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NXP Semiconductors
NPN 5 GHz wideband transistor

**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**

<table>
<thead>
<tr>
<th>PIN</th>
<th>DESCRIPTION</th>
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<tbody>
<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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<tbody>
<tr>
<td>V_CBO</td>
<td>collector-base voltage</td>
<td></td>
<td>–</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>V_CEO</td>
<td>collector-emitter voltage</td>
<td></td>
<td>–</td>
<td>15</td>
<td>V</td>
</tr>
<tr>
<td>I_C</td>
<td>collector current (DC)</td>
<td></td>
<td>–</td>
<td>25</td>
<td>mA</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; T_s = T_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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<th>UNIT</th>
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<tr>
<td>V_CBO</td>
<td>collector-base voltage</td>
<td>open emitter</td>
<td>–</td>
<td>20</td>
<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>
</tr>
<tr>
<td>V_EBO</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>–</td>
<td>2</td>
<td>V</td>
</tr>
<tr>
<td>I_C</td>
<td>collector current (DC)</td>
<td></td>
<td>–</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<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></td>
<td>–65</td>
<td>+150</td>
<td>°C</td>
</tr>
<tr>
<td>T_j</td>
<td>junction temperature</td>
<td></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.
NXP Semiconductors
Product specification

NPN 5 GHz wideband transistor  BFR92A

THERMAL CHARACTERISTICS

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<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>thermal resistance from junction to soldering point</td>
<td>$T_s \leq 95 , ^\circ C$; note 1</td>
<td>260</td>
<td>kW</td>
</tr>
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Note
1. $T_s$ is the temperature at the soldering point of the collector pin.

CHARACTERISTICS

$T_j = 25 \, ^\circ C$ unless otherwise specified.

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<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<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>
</tr>
<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>
<td></td>
</tr>
<tr>
<td>$C_c$</td>
<td>collector capacitance</td>
<td>$I_E = i_E = 0; V_{CB} = 10 , V; f = 1 , MHz$; 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>$C_{re}$</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>$I_C = 15 , mA; V_{CE} = 10 , V; f = 1 , GHz$; $T_{amb} = 25 , ^\circ C$</td>
<td>–</td>
<td>14</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 15 , mA; V_{CE} = 10 , V; f = 2 , GHz$; $T_{amb} = 25 , ^\circ C$</td>
<td>–</td>
<td>8</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>$F$</td>
<td>noise figure</td>
<td>$I_C = 5 , mA; V_{CE} = 10 , V; f = 1 , GHz$; $\Gamma_s = \Gamma_{opt}; T_{amb} = 25 , ^\circ C$; see Figs 13 and 14</td>
<td>–</td>
<td>2.1</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 5 , mA; V_{CE} = 10 , V; f = 2 , GHz$; $\Gamma_s = \Gamma_{opt}; T_{amb} = 25 , ^\circ C$; 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 $G_{UM} = 10 \log \left( \frac{|S_{21}|^2}{1 - |S_{11}|^2} \right)$ dB.
2. Measured on the same die in a SOT37 package (BFR90A).
3. $d_{im} = -60 \, dB$ (DIN 45004B); $I_C = 14 \, mA; V_{CE} = 10 \, V; R_L = 75 \, \Omega; VSWR < 2; T_{amb} = 25 \, ^\circ C$
   $V_p = V_O$ at $d_{im} = -60 \, dB$; $f_p = 795.25 \, MHz$;
   $V_q = V_O$ at $d_{im} = 803.25 \, MHz$;
   $V_r = V_O$ at $d_{im} = 805.25 \, MHz$;
   measured at $f_p$ and $f_q$.
4. $I_C = 14 \, mA; V_{CE} = 10 \, V; R_L = 75 \, \Omega; VSWR < 2; T_{amb} = 25 \, ^\circ C$
   $V_p = 60 \, mV$ at $f_p = 250 \, MHz$;
   $V_q = 60 \, mV$ at $f_q = 560 \, MHz$;
   measured at $f_p$ and $f_q$. 

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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.

V_{CE} = 10 V; T_{J} = 25 °C.

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.

\[ V_{CB} (V) \]

\[ C_C (pf) \]

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

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

\[ I_C (mA) \]

\[ f_T (GHz) \]

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

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

\[ I_C (mA) \]

\[ \text{gain (dB)} \]

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

MSG = maximum stable gain;
G\text{UM} = maximum unilateral power gain.

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

\[ I_C (mA) \]

\[ \text{gain (dB)} \]

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

MSG = maximum stable gain;
G\text{UM} = maximum unilateral power gain.
NPN 5 GHz wideband transistor

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

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

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

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

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

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

\[ I_C = 14 \, mA; V_{CE} = 10 \, V; f = 800 \, MHz. \]

**Fig. 12** Circles of constant noise figure; typical values.
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Fig. 13  Minimum noise figure as a function of collector current; typical values.

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

Fig. 15  Intermodulation distortion; typical values.

Fig. 16  Second order intermodulation distortion; typical values.
NPN 5 GHz wideband transistor  

**Fig. 17** Common emitter input reflection coefficient ($S_{11}$); typical values.

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

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

$I_C = 14 \, mA; \, V_{CE} = 10 \, V; \, T_{amb} = 25 \, ^\circ C.$
NPN 5 GHz wideband transistor

**Fig. 19** Common emitter reverse transmission coefficient ($S_{12}$); typical values.

$I_C = 14 \, mA; \quad V_{CE} = 10 \, V; \quad T_{amb} = 25 \, ^\circ C.$

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

$I_C = 14 \, mA; \quad V_{CE} = 10 \, V; \quad Z_0 = 50 \, \Omega; \quad T_{amb} = 25 \, ^\circ C.$
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BFR92A

PACKAGE OUTLINE

Plastic surface mounted package; 3 leads

SOT23

DIMENSIONS (mm are the original dimensions)

<table>
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<th>UNIT</th>
<th>A</th>
<th>A₁ max.</th>
<th>b_p</th>
<th>c</th>
<th>D</th>
<th>E</th>
<th>e</th>
<th>e₁</th>
<th>H_E</th>
<th>L_p</th>
<th>Q</th>
<th>v</th>
<th>w</th>
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<td>mm</td>
<td>1.1</td>
<td>0.9</td>
<td>0.48</td>
<td>0.35</td>
<td>0.15</td>
<td>0.09</td>
<td>3.0</td>
<td>2.8</td>
<td>1.4</td>
<td>1.2</td>
<td>1.9</td>
<td>0.95</td>
<td>2.5</td>
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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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<td>This document contains data from the objective specification for product development.</td>
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<tr>
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<td>Qualification</td>
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<tr>
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<td>Production</td>
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Modifications:
- Characteristics Table; DC current gain value changed

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