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NPN 5 GHz wideband transistor

BFR92A

FEATURES

- High power gain
- Low noise figure
- Low intermodulation distortion.

APPLICATIONS

- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT92.

PINNING

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<th>PIN</th>
<th>DESCRIPTION</th>
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<tr>
<td>1</td>
<td>base</td>
</tr>
<tr>
<td>2</td>
<td>emitter</td>
</tr>
<tr>
<td>3</td>
<td>collector</td>
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QUICK REFERENCE DATA

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<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
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<tr>
<td>V_{CBO}</td>
<td>collector-base voltage</td>
<td>–</td>
<td>20</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{CEO}</td>
<td>collector-emitter voltage</td>
<td>–</td>
<td>15</td>
<td>V</td>
<td></td>
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<tr>
<td>I_C</td>
<td>collector current (DC)</td>
<td>–</td>
<td>25</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>P_{tot}</td>
<td>total power dissipation</td>
<td>T_s ≤ 95 °C</td>
<td>–</td>
<td>300</td>
<td>mW</td>
</tr>
<tr>
<td>C_{re}</td>
<td>feedback capacitance</td>
<td>I_C = I_C = 0; V_{CE} = 10 V; f = 1 MHz</td>
<td>0.35</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>f_T</td>
<td>transition frequency</td>
<td>I_C = 15 mA; V_{CE} = 10 V; f = 500 MHz</td>
<td>5</td>
<td>–</td>
<td>GHz</td>
</tr>
<tr>
<td>G_{UM}</td>
<td>maximum unilateral power gain</td>
<td>I_C = 15 mA; V_{CE} = 10 V; f = 1 GHz; T_{amb} = 25 °C</td>
<td>14</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_C = 15 mA; V_{CE} = 10 V; f = 2 GHz; T_{amb} = 25 °C</td>
<td>8</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>F</td>
<td>noise figure</td>
<td>I_C = 5 mA; V_{CE} = 10 V; f = 1 GHz; \Gamma_s = \Gamma_{opt}; T_{amb} = 25 °C</td>
<td>2.1</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>V_O</td>
<td>output voltage</td>
<td>d_{im} = –60 dB; I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; f_p + f_q – f_r = 793.25 MHz</td>
<td>150</td>
<td>–</td>
<td>mV</td>
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LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

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<td>V</td>
</tr>
<tr>
<td>V_{CEO}</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>–</td>
<td>15</td>
<td>V</td>
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<tr>
<td>V_{EBO}</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>–</td>
<td>2</td>
<td>V</td>
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<td>I_C</td>
<td>collector current (DC)</td>
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<td>25</td>
<td>mA</td>
<td></td>
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<td>P_{tot}</td>
<td>total power dissipation</td>
<td>T_s ≤ 95 °C; note 1; see Fig.3</td>
<td>–</td>
<td>300</td>
<td>mW</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>storage temperature</td>
<td>–65</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>T_j</td>
<td>junction temperature</td>
<td>–</td>
<td>175</td>
<td>°C</td>
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Note

1. T_s is the temperature at the soldering point of the collector pin.
THERMAL CHARACTERISTICS

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<th>CONDITIONS</th>
<th>VALUE</th>
<th>UNIT</th>
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<td>$R_{th,j-s}$</td>
<td>thermal resistance from junction to soldering point</td>
<td>$T_s \leq 95 \degree$ C; note 1</td>
<td>260</td>
<td>K/W</td>
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**Note**
1. $T_s$ is the temperature at the soldering point of the collector pin.

CHARACTERISTICS

$T_j = 25 \degree$ C unless otherwise specified.

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<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
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<tbody>
<tr>
<td>$I_{CBO}$</td>
<td>collector leakage current</td>
<td>$I_E = 0; V_{CB} = 10$ V</td>
<td>–</td>
<td>–</td>
<td>50</td>
<td>nA</td>
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<tr>
<td>$h_{FE}$</td>
<td>DC current gain</td>
<td>$I_C = 15$ mA; $V_{CE} = 10$ V; see Fig.4</td>
<td>65</td>
<td>90</td>
<td>135</td>
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<tr>
<td>$C_c$</td>
<td>collector capacitance</td>
<td>$I_E = I_c = 0; V_{CB} = 10$ V; $f = 1$ MHz; see Fig.5</td>
<td>–</td>
<td>0.6</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>$C_e$</td>
<td>emitter capacitance</td>
<td>$I_C = I_c = 0; V_{EB} = 10$ V; $f = 1$ MHz</td>
<td>–</td>
<td>1.2</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>$C_{fe}$</td>
<td>feedback capacitance</td>
<td>$I_C = I_c = 0; V_{CE} = 10$ V; $f = 1$ MHz</td>
<td>–</td>
<td>0.35</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>$f_T$</td>
<td>transition frequency</td>
<td>$I_C = 15$ mA; $V_{CE} = 10$ V; $f = 500$ MHz; see Fig.6</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>GHz</td>
</tr>
<tr>
<td>$G_{UM}$</td>
<td>maximum unilateral power gain (note 1)</td>
<td>$I_C = 15$ mA; $V_{CE} = 10$ V; $f = 1$ GHz; $T_{amb} = 25$ °C</td>
<td>–</td>
<td>14</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 15$ mA; $V_{CE} = 10$ V; $f = 2$ GHz; $T_{amb} = 25$ °C</td>
<td>–</td>
<td>8</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>$F$</td>
<td>noise figure</td>
<td>$I_C = 5$ mA; $V_{CE} = 10$ V; $f = 1$ GHz; $\Gamma_s = \Gamma_{opt}; T_{amb} = 25$ °C; see Figs 13 and 14</td>
<td>–</td>
<td>2.1</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 5$ mA; $V_{CE} = 10$ V; $f = 2$ GHz; $\Gamma_s = \Gamma_{opt}; T_{amb} = 25$ °C; see Figs 13 and 14</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>$V_O$</td>
<td>output voltage</td>
<td>notes 2 and 3</td>
<td>–</td>
<td>150</td>
<td>–</td>
<td>mV</td>
</tr>
<tr>
<td>$d_2$</td>
<td>second order intermodulation distortion</td>
<td>notes 2 and 4; see Fig.16</td>
<td>–</td>
<td>–50</td>
<td>–</td>
<td>dB</td>
</tr>
</tbody>
</table>

**Notes**
1. $G_{UM}$ is the maximum unilateral power gain, assuming $S_{12}$ is zero and $G_{UM} = 10 \log \left( 1 - \frac{|S_{21}|^2}{1 - |S_{22}|^2} \right)$ dB.
2. Measured on the same die in a SOT37 package (BFR90A).
3. $d_{im} = -60$ dB (DIN 45004B); $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75$ Ω; VSWR < 2; $T_{amb} = 25$ °C
   $V_p = V_O$ at $d_{im} = -60$ dB; $f_p = 795.25$ MHz;
   $V_q = V_O$ –6 dB; $f_q = 803.25$ MHz;
   $V_r = V_O$ –6 dB; $f_r = 805.25$ MHz;
   measured at $f_p + f_q - f_r = 793.25$ MHz.
4. $I_C = 14$ mA; $V_{CE} = 10$ V; $R_L = 75$ Ω; VSWR < 2; $T_{amb} = 25$ °C
   $V_p = 60$ mV at $f_p = 250$ MHz;
   $V_q = 60$ mV at $f_q = 560$ MHz;
   measured at $f_p + f_q = 810$ MHz.
NPN 5 GHz wideband transistor

**Fig. 2** Intermodulation distortion and second harmonic distortion MATV test circuit.

L1 = L3 = 5 µH choke.
L2 = 3 turns 0.4 mm copper wire, internal diameter 3 mm, winding pitch 1 mm.

**Fig. 3** Power derating curve.

**Fig. 4** DC current gain as a function of collector current; typical values.
NPN 5 GHz wideband transistor

**Fig. 5** Collector capacitance as a function of collector-base voltage; typical values.

\[ C_C (\text{pF}) \text{ vs } V_{CB} (\text{V}) \]

\[ I_C = I_L = 0; f = 1 \text{ MHz}; T_j = 25 ^\circ \text{C}. \]

**Fig. 6** Transition frequency as a function of collector current; typical values.

\[ f_T (\text{GHz}) \text{ vs } I_C (\text{mA}) \]

\[ V_{CE} = 10 \text{ V}; f = 500 \text{ MHz}; T_{amb} = 25 ^\circ \text{C}. \]

**Fig. 7** Gain as a function of collector current; typical values.

\[ \text{Gain (dB)} \text{ vs } I_C (\text{mA}) \]

\[ V_{CE} = 10 \text{ V}; f = 500 \text{ MHz}. \]

MSG = maximum stable gain; 
\[ G_{UM} = \text{maximum unilateral power gain}. \]

**Fig. 8** Gain as a function of collector current; typical values.

\[ \text{Gain (dB)} \text{ vs } I_C (\text{mA}) \]

\[ V_{CE} = 10 \text{ V}; f = 1 \text{ GHz}. \]

MSG = maximum stable gain; 
\[ G_{UM} = \text{maximum unilateral power gain}. \]
NXP Semiconductors
Product specification

NPN 5 GHz wideband transistor
BFR92A

**Fig. 9** Gain as a function of frequency; typical values.

\[ I_C = 5 \text{ mA}; \ V_{CE} = 10 \text{ V}. \]
\[ G_{UM} = \text{maximum unilateral power gain}; \ MSG = \text{maximum stable gain}; \ G_{max} = \text{maximum available gain}. \]

**Fig. 10** Gain as a function of frequency; typical values.

\[ I_C = 15 \text{ mA}; \ V_{CE} = 10 \text{ V}. \]
\[ G_{UM} = \text{maximum unilateral power gain}; \ MSG = \text{maximum stable gain}; \ G_{max} = \text{maximum available gain}. \]

**Fig. 11** Circles of constant noise figure; typical values.

\[ I_C = 4 \text{ mA}; \ V_{CE} = 10 \text{ V}; f = 800 \text{ MHz}. \]

**Fig. 12** Circles of constant noise figure; typical values.

\[ I_C = 14 \text{ mA}; \ V_{CE} = 10 \text{ V}; f = 800 \text{ MHz}. \]
NPN 5 GHz wideband transistor

**Fig. 13** Minimum noise figure as a function of collector current; typical values.  

- **V<sub>CE</sub> = 10 V.**

**Fig. 14** Minimum noise figure as a function of frequency; typical values.  

- **V<sub>CE</sub> = 10 V.**

**Fig. 15** Intermodulation distortion; typical values.  

- **V<sub>CE</sub> = 10 V; V<sub>O</sub> = 150 mV (43.5 dBmV); f<sub>p</sub> + f<sub>q</sub> − fr = 793.25 MHz; T<sub>amb</sub> = 25 °C.  
  Measured in MATV test circuit (see Fig. 2).

**Fig. 16** Second order intermodulation distortion; typical values.  

- **V<sub>CE</sub> = 10 V; V<sub>O</sub> = 60 mV; f<sub>p</sub> + f<sub>q</sub> − fr = 810 MHz; T<sub>amb</sub> = 25 °C.  
  Measured in MATV test circuit (see Fig. 2).
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Fig. 17 Common emitter input reflection coefficient ($S_{11}$); typical values.

$I_C = 14 \text{ mA}; V_{CE} = 10 \text{ V}; Z_o = 50 \Omega; T_{amb} = 25 \degree \text{C}$.

Fig. 18 Common emitter forward transmission coefficient ($S_{21}$); typical values.

$I_C = 14 \text{ mA}; V_{CE} = 10 \text{ V}; T_{amb} = 25 \degree \text{C}$.
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Fig. 19 Common emitter reverse transmission coefficient (S_{12}); typical values.

Fig. 20 Common emitter output reflection coefficient (S_{22}); typical values.

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NPN 5 GHz wideband transistor

BFR92A

PACKAGE OUTLINE

Plastic surface mounted package; 3 leads

SOT23

DIMENSIONS (mm are the original dimensions)

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<th>D</th>
<th>E</th>
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<th>HE</th>
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OUTLINE VERSION

SOT23

REFERENCES

IEC

JEDEC

EIAJ

EUROPEAN PROJECTION

ISSUE DATE

97-02-28

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Legal information

Data sheet status

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<tr>
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