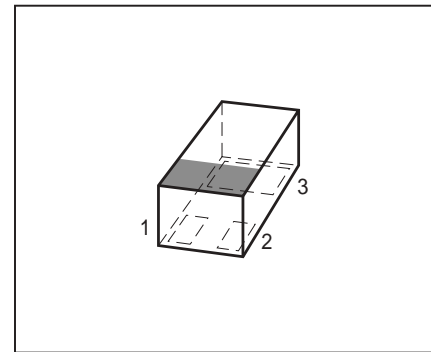


**NPN Silicon RF Transistor\***

- Low voltage/ Low current operation
- For low noise amplifiers
- For Oscillators up to 3.5 GHz and Pout > 10 dBm
- Low noise figure: 1.0 dB at 1.8 GHz
- Pb-free (RoHS compliant) package<sup>1)</sup>
- Qualified according AEC Q101



\* Short term description



**ESD (Electrostatic discharge) sensitive device, observe handling precaution!**

| Type     | Marking | Pin Configuration |       |       | Package  |
|----------|---------|-------------------|-------|-------|----------|
| BFR360L3 | FB      | 1 = B             | 2 = E | 3 = C | TSLP-3-1 |

**Maximum Ratings**

| Parameter   | Symbol    | Value       | Unit |
|---|-----------|-------------|------|
| Collector-emitter voltage   | $V_{CEO}$ | 6           | V    |
| Collector-emitter voltage   | $V_{CES}$ | 15          |      |
| Collector-base voltage  | $V_{CBO}$ | 15          |      |
| Emitter-base voltage  | $V_{EBO}$ | 2           |      |
| Collector current   | $I_C$     | 35          | mA   |
| Base current  | $I_B$     | 4           |      |
| Total power dissipation <sup>2)</sup><br>$T_S \leq 104^\circ\text{C}$ | $P_{tot}$ | 210         | mW   |
| Junction temperature  | $T_j$     | 150         | °C   |
| Ambient temperature   | $T_A$     | -65 ... 150 |      |
| Storage temperature   | $T_{stg}$ | -65 ... 150 |      |

**Thermal Resistance**

| Parameter                                | Symbol     | Value      | Unit |
|--|------------|------------|------|
| Junction - soldering point <sup>3)</sup> | $R_{thJS}$ | $\leq 220$ | K/W  |

<sup>1)</sup>Pb-containing package may be available upon special request

<sup>2)</sup> $T_S$  is measured on the collector lead at the soldering point to the pcb

<sup>3)</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. |               |
| <b>DC Characteristics</b>  |               |        |      |      |               |
| Collector-emitter breakdown voltage<br>$I_C = 1 \text{ mA}, I_B = 0$             | $V_{(BR)CEO}$ | 6      | 9    | -    | V             |
| Collector-emitter cutoff current<br>$V_{CE} = 15 \text{ V}, V_{BE} = 0$          | $I_{CES}$     | -      | -    | 10   | $\mu\text{A}$ |
| Collector-base cutoff current<br>$V_{CB} = 5 \text{ V}, I_E = 0$                 | $I_{CBO}$     | -      | -    | 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>$I_C = 15 \text{ mA}, V_{CE} = 3 \text{ V}$ , pulse measured | $h_{FE}$      | 90     | 120  | 160  | -             |

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

| Parameter   | Symbol        | Values |            |      | Unit |
|---|---------------|--------|------------|------|------|
|   |               | min.   | typ.       | max. |      |
| <b>AC Characteristics (verified by random sampling)</b>   |               |        |            |      |      |
| Transition frequency<br>$I_C = 15 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $f = 1 \text{ GHz}$  | $f_T$         | 11     | 14         | -    | GHz  |
| Collector-base capacitance<br>$V_{CB} = 5 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{BE} = 0$ ,<br>emitter grounded   | $C_{cb}$      | -      | 0.26       | 0.4  | pF   |
| Collector emitter capacitance<br>$V_{CE} = 5 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{BE} = 0$ ,<br>base grounded   | $C_{ce}$      | -      | 0.15       | -    |      |
| Emitter-base capacitance<br>$V_{EB} = 0.5 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{CB} = 0$ ,<br>collector grounded   | $C_{eb}$      | -      | 0.42       | -    |      |
| Noise figure<br>$I_C = 3 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $Z_S = Z_{Sopt}$ , $f = 1.8 \text{ GHz}$<br>$I_C = 3 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $Z_S = Z_{Sopt}$ , $f = 3 \text{ GHz}$  | $F_{min}$     | -      | 1<br>1.3   | -    | dB   |
| Power gain, maximum available <sup>1)</sup><br>$I_C = 15 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $Z_S = Z_{Sopt}$ ,<br>$Z_L = Z_{Lopt}$ , $f = 1.8 \text{ GHz}$<br>$I_C = 15 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $Z_S = Z_{Sopt}$ ,<br>$Z_L = Z_{Lopt}$ , $f = 3 \text{ GHz}$ | $G_{ma}$      | -      | 16<br>11.5 | -    |      |
| Transducer gain<br>$I_C = 15 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $Z_S = Z_L = 50 \Omega$ ,<br>$f = 1.8 \text{ GHz}$<br>$f = 3 \text{ GHz}$   | $ S_{21e} ^2$ | -      | 13.5<br>9  | -    | dB   |
| Third order intercept point at output <sup>2)</sup><br>$V_{CE} = 3 \text{ V}$ , $I_C = 15 \text{ mA}$ , $Z_S = Z_L = 50 \Omega$ , $f = 1.8 \text{ GHz}$   | $IP_3$        | -      | 24         | -    | dBm  |
| 1dB Compression point at output<br>$I_C = 15 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , $Z_S = Z_L = 50 \Omega$ , $f = 1.8 \text{ GHz}$   | $P_{-1dB}$    | -      | 9          | -    |      |

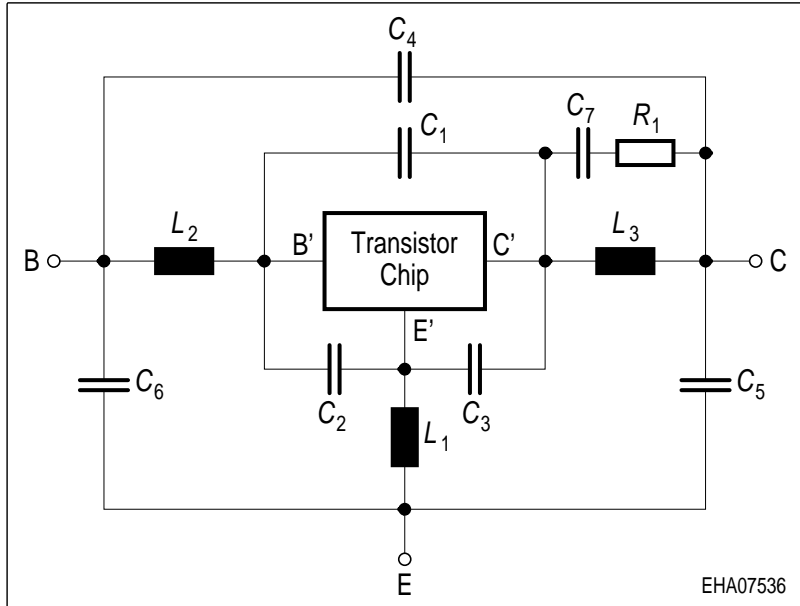
$$^1 G_{ma} = |S_{21e}| / |S_{12e}| (k - (k^2 - 1)^{1/2})$$

<sup>2)</sup>IP3 value depends on termination of all intermodulation frequency components.  
Termination used for this measurement is  $50 \Omega$  from 0.1 MHz to 6 GHz

**SPICE Parameter (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax):**
**Transistor Chip Data:**

|       |        |          |       |       |            |        |       |          |
|-------|--------|----------|-------|-------|------------|--------|-------|----------|
| IS =  | 0.0689 | fA       | BF =  | 147   | -          | NF =   | 1     | -        |
| VAF = | 20     | V        | IKF = | 77.28 | mA         | ISE =  | 150   | fA       |
| NE =  | 2.4    | -        | BR =  | 6     | -          | NR =   | 1     | -        |
| VAR = | 60     | V        | IKR = | 0.3   | A          | ISC =  | 20    | fA       |
| NC =  | 1.4    | -        | RB =  | 0.1   | $\Omega$   | IRB =  | 74    | $\mu$ A  |
| RBM = | 7.31   | $\Omega$ | RE =  | 78.2  | m $\Omega$ | RC =   | 0.35  | $\Omega$ |
| CJE = | 400    | fF       | VJE = | 1.3   | V          | MJE =  | 0.5   | -        |
| TF =  | 9.219  | ps       | XTF = | 0.115 | -          | VTF =  | 0.198 | V        |
| ITF = | 1.336  | mA       | PTF = | 0     | deg        | CJC =  | 473   | fF       |
| VJC = | 0.864  | V        | MJC = | 0.486 | -          | XCJC = | 0.129 | -        |
| TR =  | 1.92   | ns       | CJS = | 0     | fF         | VJS =  | 0.75  | V        |
| MJS = | 0      | -        | XTB = | 0     | -          | EG =   | 1.11  | eV       |
| XTI = | 0      | -        | FC =  | 0.954 | -          | NK =   | 0.5   | K        |
| AF =  | 1      | -        | KF =  | 1E-14 | -          |        |       |          |

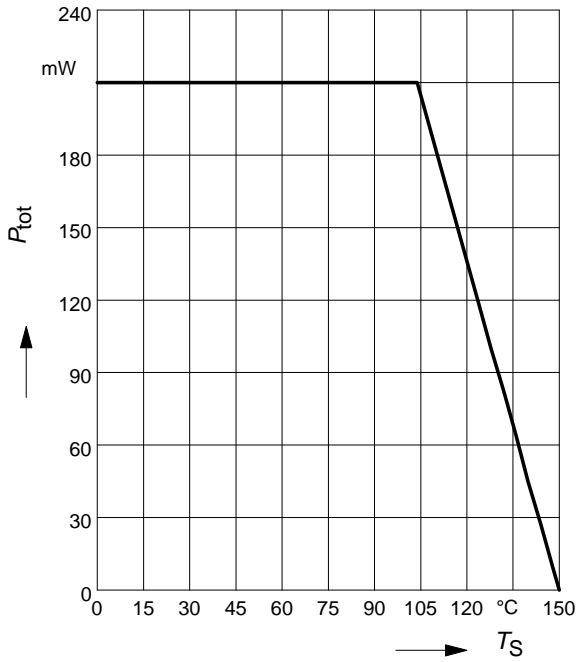
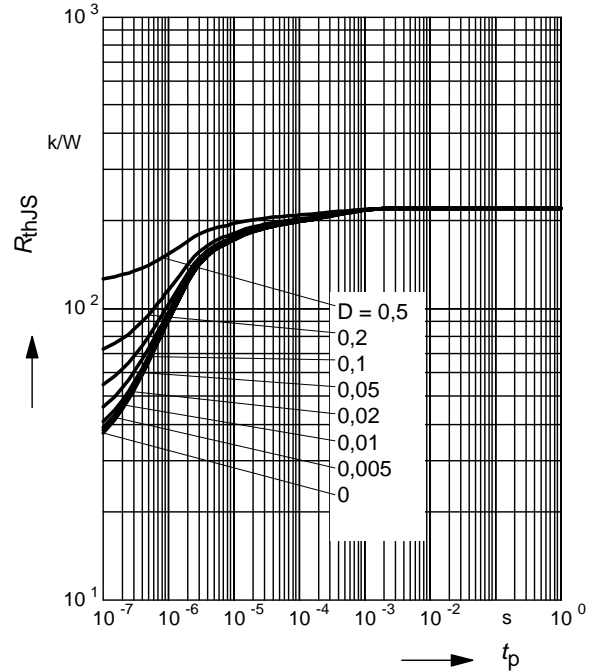
All parameters are ready to use, no scaling is necessary.

**Package Equivalent Circuit:**


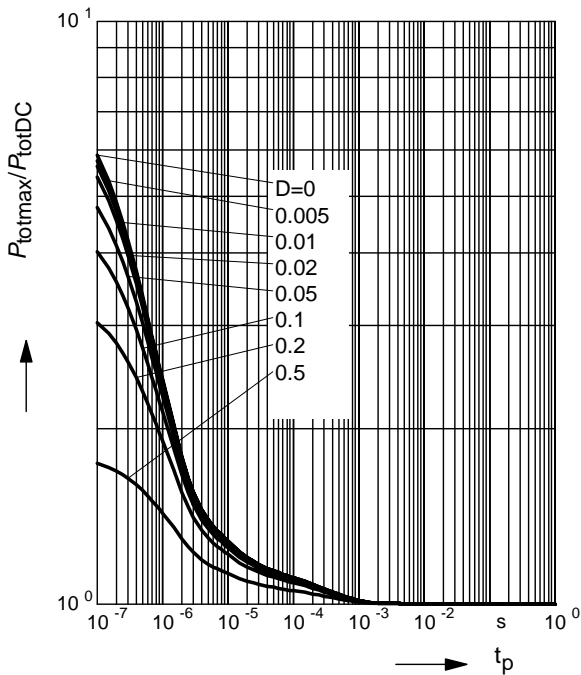
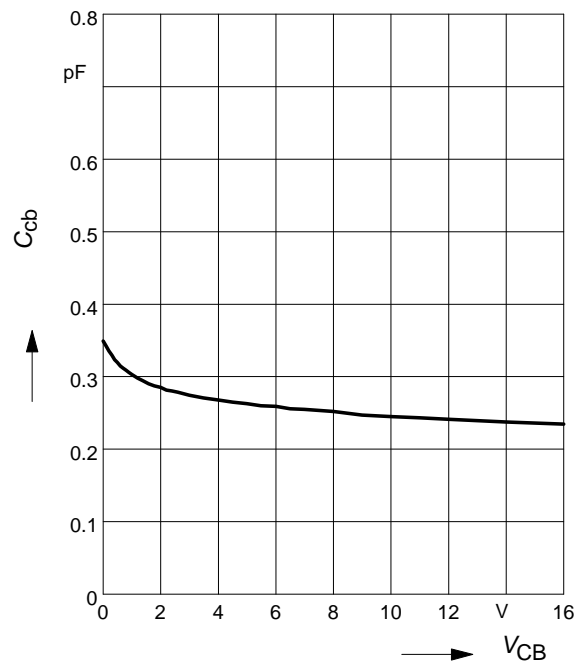
|         |       |          |
|---------|-------|----------|
| $L_1 =$ | 0.575 | nH       |
| $L_2 =$ | 0.575 | nH       |
| $L_3 =$ | 0.275 | nH       |
| $C_1 =$ | 33    | fF       |
| $C_2 =$ | 28    | fF       |
| $C_3 =$ | 131   | fF       |
| $C_4 =$ | 8     | fF       |
| $C_5 =$ | 8     | fF       |
| $C_6 =$ | 24    | fF       |
| $C_7 =$ | 300   | fF       |
| $R_1 =$ | 204   | $\Omega$ |

Valid up to 6GHz

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>

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

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

**Permissible Pulse Load**

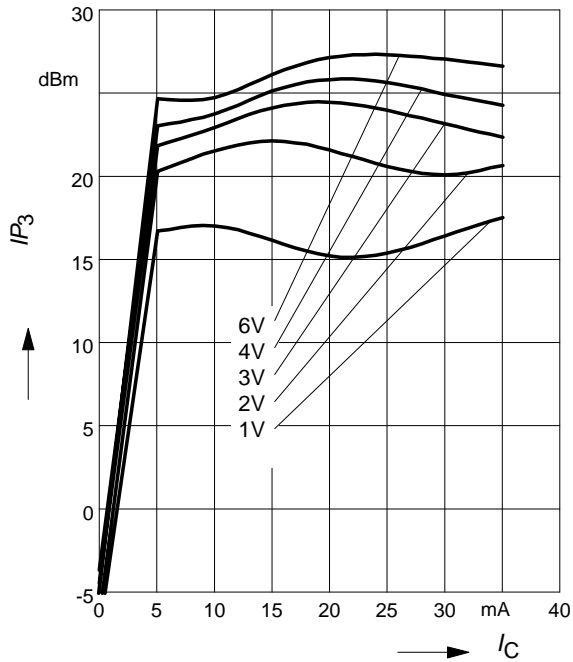
$$P_{\text{totmax}}/P_{\text{totDC}} = f(t_p)$$


**Collector-base capacitance  $C_{\text{cb}} = f(V_{\text{CB}})$** 
 $f = 1\text{MHz}$ 


**Third order Intercept Point  $IP_3=f(I_C)$**

(Output,  $Z_S=Z_L=50\Omega$ )

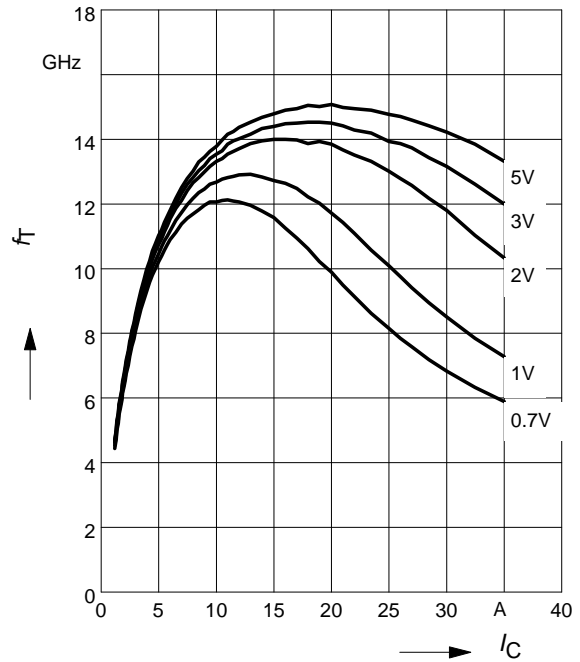
$V_{CE}$  = parameter,  $f = 1.8$  GHz



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

$f = 1$  GHz

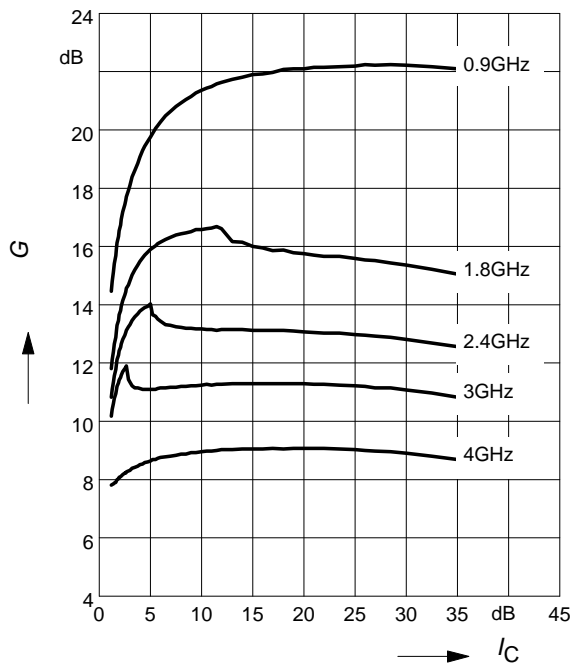
$V_{CE}$  = parameter



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

$V_{CE} = 3$  V

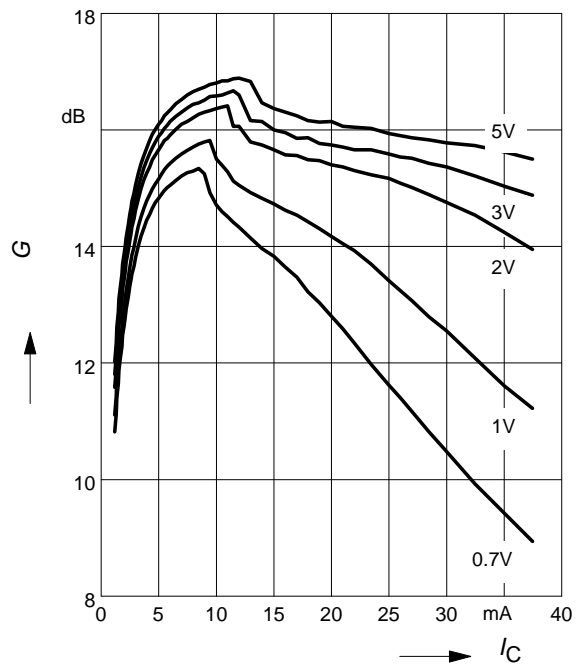
$f$  = parameter in GHz



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

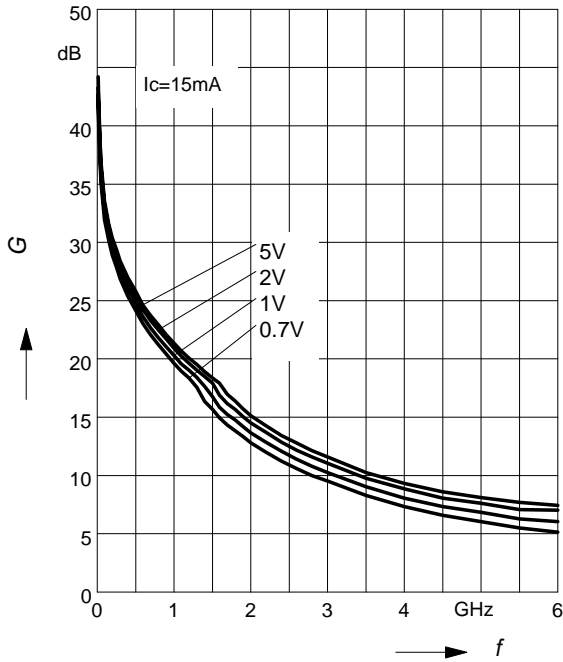
$f = 1.8$ GHz

$V_{CE}$  = parameter



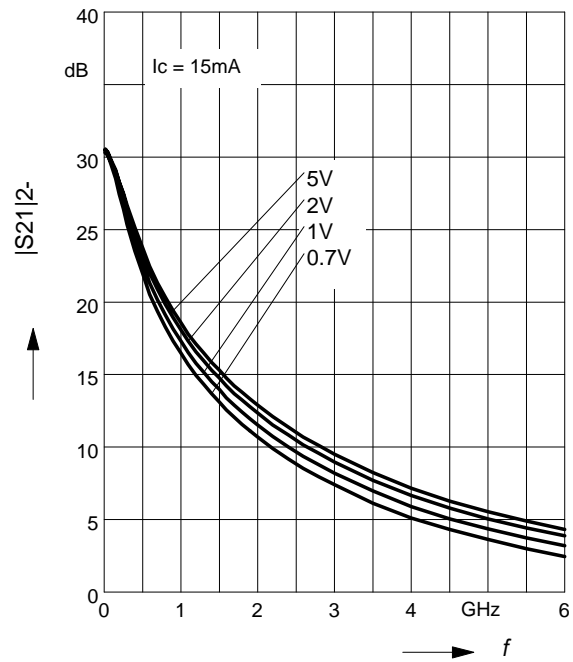
**Power Gain  $G_{ma}$ ,  $G_{ms} = f(f)$**

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



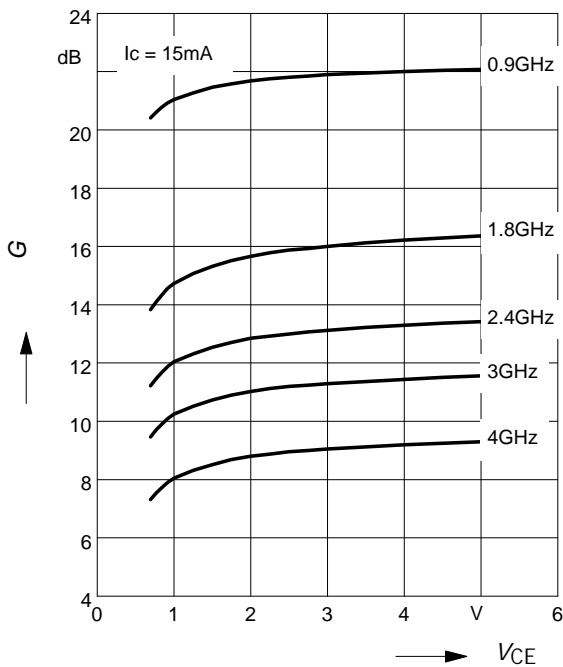
**Power Gain  $|S_{21}|^2 = f(f)$**

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

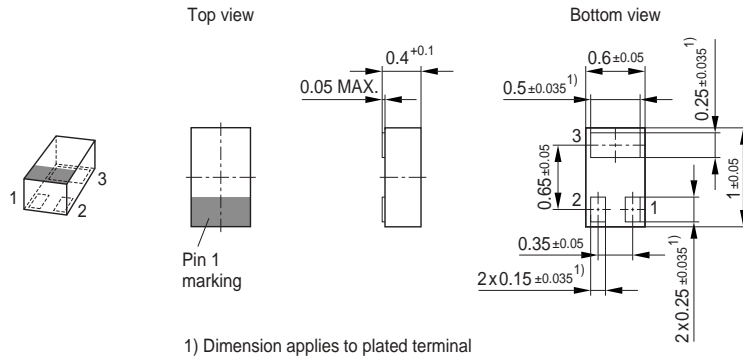


**Power Gain  $G_{ma}$ ,  $G_{ms} = f(V_{CE})$ :**

$f = \text{parameter}$

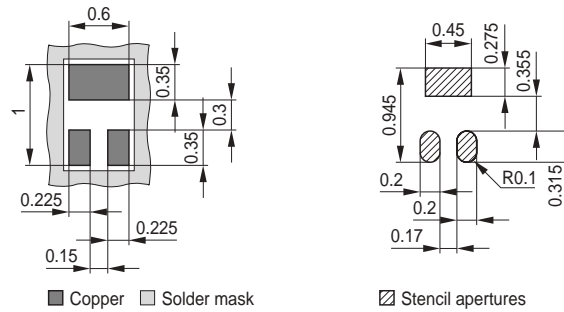


### Package Outline

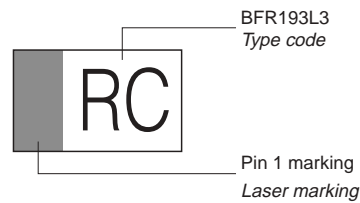


### Foot Print

For board assembly information please refer to Infineon website "Packages"

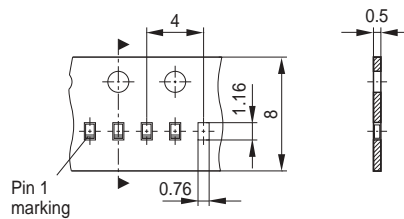


### Marking Layout (Example)



### Standard Packing

Reel ø180 mm = 15.000 Pieces/Reel





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