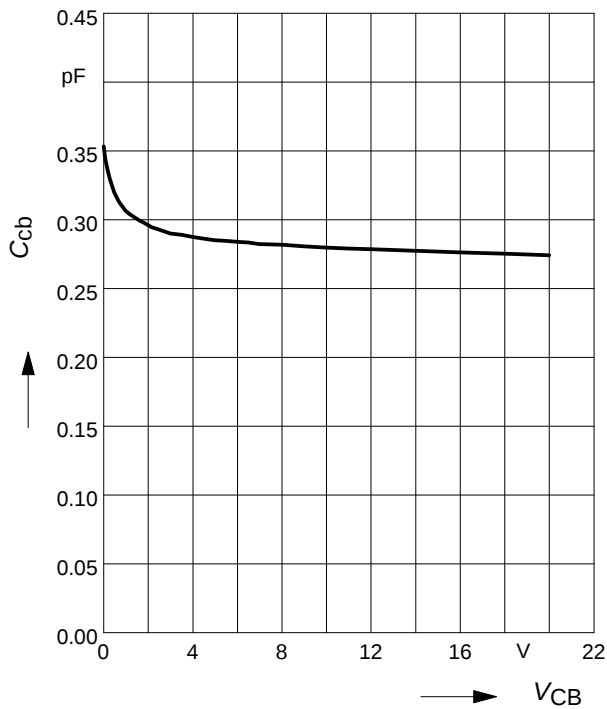
Permissible Pulse Load

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



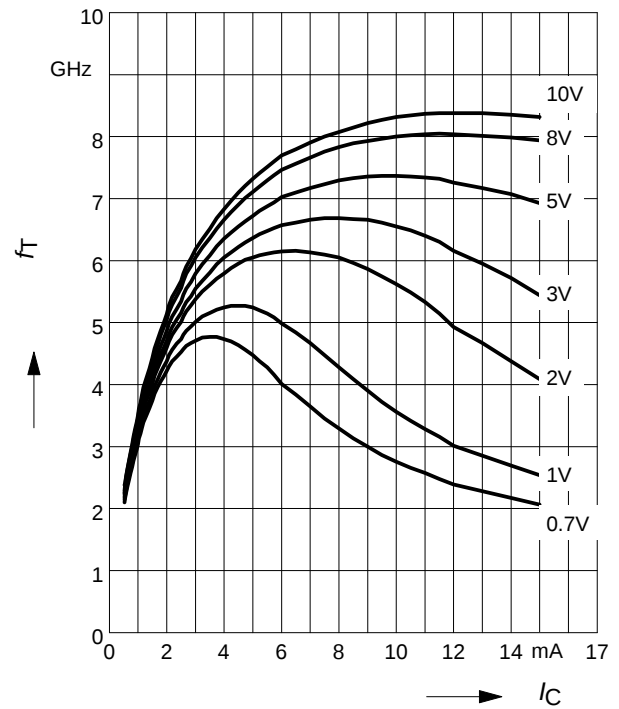
**Collector-base capacitance  $C_{cb} = f(V_{CB})$**

$f = 1\text{MHz}$



**Transition frequency  $f_T = f(I_C)$**

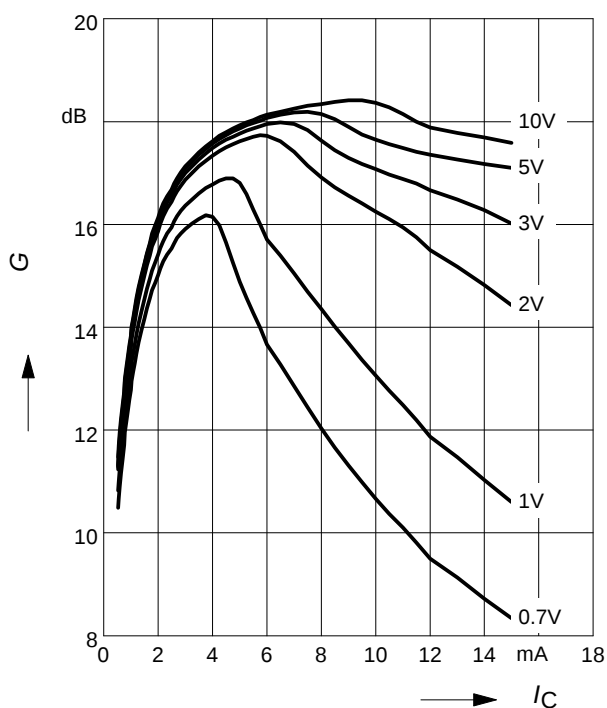
$V_{CE} = \text{Parameter}$



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

$f = 0.9\text{GHz}$

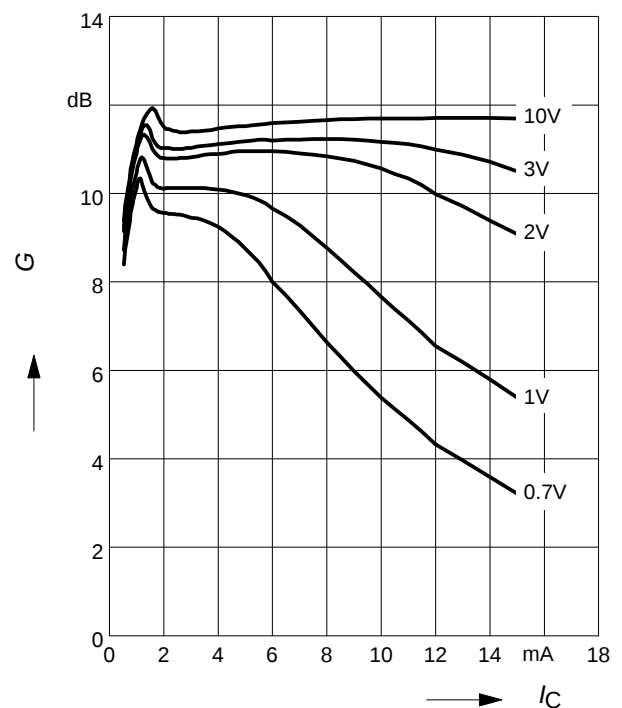
$V_{CE} = \text{Parameter}$



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

$f = 1.8\text{GHz}$

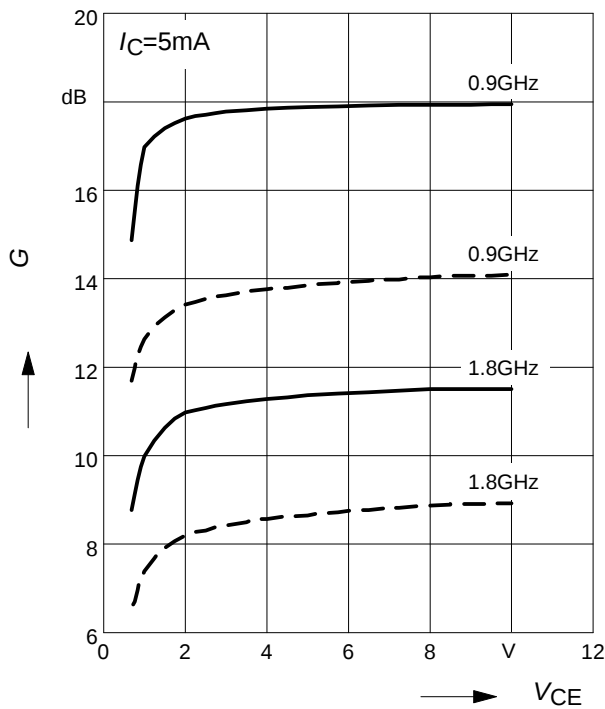
$V_{CE} = \text{Parameter}$



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

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

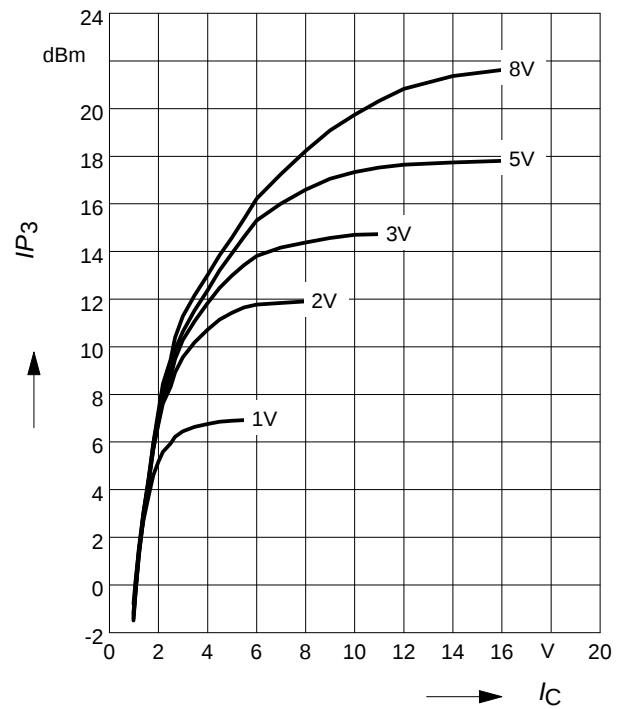
$f$  = Parameter



**Intermodulation Intercept Point**  $IP_3 = f(I_C)$

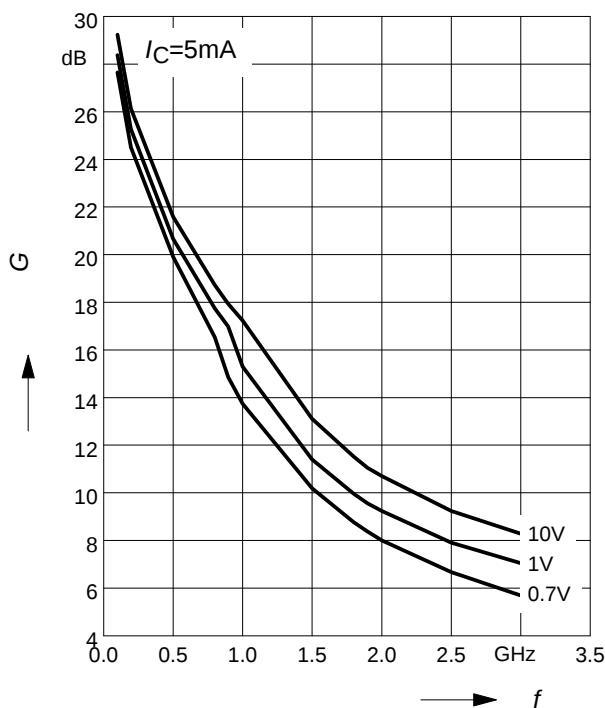
(3rd order, Output,  $Z_S = Z_L = 50\Omega$ )

$V_{CE}$  = 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

