# NPN Silicon RF Broadband Transistor

**BFT 12**

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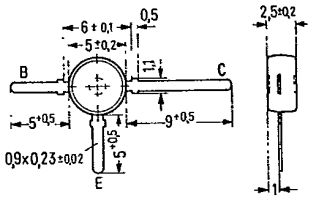
BFT 12 is an epitaxial NPN silicon planar RF transistor in a plastic package similar to TO 119 (50 B 3 DIN 41 867), intended for universal application in amplifiers up to the GHz range, e. g. for broadband antenna amplifiers with a high output power and linearity and for oscillators.

| Type | Ordering code |
|---|---|
| BFT 12 | Q62702-F390 |




Approx. weight 0.3 g Dimensions in mm

## Maximum ratings

| | | | |
|---|---|---|---|
| Collector-base-voltage | $V_{CBO}$ | 25 | V |
| Collector-emitter voltage | $V_{CEO}$ | 15 | V |
| Emitter-base voltage | $V_{EBO}$ | 3.5 | V |
| Collector current | $I_C$ | 150 | mA |
| Collector peak current ($f > 1$ MHz) | $I_{CM}$ | 300 | mA |
| Base current | $I_B$ | 50 | mA |
| Junction temperature | $T_j$ | 150 | °C |
| Storage temperature range | $T_{stg}$ | –55 to +125 | °C |
| Total power dissipation ($T_{amb}$ = 66°C) | $P_{tot}$ | 700 | mW |

## Thermal resistance

| | | | |
|---|---|---|---|
| Juncition to ambient air[1)] | $R_{thJA}$ | ≦120 | K/W |
| Junction to case | $R_{thJC}$ | ≦90 | K/W |

1) when mounted on glass fiber epoxy resin PCB 40 mm x 25 mm x 1 mm

| | | | |
|---|---|---|---|
| **Static characteristics** ($T_{amb}$ = 25°C) | | | |
| Collector-base breakdown voltage ($I_{CBO}$ = 100 µA) | $V_{(BR)CBO}$ | >25 | V |
| DC current gain ($I_C$ = 50 mA; $V_{CE}$ = 5 V) | $h_{FE}$ | ≧25 | – |
| **Dynamic characteristics** ($T_{amb}$ = 25°C) | | | |
| Transition frequency ($I_C$ = 80 mA; $V_{CE}$ = 5 V; $f$ = 200 MHz) | $f_T$ | 1.9 | GHz |
| Reverse transfer capacitance ($I_C$ = 5 mA; $V_{CE}$ = 10 V; $f$ = 1 MHz) | $C_{12e}$ | 2.4 | pF |
| Collector-base capacitance ($V_{CBO}$ = 10 V; $f$ = 1 MHz) | $C_{CBO}$ | 3 | pF |
| Power gain ($I_C$ = 40 mA; $V_{CE}$ = 7.5 V; $f$ = 800 MHz; $R_g$ = 60 Ω) | $G_{pe}$ | 7.5 | dB |
| ($I_C$ = 80 mA; $V_{CE}$ = 7.5 V; $f$ = 800 MHz; $R_g$ = 60 Ω) | $G_{pe}$ | 8 | dB |
| Noise figure ($R_g$ = 60 Ω; $I_C$ = 40 mA; $V_{CE}$ = 7.5 V; $f$ = 800 MHz) | $NF$ | 6.5 | dB |
| Output voltage[1] ($I_C$ = 80 mA; $V_{CE}$ = 7.5 V; $f$ = 800 MHz; $d_{IM}$ = 60 dB, $R_g$ = $R_L$ = 75 Ω) | $V_0$ | 1000 | mV |

**S parameter at** $V_{CE}$ = 7.5 V; $I_C$ = 60 mA; $Z_o$ = 50 Ω

| $f$ (GHz) | $S_{11e}$ | $\varphi$ | $S_{21e}$ | $\varphi$ | $S_{12e}$ | $\varphi$ | $S_{22e}$ | $\varphi$ |
|---|---|---|---|---|---|---|---|---|
| 0,1 | 0,691 | –170 | 14,199 | 94 | 0,022 | 55 | 0,208 | –115 |
| 0,2 | 0,701 | –177 | 7,261 | 85 | 0,038 | 68 | 0,160 | –135 |
| 0,3 | 0,717 | 177 | 4,860 | 78 | 0,053 | 70 | 0,151 | –147 |
| 0,4 | 0,722 | 175 | 3,666 | 73 | 0,069 | 71 | 0,159 | –148 |
| 0,5 | 0,715 | 173 | 2,909 | 67 | 0,083 | 72 | 0,168 | –149 |
| 0,6 | 0,726 | 169 | 2,458 | 63 | 0,101 | 73 | 0,179 | –148 |
| 0,7 | 0,738 | 167 | 2,102 | 59 | 0,115 | 72 | 0,192 | –149 |
| 0,8 | 0,736 | 165 | 1,823 | 53 | 0,130 | 72 | 0,214 | –149 |
| 0,9 | 0,740 | 163 | 1,619 | 49 | 0,146 | 71 | 0,240 | –147 |
| 1 | 0,752 | 161 | 1,458 | 44 | 0,159 | 70 | 0,244 | –148 |

1) three tone modulation $f$ approx. 800 MHz

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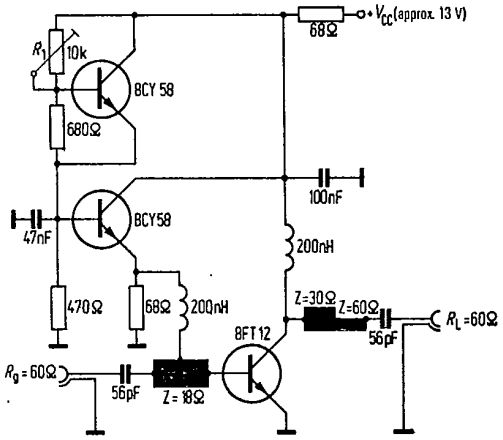
## Circuit example: Broadband RF amplifier




Operating point (set with $R_1$):
$I_C$ = 80 mA; $V_{CE}$ = 7.5 V.

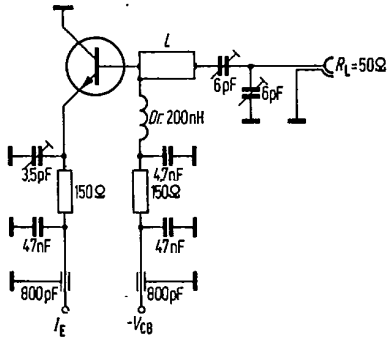
At $f$ = 800 MHz and an intermodulation product distance of $d_{IM}$ = 60 dB[1], the following values are obtained:

Output voltage $V_o$ = 700 mV
Power gain $G_p$ = 8 dB
(refer to curve $G_p = f(f)$)

1) Two-tone modulation $f_1$ = 800 MHz; $f_2$ = 804 MHz.

**Oscillator diagram**

$f$ = 1 GHz; $L$ = 15 mm strip-line
$Z_o$ = 50 Ω



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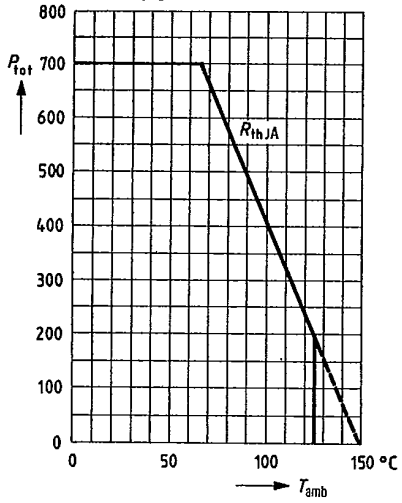
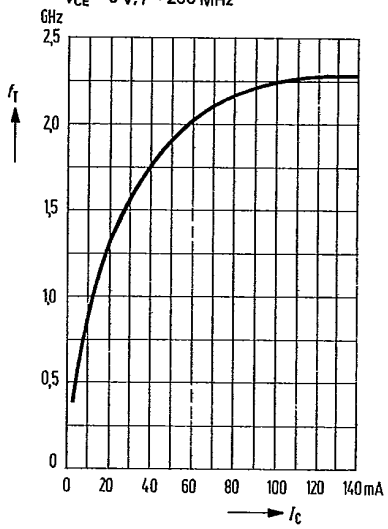
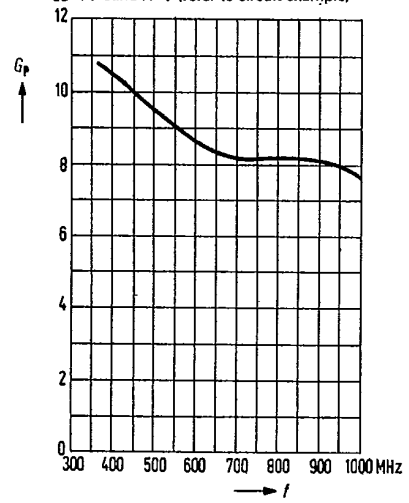
**Total perm. power dissipation versus temperature**
$P_{tot} = f(T_{amb})$




**Transition frequency $f_T = f(I_C)$**
$V_{CE}$ = 5 V; $f$ = 200 MHz




**Power gain $G_p = f(f)$**
$I_C$ = 80 mA; $V_{CE}$ = 7,5 V
dB TV band IV-V (refer to circuit example)




**Oscillator output power**
$P_{osc} = f(V_{CB})$; $I_C$ = 75 mA; $f$ = 1 GHz