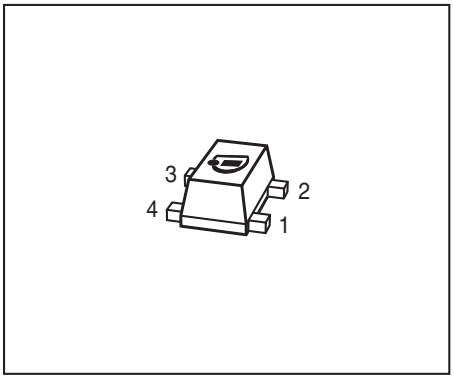
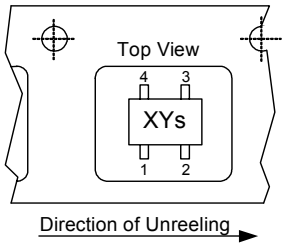
## NPN Silicon Germanium RF Transistor*




- High gain low noise RF transistor
- Provides outstanding performance for a wide range of wireless applications
- Ideal for CDMA and WLAN applications
- Outstanding noise figure $F$ = 0.65 dB at 1.8 GHz
  Outstanding noise figure $F$ = 1.2 dB at 6 GHz
- High maximum stable gain
  $G_{ms}$ = 23 dB at 1.8 GHz
- Gold metallization for extra high reliability
- 70 GHz $f_T$-Silicon Germanium technology
- Pb-free (RoHS compliant) package [1)]
- Qualified according AEC Q101




* Short term description

**ESD** (**E**lectro**s**tatic **d**ischarge) sensitive device, observe handling precaution!

| Type | Marking | Pin Configuration | | | | | | Package |
|---|---|---|---|---|---|---|---|---|
| BFP640F | R4s | 1=B | 2=E | 3=C | 4=E | - | - | TSFP-4 |

[1]Pb-containing package may be available upon special request

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## Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CEO}$ | | V |
| $T_A > 0°C$ | | 4 | |
| $T_A \leq 0°C$ | | 3.7 | |
| Collector-emitter voltage | $V_{CES}$ | 13 | |
| Collector-base voltage | $V_{CBO}$ | 13 | |
| Emitter-base voltage | $V_{EBO}$ | 1.2 | |
| Collector current | $I_C$ | 50 | mA |
| Base current | $I_B$ | 3 | |
| Total power dissipation[1)] | $P_{tot}$ | 200 | mW |
| $T_S \leq 92°C$ | | | |
| 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[2)] | $R_{thJS}$ | ≤ 290 | K/W |

## Electrical Characteristics at $T_A$ = 25°C, unless otherwise specified

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **DC Characteristics** | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | 4 | 4.5 | - | V |
| $I_C$ = 1 mA, $I_B$ = 0 | | | | | |
| Collector-emitter cutoff current | $I_{CES}$ | - | - | 30 | µA |
| $V_{CE}$ = 13 V, $V_{BE}$ = 0 | | | | | |
| Collector-base cutoff current | $I_{CBO}$ | - | - | 100 | nA |
| $V_{CB}$ = 5 V, $I_E$ = 0 | | | | | |
| Emitter-base cutoff current | $I_{EBO}$ | - | - | 3 | µA |
| $V_{EB}$ = 0.5 V, $I_C$ = 0 | | | | | |
| DC current gain | $h_{FE}$ | 110 | 180 | 270 | - |
| $I_C$ = 30 mA, $V_{CE}$ = 3 V, puls measured | | | | | |

[1] $T_S$ is measured on the collector 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°C, unless otherwise specified

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **AC Characteristics** (verified by random sampling) | | | | | |
| Transition frequency<br>$I_C$ = 30 mA, $V_{CE}$ = 3 V, $f$ = 1 GHz | $f_T$ | 30 | 40 | - | GHz |
| Collector-base capacitance<br>$V_{CB}$ = 3 V, $f$ = 1 MHz, $V_{BE}$ = 0 ,<br>emitter grounded | $C_{cb}$ | - | 0.09 | 0.2 | pF |
| Collector emitter capacitance<br>$V_{CE}$ = 3 V, $f$ = 1 MHz, $V_{BE}$ = 0 ,<br>base grounded | $C_{ce}$ | - | 0.18 | - | |
| Emitter-base capacitance<br>$V_{EB}$ = 0.5 V, $f$ = 1 MHz, $V_{CB}$ = 0 ,<br>collector grounded | $C_{eb}$ | - | 0.5 | - | |
| Noise figure<br>$I_C$ = 5 mA, $V_{CE}$ = 3 V, $f$ = 1.8 GHz, $Z_S$ = $Z_{Sopt}$<br>$I_C$ = 5 mA, $V_{CE}$ = 3 V, $f$ = 6 GHz, $Z_S$ = $Z_{Sopt}$ | $F$ | <br>- <br>- | <br>0.65<br>1.2 | <br>-<br>- | dB |
| Power gain, maximum stable[1)]<br>$I_C$ = 30 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_{Sopt}$,<br>$Z_L$ = $Z_{Lopt}$ , $f$ = 1.8 GHz | $G_{ms}$ | - | 23 | - | dB |
| Power gain, maximum available[1)]<br>$I_C$ = 30 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_{Sopt}$,<br>$Z_L$ = $Z_{Lopt}$, $f$ = 6 GHz | $G_{ma}$ | - | 12 | - | dB |
| Transducer gain<br>$I_C$ = 30 mA, $V_{CE}$ = 3 V, $Z_S$ = $Z_L$ = 50 Ω,<br>$f$ = 1.8 GHz<br>$f$ = 6 GHz | $\lvert S_{21e}\rvert^2$ | <br>-<br>- | <br>20.5<br>10 | <br>-<br>- | dB |
| Third order intercept point at output[2)]<br>$V_{CE}$ = 3 V, $I_C$ = 30 mA, $Z_S$=$Z_L$=50 Ω, $f$ = 1.8 GHz | $IP_3$ | - | 27.5 | - | dBm |
| 1dB Compression point at output<br>$I_C$ = 30 mA, $V_{CE}$ = 3 V, $Z_S$=$Z_L$=50 Ω, $f$ = 1.8 GHz | $P_{-1dB}$ | - | 13.5 | - | |

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

[2] IP3 value depends on termination of all intermodulation frequency components. Termination used for this measurement is 50Ω from 0.1 MHz to 6 GHz

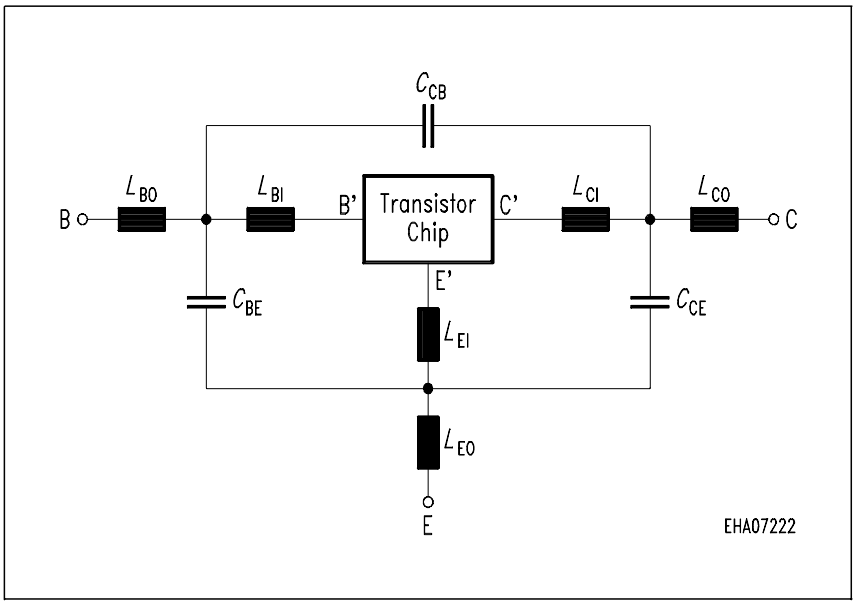
## SPICE Parameter (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax):

### Transistor Chip Data:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| IS = | 0.22 | fA | BF = | 450 | - | NF = | 1.025 | - |
| VAF = | 1000 | V | IKF = | 0.15 | A | ISE = | 21 | fA |
| NE = | 2 | - | BR = | 55 | - | NR = | 1 | - |
| VAR = | 2 | V | IKR = | 3.8 | mA | ISC = | 400 | fA |
| NC = | 1.8 | - | RB = | 3.129 | Ω | IRB = | 1.522 | mA |
| RBM = | 2.707 | Ω | RE = | 0.6 | - | RC = | 3.061 | Ω |
| CJE = | 227.6 | fF | VJE = | 0.8 | V | MJE = | 0.3 | - |
| TF = | 1.8 | ps | XTF = | 10 | - | VTF = | 1.5 | V |
| ITF = | 0.4 | A | PTF = | 0 | deg | CJC = | 67.43 | fF |
| VJC = | 0.6 | V | MJC = | 0.5 | - | XCJC = | 1 | - |
| TR = | 0.2 | ns | CJS = | 93.4 | fF | VJS = | 0.6 | V |
| MJS = | 0.27 | - | XTB = | -1.42 | - | EG = | 1.078 | eV |
| XTI = | 3 | - | FC = | 0.8 | | TNOM | 298 | K |
| AF = | 2 | - | KF = | 7.291E-11 | | | | |
| TITF1 | -0.0065 | - | TITF2 | 1.0E-5 | | | | |

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

### Package Equivalent Circuit:

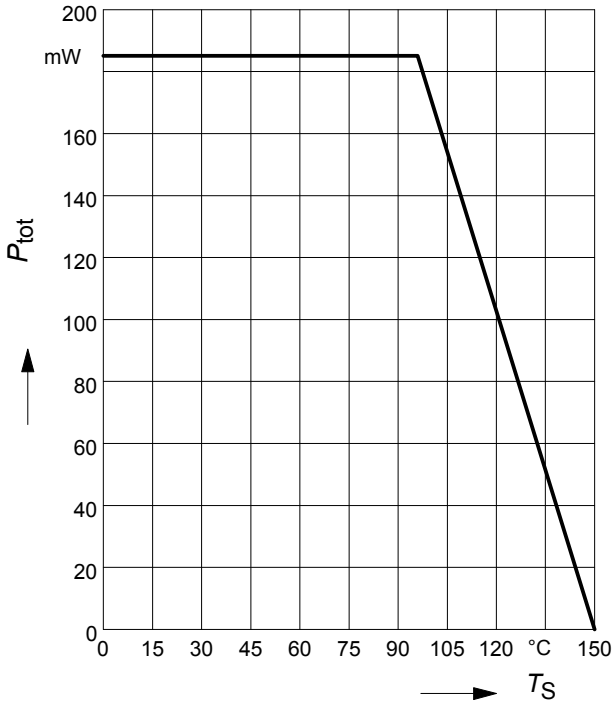



| | | |
|---|---|---|
| LBO = | 0.22 | nH |
| LEO = | 0.28 | nH |
| LCO = | 0.22 | nH |
| LBI = | 0.42 | nH |
| LEI = | 0.26 | nH |
| LCI = | 0.35 | nH |
| CBE = | 34 | fF |
| CBC = | 2 | fF |
| CCE = | 33 | fF |
| KBO-EO = | 0.1 | - |
| KBO-CO = | 0.01 | - |
| KEO-CO = | 0.11 | - |
| KCI-EI = | 0.2 | - |
| KBI-CI = | -0.08 | - |
| KBI-EI = | -0.05 | - |
| RLBI = | 0.15 | Ω |
| RLEI = | 0.11 | Ω |
| RLCI = | 0.13 | Ω |

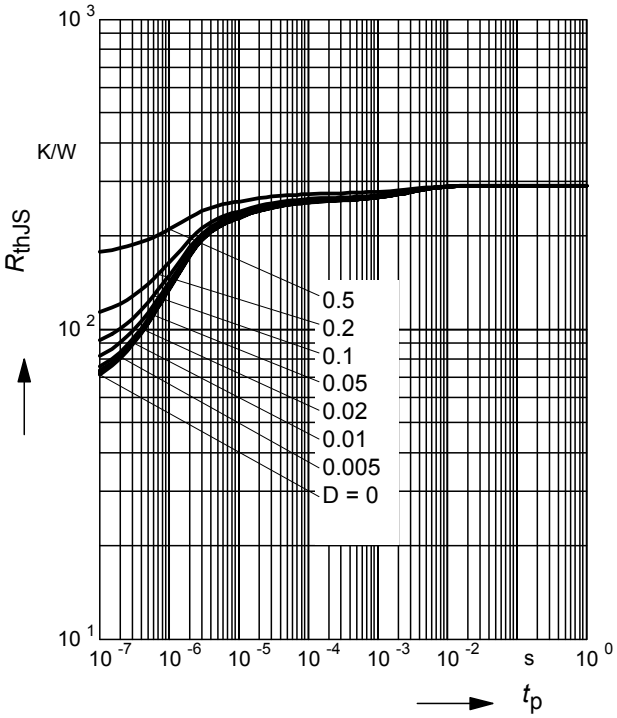
Valid up to 6GHz

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 $P_{tot} = f(T_S)$**

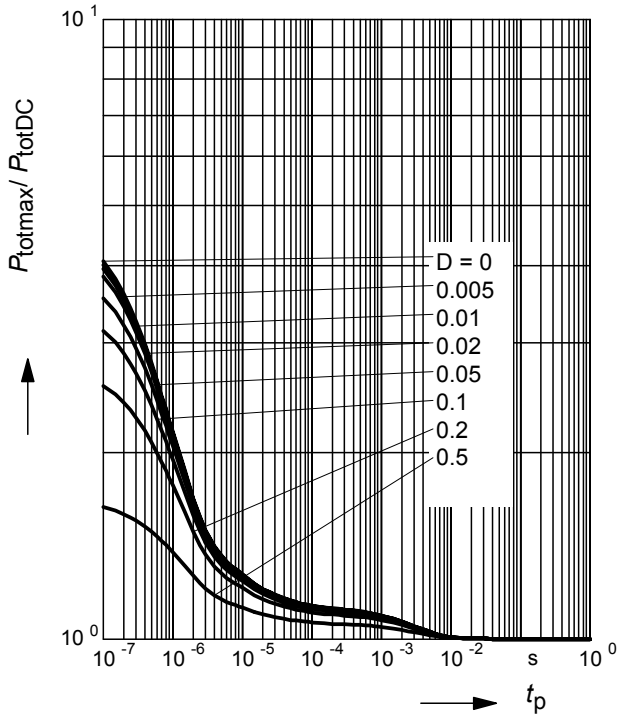



**Permissible Pulse Load $R_{thJS} = f(t_p)$**



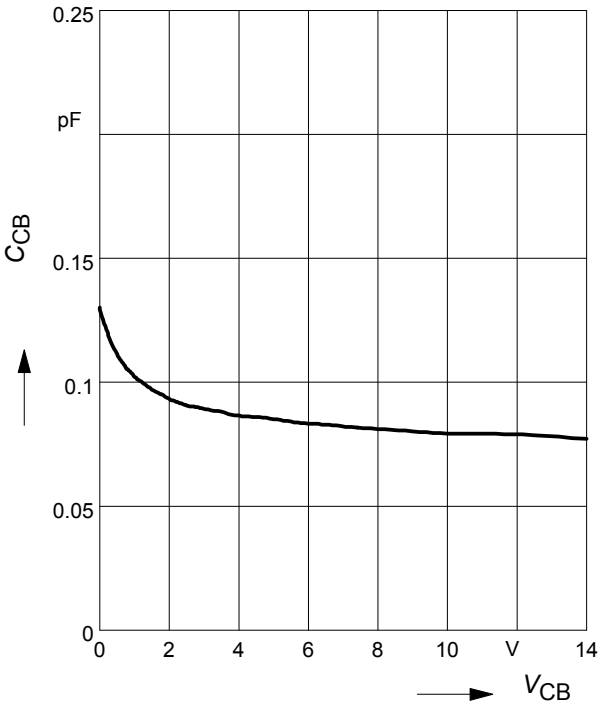

**Permissible Pulse Load**

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




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

$f$ = 1MHz

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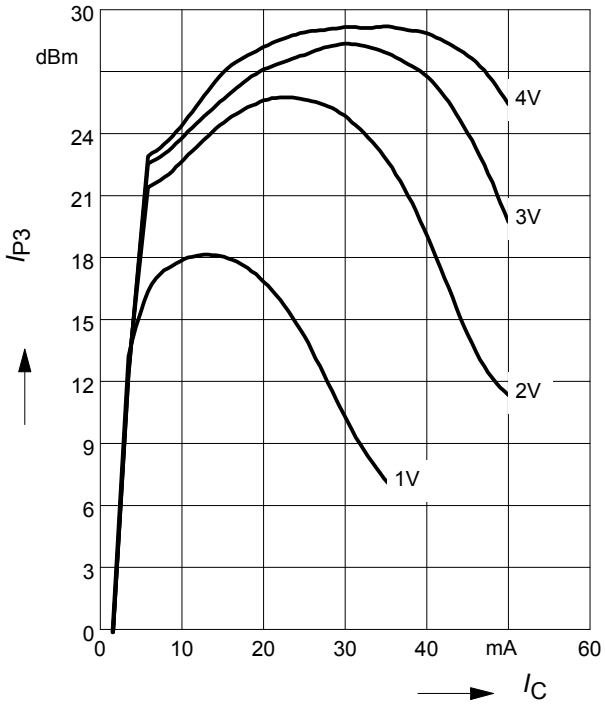
**Third order Intercept Point** $IP_3=f(I_C)$

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

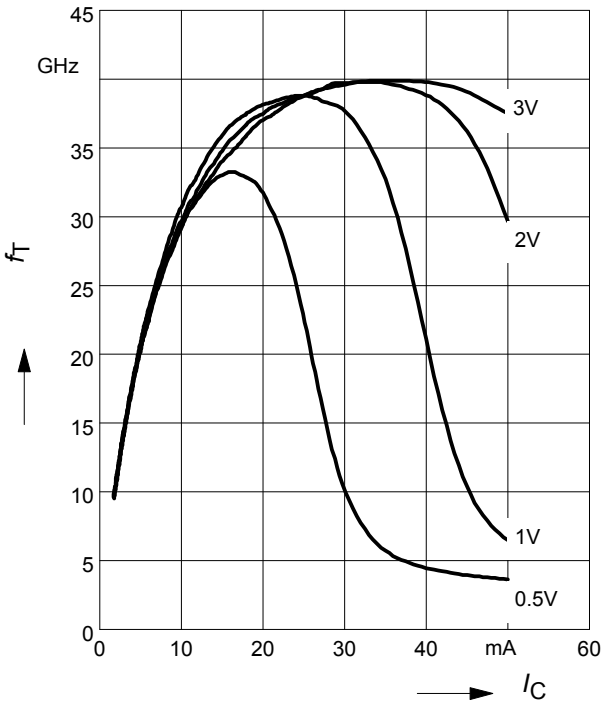
$V_{CE}$ = parameter, $f$ = 1.8 GHz




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

$f$ = 1GHz

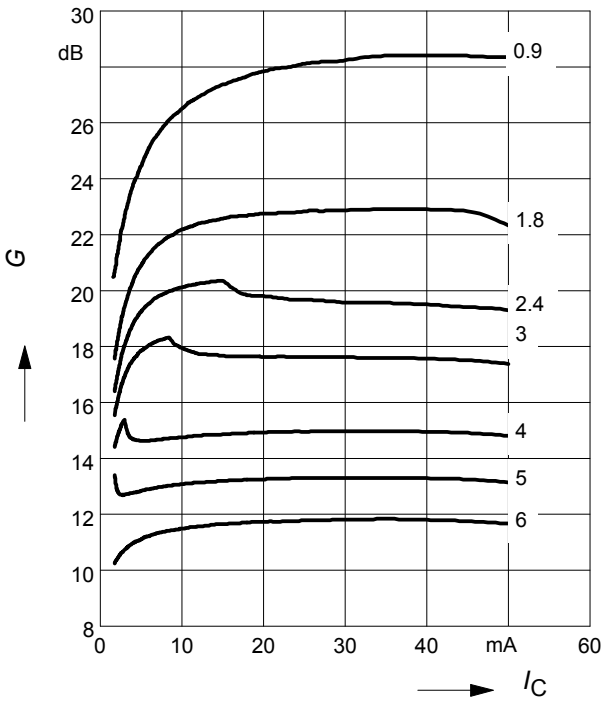
$V_{CE}$ = parameter




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

$V_{CE}$ = 3V

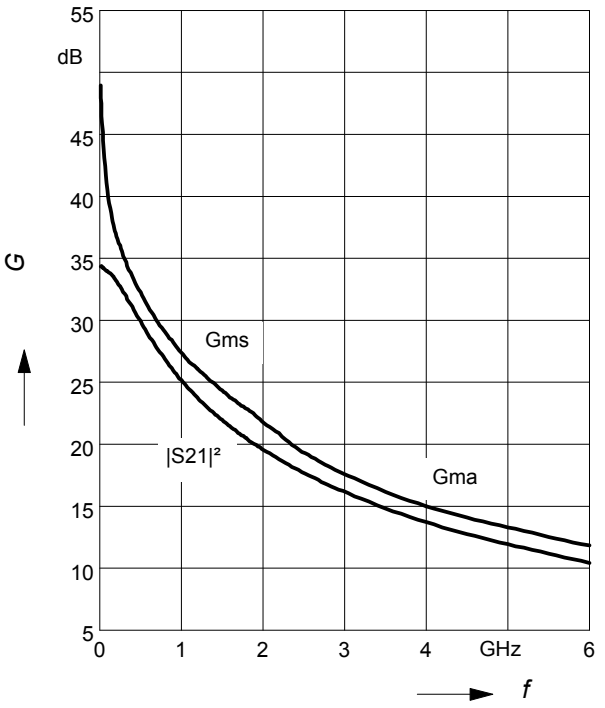
$f$ = parameter




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

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

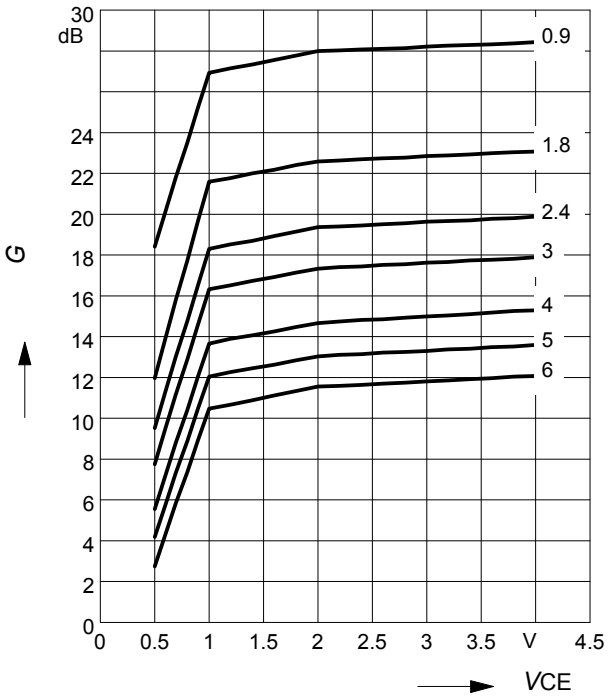
$V_{CE}$ = 3V, $I_C$ = 30mA



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

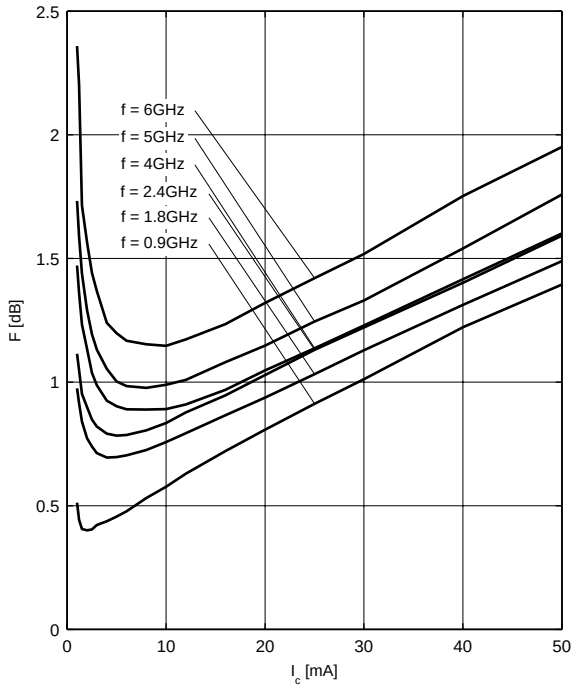
$I_C$ = 30mA

$f$ = parameter



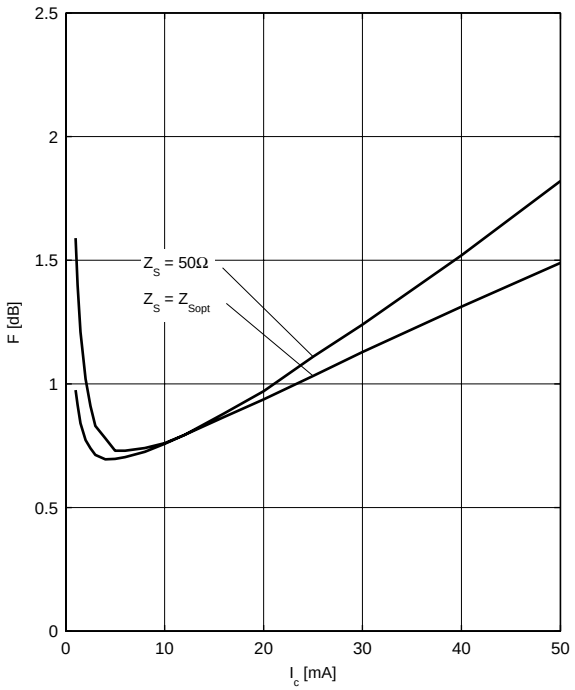

**Noise figure** $F$ = $f(I_C)$

$V_{CE}$ = 3V, $Z_S$ = $Z_{Sopt}$



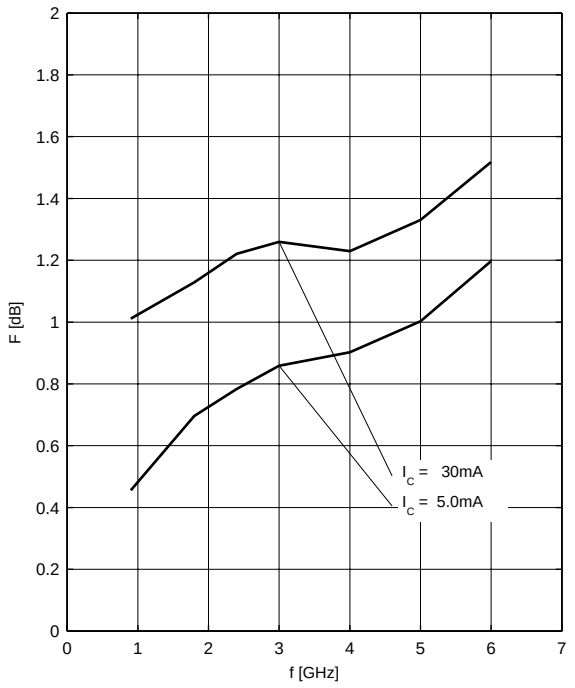

**Noise figure** $F$ = $f(I_C)$

$V_{CE}$ = 3V, $f$ = 1.8 GHz

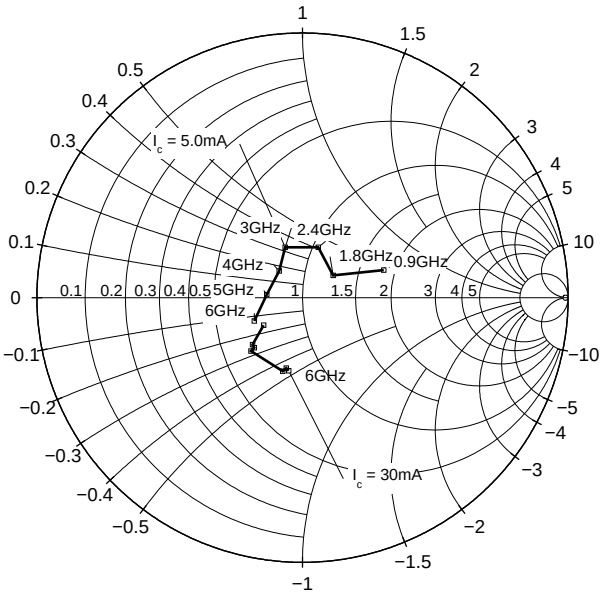



**Noise figure** $F$ = $f(f)$

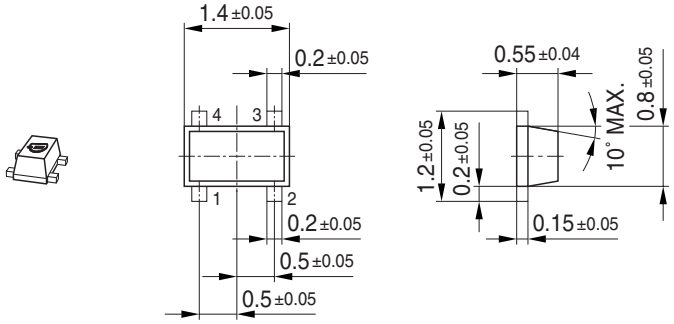
$V_{CE}$ = 3V, $Z_S$ = $Z_{Sopt}$



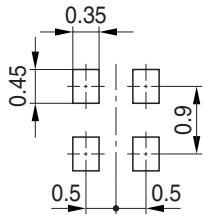
**Source impedance** for min.
noise figure vs. frequency
$V_{CE}$ = 3 V, $I_C$ = 5 mA/ 30 mA



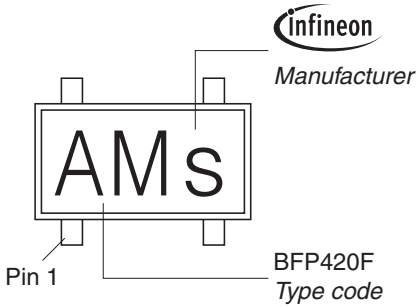
## Package Outline




## Foot Print

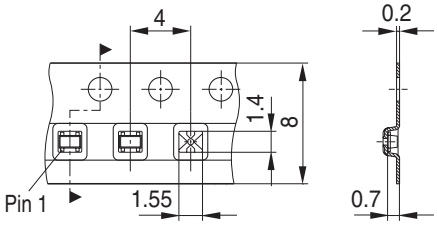



## Marking Layout (Example)




## Standard Packing

Reel ø180 mm = 3.000 Pieces/Reel
Reel ø330 mm = 10.000 Pieces/Reel

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