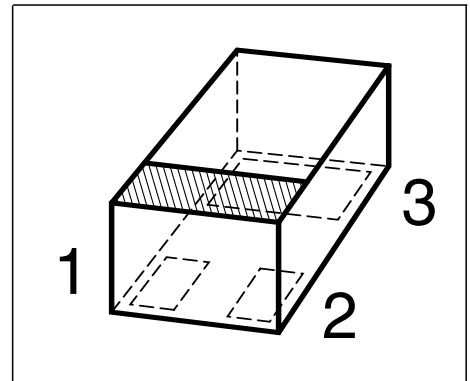


# **NPN Silicon RF Transistor**

Preliminary data

- 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



**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>1)</sup><br>$T_S \leq 106^\circ\text{C}$ | $P_{tot}$ | 210         | mW               |
| Junction temperature                                                  | $T_j$     | 150         | $^\circ\text{C}$ |
| Ambient temperature                                                   | $T_A$     | -65 ... 150 |                  |
| Storage temperature                                                   | $T_{stg}$ | -65 ... 150 |                  |

## **Thermal Resistance**

| Parameter                                | Symbol     | Value | Unit |
|------------------------------------------|------------|-------|------|
| Junction - soldering point <sup>2)</sup> | $R_{thJS}$ | tbd   | 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. |               |
| 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>$V_{CE} = 15\text{ V}$ , $V_{BE} = 0$ | $I_{CES}$     | -      | -    | 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>$I_C = 15\text{ mA}$ , $V_{CE} = 3\text{ V}$          | $h_{FE}$      | 60     | 130  | 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>$I_C = 15\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 1\text{ GHz}$                                                                                                                           | $f_T$         | 11         | 14            | -          | GHz  |
| Collector-base capacitance<br>$V_{CB} = 5\text{ V}$ , $f = 1\text{ MHz}$ , emitter grounded                                                                                                                         | $C_{cb}$      | -          | 0.26          | 0.5        | pF   |
| Collector emitter capacitance<br>$V_{CE} = 5\text{ V}$ , $f = 1\text{ MHz}$ , base grounded                                                                                                                         | $C_{ce}$      | -          | 0.15          | -          |      |
| Emitter-base capacitance<br>$V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$ , collector grounded                                                                                                                       | $C_{eb}$      | -          | 0.43          | -          |      |
| Noise figure<br>$I_C = 3\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ ,<br>$f = 1.8\text{ GHz}$                                                                                                            | $F_{min}$     | -          | 1             | -          | dB   |
| Power gain, maximum stable <sup>1)</sup><br>$I_C = 15\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ ,<br>$Z_L = Z_{Lopt}$ , $f = 1.8\text{ GHz}$                                                            | $G_{ms}$      | -          | 16.5          | -          | -    |
| Power gain, maximum available <sup>1)</sup><br>$I_C = 15\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ ,<br>$Z_L = Z_{Lopt}$ , $f = 3\text{ GHz}$                                                           | $G_{ma}$      | -          | 11.5          | -          | dB   |
| 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>$I_C = 30\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\Omega$ ,<br>$f = 3\text{ GHz}$ | $ S_{21e} ^2$ | -<br><br>- | 13.5<br><br>9 | -<br><br>- | dB   |
| Third order intercept point at output <sup>2)</sup><br>$V_{CE} = 3\text{ V}$ , $I_C = 15\text{ mA}$ , $f = 1.8\text{ GHz}$ ,<br>$Z_S = Z_L = 50\Omega$                                                              | $IP_3$        | -          | 24            | -          | dBm  |
| 1dB Compression point at output<br>$I_C = 15\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\Omega$ ,<br>$f = 1.8\text{ GHz}$                                                                                  | $P_{-1dB}$    | -          | 8.5           | -          |      |

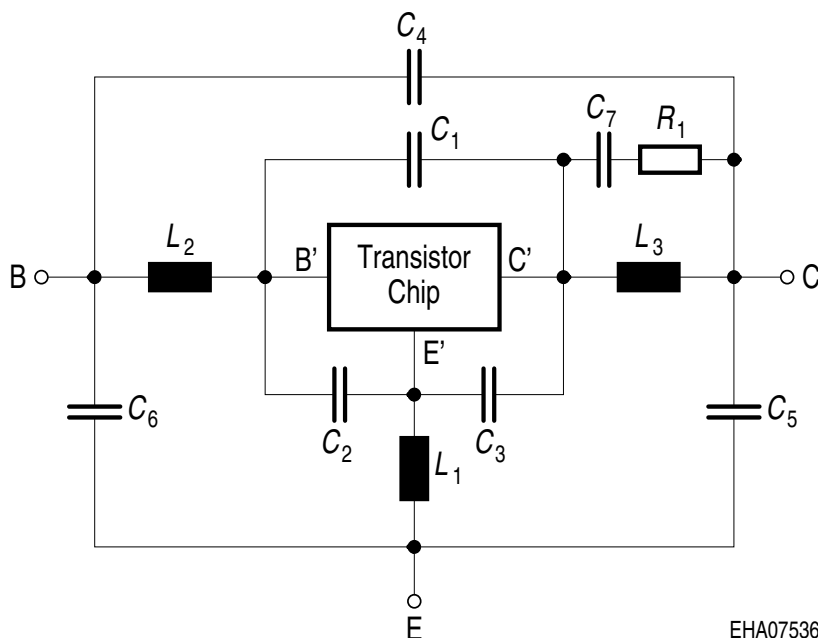
$$^1G_{ma} = |S_{21e}| / |S_{12e}| (k - (k^2 - 1)^{1/2})$$

<sup>2)</sup> $IP_3$  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

EHA07536

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>