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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**

<table>
<thead>
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<th>PARAMETER</th>
<th>CONDITIONS</th>
<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>–</td>
<td>20 V</td>
<td>–</td>
</tr>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td></td>
<td>–</td>
<td>15 V</td>
<td>–</td>
</tr>
<tr>
<td>$I_C$</td>
<td>collector current (DC)</td>
<td>$I_C = I_C = 0; V_{CE} = 10 V; f = 1 MHz$</td>
<td>0.35</td>
<td>– pF</td>
<td>–</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_s \leq 95 , ^\circ C$</td>
<td>–</td>
<td>300 mW</td>
<td>–</td>
</tr>
<tr>
<td>$C_{fe}$</td>
<td>feedback capacitance</td>
<td>$I_C = 15 , mA; V_{CE} = 10 , V; f = 500 , MHz$</td>
<td>5</td>
<td>– GHz</td>
<td>–</td>
</tr>
<tr>
<td>$f_T$</td>
<td>transition frequency</td>
<td>$I_C = 15 , mA; V_{CE} = 10 , V; f = 1 , GHz$</td>
<td>14</td>
<td>– dB</td>
<td>–</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$I_C = 15 , mA; V_{CE} = 10 , V; f = 2 , GHz$</td>
<td>8</td>
<td>– dB</td>
<td>–</td>
</tr>
<tr>
<td>$G_{UM}$</td>
<td>maximum unilateral power gain</td>
<td>$I_C = 15 , mA; V_{CE} = 10 , V; f = 1 , GHz$</td>
<td>2.1</td>
<td>– dB</td>
<td>–</td>
</tr>
<tr>
<td>$F$</td>
<td>noise figure</td>
<td>$I_C = 5 , mA; V_{CE} = 10 , V; f = 1 , GHz$</td>
<td>–</td>
<td>– dB</td>
<td>–</td>
</tr>
<tr>
<td>$V_O$</td>
<td>output voltage</td>
<td>$d_{im} = -60 , dB; I_C = 14 , mA; V_{CE} = 10 , V; R_L = 75 , \Omega; f_p + f_q - f_r = 793.25 , MHz$</td>
<td>150</td>
<td>– mV</td>
<td>–</td>
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**LIMITING VALUES**
In accordance with the Absolute Maximum Rating System (IEC 134).

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<th>MAX.</th>
<th>UNIT</th>
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<td>collector-base voltage</td>
<td>open emitter</td>
<td>–</td>
<td>20 V</td>
<td>–</td>
</tr>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>–</td>
<td>15 V</td>
<td>–</td>
</tr>
<tr>
<td>$V_{EBO}$</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>–</td>
<td>2 V</td>
<td>–</td>
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<tr>
<td>$I_C$</td>
<td>collector current (DC)</td>
<td></td>
<td>–</td>
<td>25 mA</td>
<td>–</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_s \leq 95 , ^\circ C$; note 1; see Fig.3</td>
<td>–</td>
<td>300 mW</td>
<td>–</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td></td>
<td>−65</td>
<td>+150 °C</td>
<td>–</td>
</tr>
<tr>
<td>$T_J$</td>
<td>junction temperature</td>
<td></td>
<td>–</td>
<td>175 °C</td>
<td>–</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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<tr>
<td>Rthj-s</td>
<td>thermal resistance from junction to soldering point</td>
<td>T_s ≤ 95 °C; note 1</td>
<td>260</td>
<td>K/W</td>
</tr>
</tbody>
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Note
1. T_s is the temperature at the soldering point of the collector pin.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>VALUE</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
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<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>
<td></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_E = 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_E = 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(\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 °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 \Omega; 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.
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.
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Fig. 5 Collector capacitance as a function of collector-base voltage; typical values.

\[ C_C \text{ (pF)} \]

\[ V_{CB} \text{ (V)} \]

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

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

\[ f_T \text{ (GHz)} \]

\[ I_C \text{ (mA)} \]

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

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

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

\[ I_C \text{ (mA)} \]

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

MSG = maximum stable gain;

\( G_{UM} \) = maximum unilateral power gain.

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

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

\[ I_C \text{ (mA)} \]

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

MSG = maximum stable gain;

\( G_{UM} \) = maximum unilateral power gain.
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**Figure 9**  
Gain as a function of frequency;  
typical values.  

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

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

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

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

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

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

- $I_C = 14 \text{ mA}$; $V_{CE} = 10 \text{ V}$; $f = 800 \text{ MHz}$.  

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**BFR92A**

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

- **$V_{CE} = 10\, \text{V}$**.

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

- **$V_{CE} = 10\, \text{V}$**.

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

- **$V_{CE} = 10\, \text{V}$; $V_{O} = 150\, \text{mV}$ (43.5 dBmV); $f_{p} + f_{q} - f_{r} = 793.25\, \text{MHz}$; $T_{\text{Amb}} = 25\, ^{\circ}\, \text{C}$.

Measured in MATV test circuit (see Fig. 2).

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

- **$V_{CE} = 10\, \text{V}$; $V_{O} = 60\, \text{mV}$; $f_{p} + f_{q} - f_{r} = 810\, \text{MHz}$; $T_{\text{Amb}} = 25\, ^{\circ}\, \text{C}$.

Measured in MATV test circuit (see Fig. 2).
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**Fig.17** Common emitter input reflection coefficient ($S_{11}$); typical values.

$I_C = 14$ mA; $V_{CE} = 10$ V; $Z_o = 50$ Ω; $T_{amb} = 25$ °C.

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

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

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

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

$I_C = 14 \text{ mA}; V_{CE} = 10 \text{ V}; Z_0 = 50 \text{ Ω}; T_{amb} = 25 ^\circ \text{C}.$
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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>
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<th>$b_p$</th>
<th>c</th>
<th>D</th>
<th>E</th>
<th>e</th>
<th>$e_1$</th>
<th>$H_E$</th>
<th>$L_p$</th>
<th>Q</th>
<th>v</th>
<th>w</th>
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<tr>
<td>mm</td>
<td>1.1</td>
<td>0.1</td>
<td>0.48</td>
<td>0.15</td>
<td>3.0</td>
<td>1.4</td>
<td>1.9</td>
<td>0.95</td>
<td>2.5</td>
<td>0.45</td>
<td>0.55</td>
<td>0.2</td>
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OUTLINE VERSION | REFERENCES | EUROPEAN PROJECTION | ISSUE DATE
SOT23 | IEC | JEDEC | EIAJ | | | 97-02-28

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<td>This document contains data from the objective specification for product development.</td>
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<tr>
<td>Preliminary [short] data sheet</td>
<td>Qualification</td>
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<tr>
<td>Product [short] data sheet</td>
<td>Production</td>
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