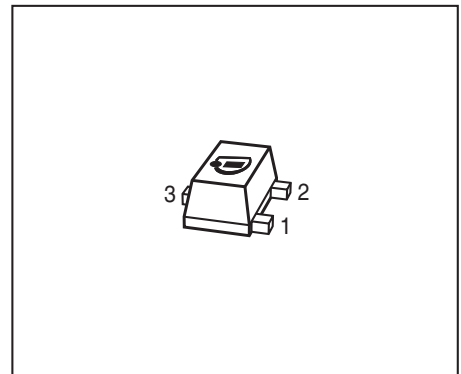


## Low Noise Silicon Bipolar RF Transistor

- General purpose Low Noise Amplifier
- Ideal for low current operation
- High breakdown voltage enables operation in automotive applications
- Minimum noise figure 1.0 dB @ 1mA, 1.5 V, 1.9 GHz
- Pb-free (RoHS compliant) and halogen-free thin small flat package (1.2 x 1.2 mm<sup>2</sup>) with visible leads
- Qualification report according to AEC-Q101 available



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

| Type    | Marking | Pin Configuration |       |       | Package |
|---------|---------|-------------------|-------|-------|---------|
| BFR340F | FAs     | 1 = B             | 2 = E | 3 = C | TSFP-3  |

**Maximum Ratings** at  $T_A = 25\text{ °C}$ , unless otherwise specified

| 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                                                 | $I_C$     | 20          | mA   |
| Base current                                                      | $I_B$     | 2           |      |
| Total power dissipation <sup>1)</sup><br>$T_S \leq 110\text{ °C}$ | $P_{tot}$ | 75          | mW   |
| Junction temperature                                              | $T_J$     | 150         | °C   |
| Storage temperature                                               | $T_{Stg}$ | -55 ... 150 |      |

### Thermal Resistance

| Parameter                                | Symbol     | Value | Unit |
|------------------------------------------|------------|-------|------|
| Junction - soldering point <sup>2)</sup> | $R_{thJS}$ | 530   | K/W  |

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

<sup>2)</sup> For the definition of  $R_{thJS}$  please refer to Application Note AN077 (Thermal Resistance Calculation)

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

| Parameter                                                                                                                                                                                                  | Symbol        | Values |        |          | Unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|--------|----------|------|
|                                                                                                                                                                                                            |               | min.   | typ.   | max.     |      |
| DC Characteristics                                                                                                                                                                                         |               |        |        |          |      |
| Collector-emitter breakdown voltage<br>$I_C = 1\text{ mA}$ , $I_B = 0$                                                                                                                                     | $V_{(BR)CEO}$ | 6      | 9      | -        | V    |
| Collector-emitter cutoff current<br>$V_{CE} = 4\text{ V}$ , $V_{BE} = 0$ , $T_A = 25^{\circ}\text{C}$<br>$V_{CE} = 10\text{ V}$ , $V_{BE} = 0$ , $T_A = 85^{\circ}\text{C}$<br>Verified by random sampling | $I_{CES}$     | -<br>- | 1<br>2 | 30<br>50 | nA   |
| Collector-base cutoff current<br>$V_{CB} = 4\text{ V}$ , $I_E = 0$                                                                                                                                         | $I_{CBO}$     | -      | 1      | 30       |      |
| Emitter-base cutoff current<br>$V_{EB} = 1\text{ V}$ , $I_C = 0$                                                                                                                                           | $I_{EBO}$     | -      | 1      | 500      |      |
| DC current gain<br>$I_C = 5\text{ mA}$ , $V_{CE} = 3\text{ V}$ , pulse measured                                                                                                                            | $h_{FE}$      | 90     | 120    | 160      | -    |

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

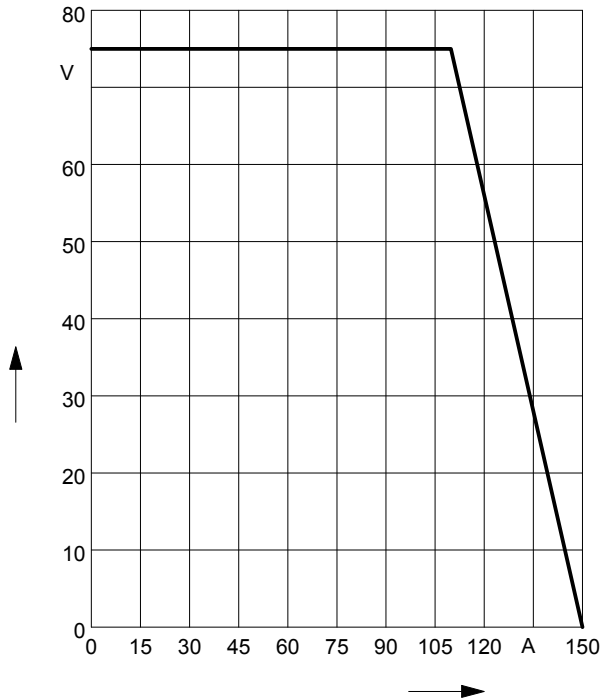
| Parameter                                                                                                                                                                                                                                                                                             | Symbol     | Values      |                 |             | Unit |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|-----------------|-------------|------|
|                                                                                                                                                                                                                                                                                                       |            | min.        | typ.            | max.        |      |
| AC Characteristics (verified by random sampling)                                                                                                                                                                                                                                                      |            |             |                 |             |      |
| Transition frequency<br>$I_C = 6\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 1\text{ GHz}$                                                                                                                                                                                                              | $f_T$      | 11          | 14              | -           | GHz  |
| Collector-base capacitance<br>$V_{CB} = 5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ ,<br>emitter grounded                                                                                                                                                                                         | $C_{cb}$   | -           | 0.21            | 0.4         | pF   |
| Collector emitter capacitance<br>$V_{CE} = 5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ ,<br>base grounded                                                                                                                                                                                         | $C_{ce}$   | -           | 0.17            | -           |      |
| Emitter-base capacitance<br>$V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{CB} = 0$ ,<br>collector grounded                                                                                                                                                                                       | $C_{eb}$   | -           | 0.11            | -           |      |
| Minimum noise figure<br>$I_C = 3\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_{Sopt}$ , $f = 100\text{ MHz}$<br>$I_C = 1\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_{Sopt}$ , $f = 1.9\text{ GHz}$<br>$I_C = 1\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_{Sopt}$ , $f = 2.4\text{ GHz}$ | $NF_{min}$ | -<br>-<br>- | 0.9<br>1<br>1.2 | -<br>-<br>- | dB   |

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

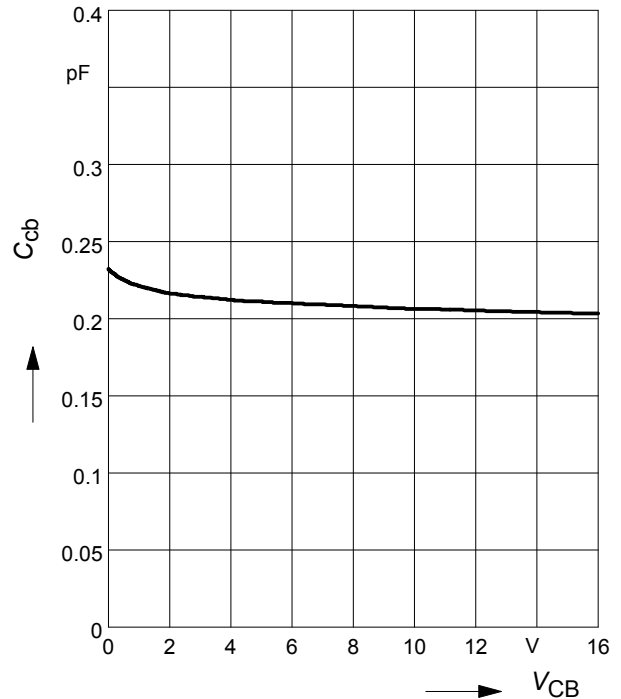
| Parameter                                                                                                                                                                                                                                                                              | Symbol        | Values      |                  |             | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|------------------|-------------|------|
|                                                                                                                                                                                                                                                                                        |               | min.        | typ.             | max.        |      |
| AC Characteristics (verified by random sampling)                                                                                                                                                                                                                                       |               |             |                  |             |      |
| Maximum power gain <sup>1)</sup><br>$I_C = 3\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ ,<br>$f = 100\text{ MHz}$<br>$I_C = 5\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ ,<br>$f = 1.8\text{ GHz}$<br>$f = 3\text{ GHz}$ | $G_{max}$     | -<br>-<br>- | 28<br>16.5<br>13 | -<br>-<br>- | dB   |
| Transducer gain<br>$I_C = 3\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_L = 50\Omega$ ,<br>$f = 100\text{ MHz}$<br>$I_C = 5\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\Omega$ ,<br>$f = 1.8\text{ GHz}$<br>$f = 3\text{ GHz}$                                            | $ S_{21e} ^2$ | -<br>-<br>- | 19<br>14<br>10   | -<br>-<br>- | dB   |
| Third order intercept point at output <sup>2)</sup><br>$V_{CE} = 3\text{ V}$ , $I_C = 5\text{ mA}$ , $f = 100\text{ MHz}$ ,<br>$Z_S = Z_L = 50\Omega$<br>$V_{CE} = 3\text{ V}$ , $I_C = 5\text{ mA}$ , $f = 1.8\text{ GHz}$ ,<br>$Z_S = Z_L = 50\Omega$                                | $IP3$         | -<br>-      | 14<br>13         | -<br>-      | dBm  |
| 1dB compression point at output<br>$V_{CE} = 3\text{V}$ , $I_C = 5\text{ mA}$ , $Z_S = Z_L = 50\Omega$ , $f = 100\text{ MHz}$<br>$V_{CE} = 3\text{V}$ , $I_C = 5\text{ mA}$ , $Z_S = Z_L = 50\Omega$ , $f = 1.8\text{ GHz}$                                                            | $P_{-1dB}$    | -<br>-      | -3<br>-1         | -<br>-      |      |

<sup>1)</sup>  $G_{ma} = |S_{21e} / S_{12e}| (k - (k^2 - 1)^{1/2})$ ,  $G_{ms} = |S_{21e} / S_{12e}|$ 
<sup>2)</sup> IP3 value depends on termination of all intermodulation frequency components.  
Termination used for this measurement is 50Ω from 0.1 MHz to 6 GHz

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



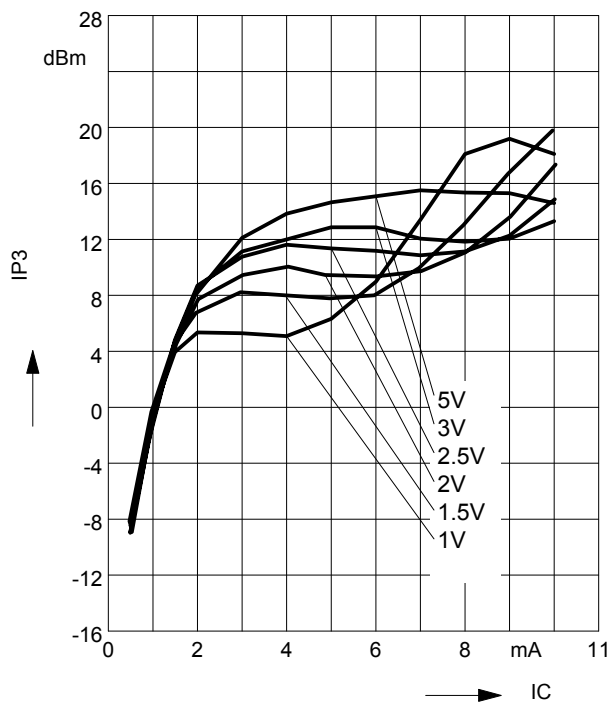
**Collector-base capacitance  $C_{\text{cb}} = f(V_{\text{CB}})$**   
 $f = 1\text{MHz}$



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

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

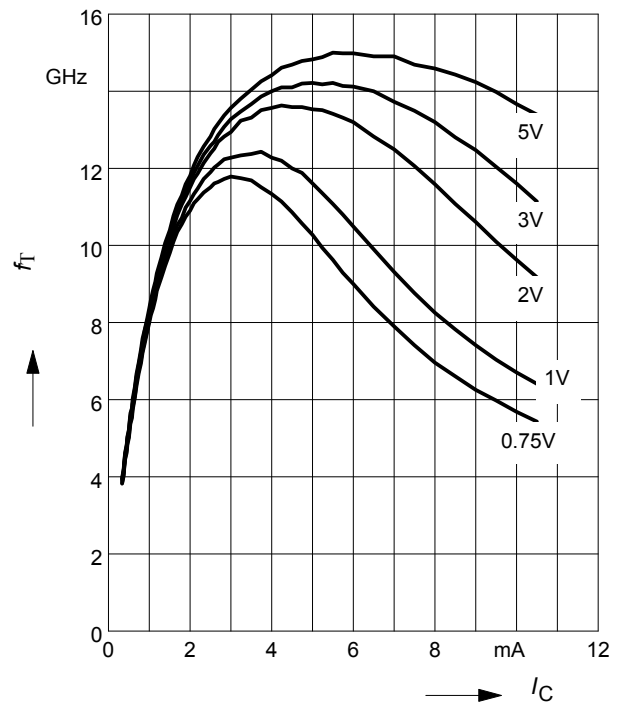
$V_{\text{CE}} = \text{parameter}, f = 1.9\text{GHz}$



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

$f = 1\text{GHz}$

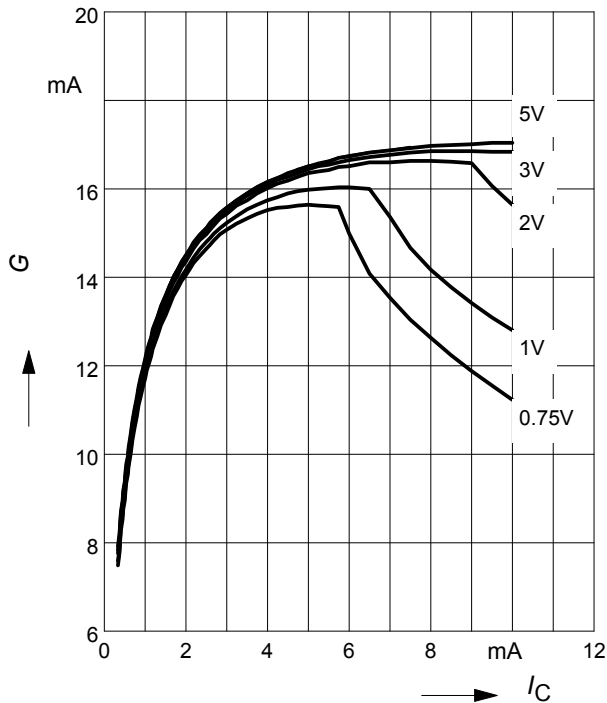
$V_{\text{CE}} = \text{parameter}$



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

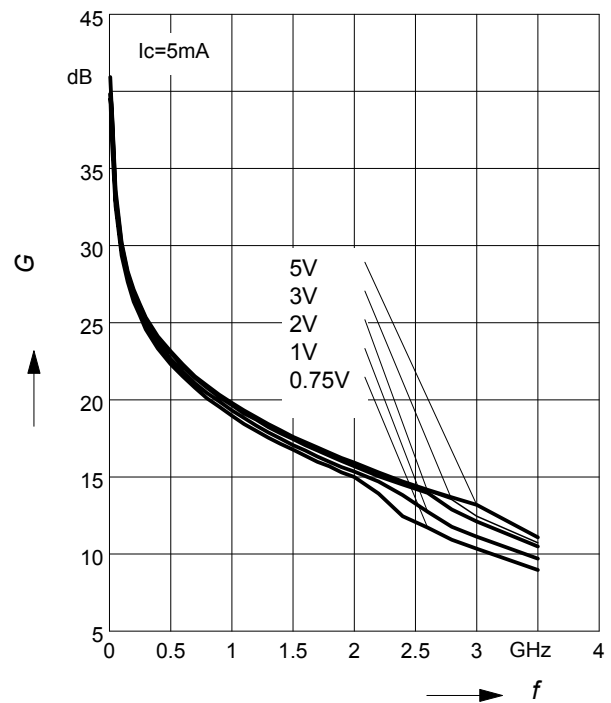
$f = 1.8\text{GHz}$

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



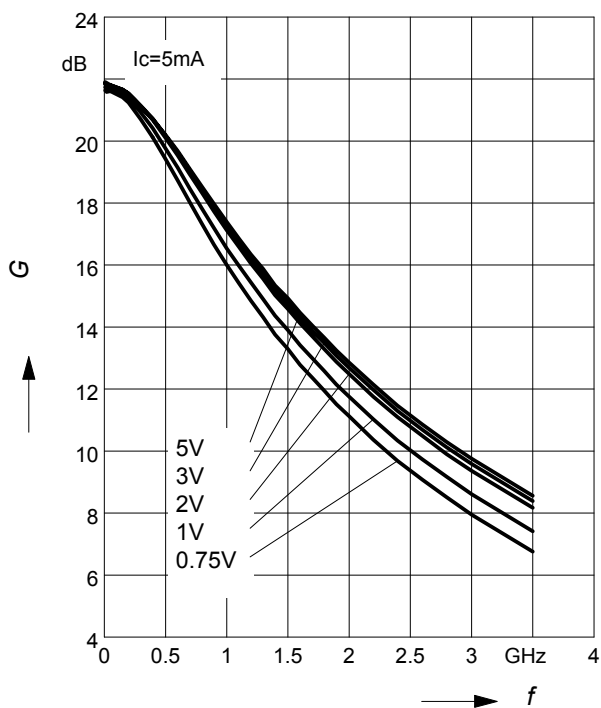
**Power Gain  $G_{ma}$ ,  $G_{ms} = f(f)$**

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



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

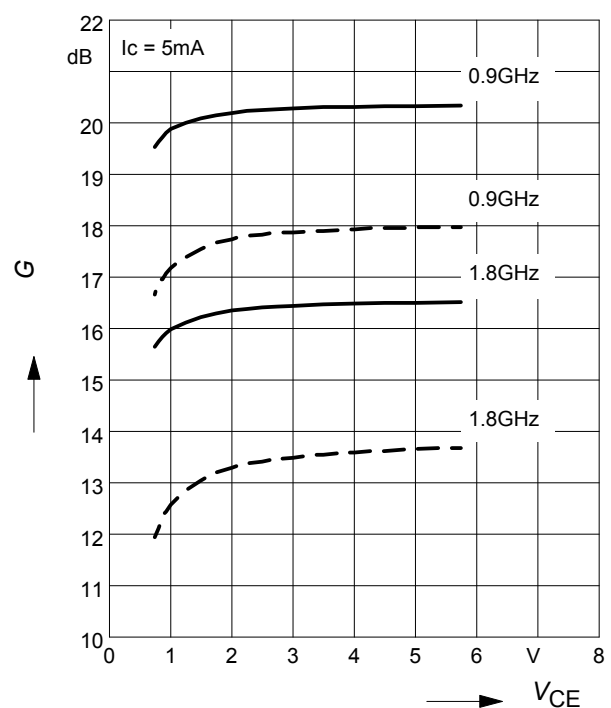
$V_{CE} = \text{parameter}$



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

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

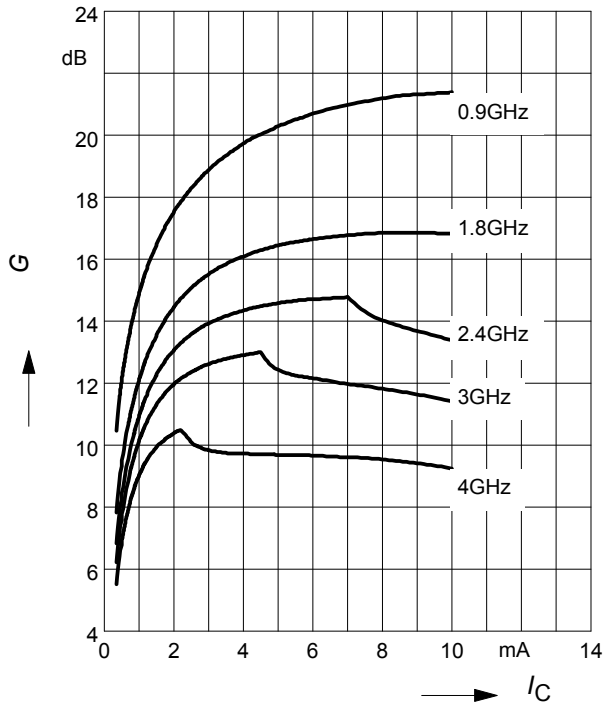
$f = \text{parameter}$



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

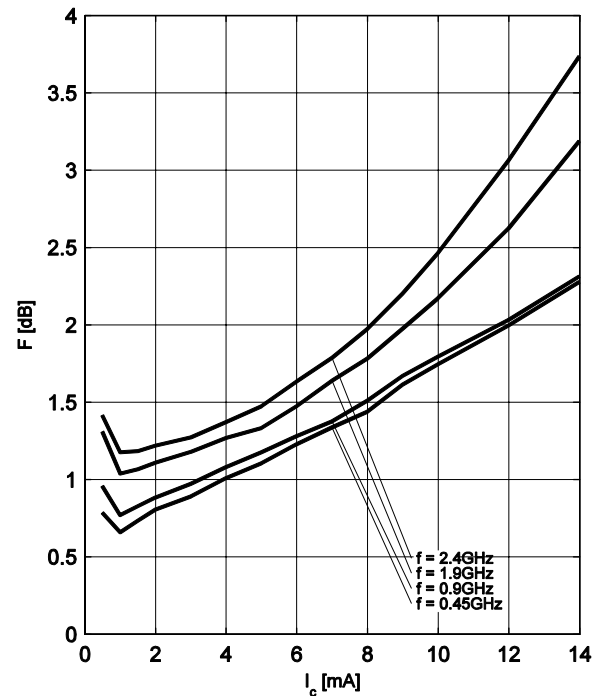
$V_{CE} = 3V$

$f = \text{parameter}$



**Noise figure  $F = f(I_C)$**

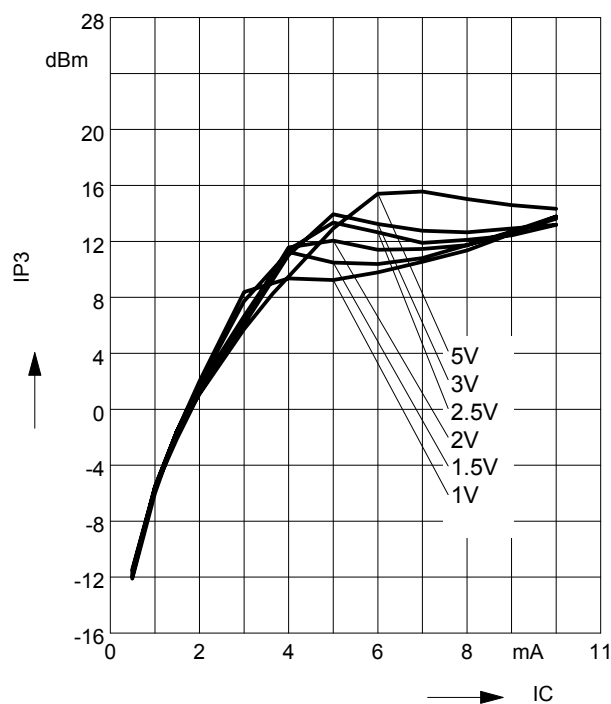
$V_{CE} = 1.5V$ ,  $Z_S = Z_{Sopt}$



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

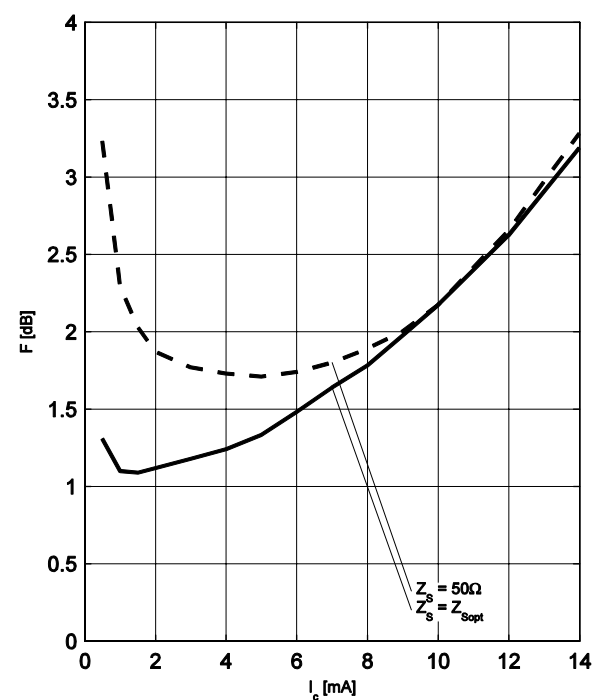
(Output,  $Z_S = Z_L = 50\Omega$ )

$V_{CE} = \text{parameter}$ ,  $f = 100\text{MHz}$



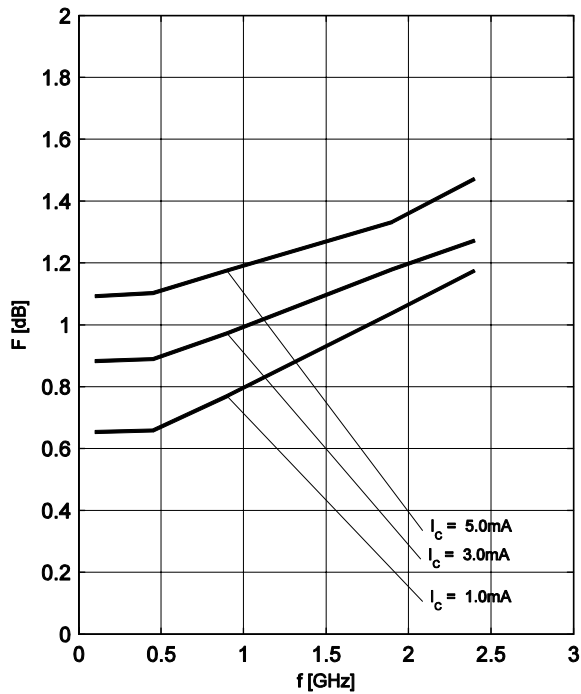
**Noise figure  $F = f(I_C)$**

$V_{CE} = 1.5V$ ,  $f = 1.9\text{GHz}$



**Noise figure  $F = f(f)$**

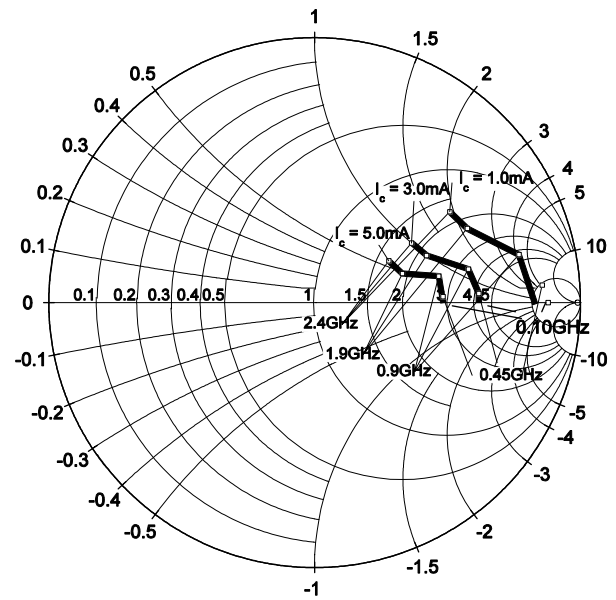
$V_{CE} = 1.5V$ ,  $Z_S = Z_{Sopt}$ ,  $I_C = \text{Parameter}$



**Source impedance for min.**

noise figure vs. frequency

$V_{CE} = 1.5V$ ,  $I_C = \text{Parameter}$





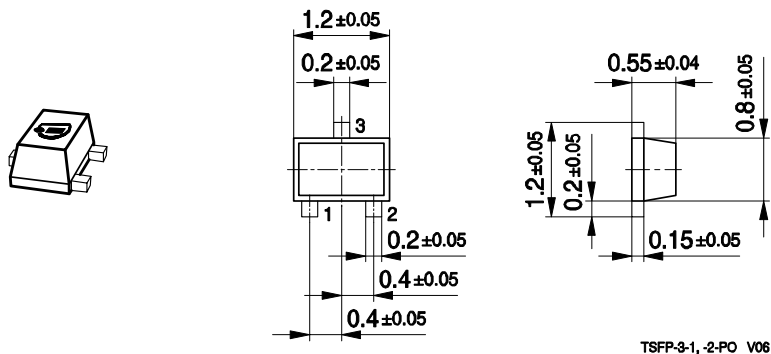
**SPICE GP Model**

For the SPICE Gummel Poon (GP) model as well as for the S-parameters (including noise parameters) please refer to our internet website

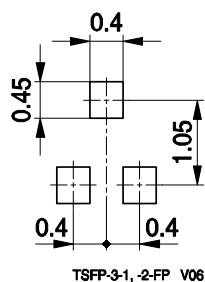
[www.infineon.com/rf.models](http://www.infineon.com/rf.models).

Please consult our website and download the latest versions before actually starting your design. You find the BFR340F SPICE GP model in the internet in MWO- and ADS-format, which you can import into these circuit simulation tools very quickly and conveniently. The model already contains the package parasitics and is ready to use for DC and high frequency simulations. The terminals of the model circuit correspond to the pin configuration of the device. The model parameters have been extracted and verified up to 10 GHz using typical devices. The BFR340F SPICE GP model reflects the typical DC- and RF-performance within the limitations which are given by the SPICE GP model itself. Besides the DC characteristics all S-parameters in magnitude and phase, as well as noise figure (including optimum source impedance, equivalent noise resistance and flicker noise) and intermodulation have been extracted.

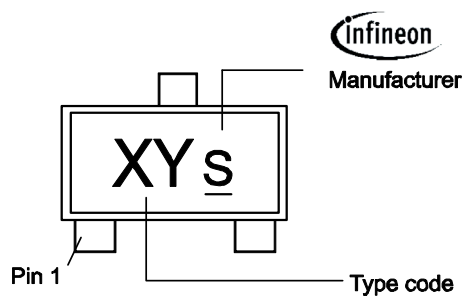
## Package Outline



## Foot Print



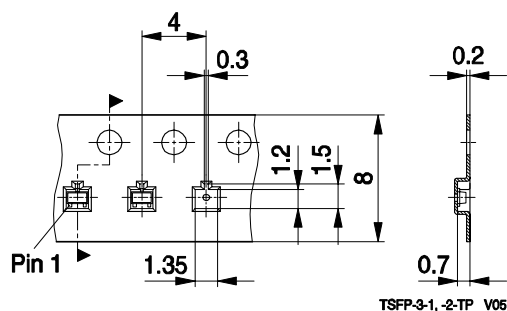
## Marking Layout (Example)



## Standard Packing

Reel Ø 180 mm = 3.000 Pieces/Reel

Reel Ø 330 mm = 10.000 Pieces/Reel



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