

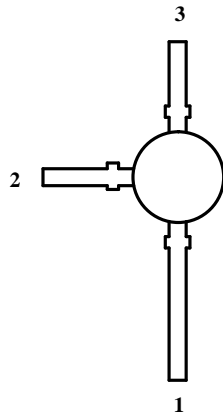
## Silicon NPN Planar RF Transistor

### Applications

RF-amplifier up to GHz range specially for wide band antenna amplifier.

### Features

- High power gain
- Low noise figure
- High transition frequency



BFR90 Marking

Plastic case (~TO 50)

1= Collector; 2= Base; 3= Emitter

### Absolute Maximum Ratings

| Parameters  | Symbol    | Value       | Unit             |
|---|-----------|-------------|------------------|
| Collector-base voltage                                  | $V_{CBO}$ | 20          | V                |
| Collector-emitter voltage                               | $V_{CEO}$ | 15          | V                |
| Emitter-base voltage                                    | $V_{EBO}$ | 2           | V                |
| Collector current                                       | $I_C$     | 30          | mA               |
| Total power dissipation $T_{amb} \leq 60^\circ\text{C}$ | $P_{tot}$ | 300         | mW               |
| Junction temperature                                    | $T_j$     | 150         | $^\circ\text{C}$ |
| Storage temperature range                               | $T_{stg}$ | -65 to +150 | $^\circ\text{C}$ |

### Maximum Thermal Resistance

| Parameters       | Symbol     | Value | Unit |
|------------------|------------|-------|------|
| Junction ambient | $R_{thJA}$ | 300   | K/W  |

### Electrical DC Characteristics

$T_j = 25^\circ\text{C}$ , unless otherwise specified

| Parameters / Test Conditions  | Symbol        | Min. | Typ. | Max. | Unit |
|---|---------------|------|------|------|------|
| Collector cut-off current<br>$V_{CB} = 20\text{ V}, I_E = 0\text{ A}$           | $I_{CBO}$     |      |      | 50   | nA   |
| Collector-base breakdown voltage<br>$I_C = 10\text{ }\mu\text{A}$               | $V_{(BR)CBO}$ | 20   |      |      | V    |
| Collector-emitter breakdown voltage<br>$I_C = 2\text{ mA}$                      | $V_{(BR)CEO}$ | 15   |      |      | V    |
| Emitter-base breakdown voltage<br>$I_E = 10\text{ }\mu\text{A}$                 | $V_{(BR)EBO}$ | 2    |      |      | V    |
| DC forward current transfer ratio<br>$I_C = 14\text{ mA}, V_{CE} = 10\text{ V}$ | $h_{FE}$      | 25   | 50   |      | mA   |

### Electrical AC Characteristics

$T_{amb} = 25^\circ\text{C}$

| Parameters / Test Conditions  | Symbol               | Min. | Typ.       | Max. | Unit     |
|---|----------------------|------|------------|------|----------|
| Transition frequency<br>$I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, f = 500\text{ MHz}$  | $f_T$                |      | 5          |      | GHz      |
| Collector-emitter capacitance<br>$V_{CE} = 10\text{ V}, f = 1\text{ MHz}$   | $C_{CE}$             |      | 0.27       |      | pF       |
| Collector-base capacitance<br>$V_{CB} = 10\text{ V}, f = 1\text{ MHz}$  | $C_{CB}$             |      | 0.36       |      | pF       |
| Emitter-base capacitance<br>$V_{EB} = 0.5\text{ V}, f = 1\text{ MHz}$   | $C_{EB}$             |      | 1.3        |      | pF       |
| Noise figure<br>$I_C = 2\text{ mA}, V_{CE} = 10\text{ V}, f = 500\text{ MHz}, Z_G = 50\text{ }\Omega$   | $F_e$                |      | 2.2        |      | dB       |
| Power gain<br>$I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, Z_L = Z_{Lopt},$<br>$f = 500\text{ MHz}$<br>$f = 800\text{ MHz}$   | $G_{pe}$<br>$G_{pe}$ |      | 19.5<br>14 |      | dB<br>dB |
| Linear output voltage – two tone intermodulation test<br>$I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, d_{IM} = 60\text{ dB},$<br>$Z_G = Z_L = 50\text{ }\Omega, f_1 = 806\text{ MHz}, f_2 = 810\text{ MHz}$ | $V_1 = V_2$          |      | 100        |      | mV       |
| Third order intercept point<br>$I_C = 14\text{ mA}, V_{CE} = 10\text{ V}, f = 800\text{ MHz}$   | $IP_3$               |      | 23         |      | dBm      |

## Common Source S-Parameters

| V <sub>CE</sub> /V | I <sub>C</sub> /mA | f/MHz | S <sub>11</sub> |        | S <sub>21</sub> |        | S <sub>12</sub> |       | S <sub>22</sub> |       |
|--------------------|--------------------|-------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|-------|
|                    |                    |       | LIN<br>MAG      | ANG    | LIN<br>MAG      | ANG    | LIN<br>MAG      | ANG   | LIN<br>MAG      | ANG   |
|                    |                    |       |                 | deg    |                 | deg    |                 | deg   |                 | deg   |
| 10                 | 2                  | 100   | 0.84            | -25.7  | 6.21            | 157.1  | 0.02            | 74.8  | 0.96            | -8.3  |
|                    |                    | 300   | 0.61            | -68.0  | 4.69            | 123.8  | 0.05            | 56.2  | 0.84            | -18.4 |
|                    |                    | 500   | 0.42            | -101.2 | 3.57            | 102.1  | 0.07            | 49.3  | 0.75            | -22.7 |
|                    |                    | 800   | 0.28            | -147.9 | 2.53            | 80.4   | 0.08            | 48.1  | 0.69            | -27.8 |
|                    |                    | 1000  | 0.26            | -177.6 | 2.14            | 69.5   | 0.09            | 50.0  | 0.67            | -31.6 |
|                    |                    | 1200  | 0.27            | 156.2  | 1.84            | 59.0   | 0.11            | 51.9  | 0.65            | -35.6 |
|                    |                    | 1500  | 0.32            | 127.9  | 1.54            | 46.0   | 0.13            | 54.1  | 0.62            | -41.9 |
|                    |                    | 1800  | 0.39            | 109.1  | 1.34            | 34.2   | 0.15            | 55.0  | 0.59            | -48.8 |
|                    | 2000               | 0.43  | 98.7            | 1.24   | 27.3            | 0.18   | 54.2            | 0.57  | -53.8           |       |
|                    | 5                  | 100   | 0.67            | -36.6  | 12.62           | 146.6  | 0.02            | 71.9  | 0.91            | -13.0 |
|                    |                    | 300   | 0.36            | -83.1  | 7.54            | 110.1  | 0.04            | 60.7  | 0.72            | -20.7 |
|                    |                    | 500   | 0.21            | -116.9 | 5.07            | 91.8   | 0.06            | 60.6  | 0.65            | -22.2 |
|                    |                    | 800   | 0.13            | -173.7 | 3.37            | 74.5   | 0.08            | 61.0  | 0.61            | -26.3 |
|                    |                    | 1000  | 0.14            | 153.1  | 2.78            | 65.5   | 0.10            | 60.5  | 0.59            | -29.8 |
|                    |                    | 1200  | 0.17            | 130.1  | 2.37            | 56.7   | 0.12            | 59.0  | 0.57            | -33.6 |
|                    |                    | 1500  | 0.23            | 110.4  | 1.97            | 45.3   | 0.15            | 56.1  | 0.54            | -39.7 |
|                    |                    | 1800  | 0.29            | 97.7   | 1.71            | 34.6   | 0.18            | 53.1  | 0.51            | -45.7 |
|                    | 2000               | 0.33  | 91.2            | 1.58   | 28.0            | 0.20   | 50.3            | 0.49  | -50.0           |       |
|                    | 10                 | 100   | 0.49            | -47.6  | 18.87           | 135.7  | 0.02            | 71.4  | 0.83            | -16.8 |
|                    |                    | 300   | 0.19            | -93.8  | 9.12            | 101.1  | 0.04            | 68.0  | 0.63            | -19.6 |
|                    |                    | 500   | 0.09            | -133.4 | 5.82            | 86.1   | 0.06            | 68.4  | 0.58            | -20.2 |
|                    |                    | 800   | 0.07            | 151.2  | 3.77            | 71.2   | 0.09            | 66.5  | 0.56            | -24.4 |
|                    |                    | 1000  | 0.10            | 124.5  | 3.09            | 63.3   | 0.11            | 64.3  | 0.54            | -28.2 |
|                    |                    | 1200  | 0.14            | 109.4  | 2.63            | 55.2   | 0.13            | 61.4  | 0.52            | -32.2 |
|                    |                    | 1500  | 0.19            | 98.6   | 2.17            | 44.7   | 0.16            | 56.9  | 0.49            | -38.0 |
|                    |                    | 1800  | 0.26            | 90.8   | 1.89            | 34.6   | 0.20            | 52.4  | 0.46            | -44.1 |
|                    | 2000               | 0.29  | 86.0            | 1.75   | 28.3            | 0.22   | 48.9            | 0.44  | -48.0           |       |
|                    | 14                 | 100   | 0.39            | -53.4  | 21.53           | 130.3  | 0.01            | 72.2  | 0.79            | -17.8 |
|                    |                    | 300   | 0.13            | -98.6  | 9.58            | 97.8   | 0.04            | 71.0  | 0.60            | -18.5 |
|                    |                    | 500   | 0.06            | -146.3 | 6.02            | 84.0   | 0.06            | 70.7  | 0.57            | -19.2 |
|                    |                    | 800   | 0.07            | 131.1  | 3.89            | 70.0   | 0.09            | 67.8  | 0.55            | -23.7 |
|                    |                    | 1000  | 0.10            | 113.4  | 3.18            | 62.4   | 0.11            | 65.3  | 0.53            | -27.4 |
|                    |                    | 1200  | 0.13            | 103.2  | 2.70            | 54.7   | 0.14            | 62.0  | 0.51            | -31.5 |
|                    |                    | 1500  | 0.19            | 94.2   | 2.23            | 44.3   | 0.17            | 57.0  | 0.48            | -37.4 |
|                    |                    | 1800  | 0.24            | 89.1   | 1.93            | 34.2   | 0.20            | 52.3  | 0.45            | -43.3 |
|                    | 2000               | 0.29  | 85.3            | 1.79   | 28.13           | 0.22   | 48.6            | 0.43  | -47.3           |       |
| 5                  | 5                  | 100   | 0.65            | -39.9  | 12.44           | 145.23 | 0.02            | 70.3  | 0.88            | -16.2 |
|                    |                    | 300   | 0.35            | -91.8  | 7.26            | 108.30 | 0.05            | 58.7  | 0.65            | -25.4 |
|                    |                    | 500   | 0.22            | -130.4 | 4.85            | 90.23  | 0.07            | 58.5  | 0.57            | -26.9 |
|                    |                    | 800   | 0.16            | 177.4  | 3.22            | 72.60  | 0.10            | 58.2  | 0.52            | -30.6 |
|                    |                    | 1000  | 0.18            | 150.9  | 2.66            | 63.49  | 0.12            | 57.3  | 0.50            | -34.5 |
|                    |                    | 1200  | 0.21            | 131.6  | 2.28            | 54.46  | 0.14            | 55.5  | 0.47            | -38.6 |
|                    |                    | 1500  | 0.27            | 112.7  | 1.89            | 42.86  | 0.18            | 51.9  | 0.44            | -45.2 |
|                    |                    | 1800  | 0.33            | 100.1  | 1.65            | 31.82  | 0.21            | 48.2  | 0.40            | -52.1 |
| 2000               | 0.37               | 92.8  | 1.53            | 25.204 | 0.24            | 45.0   | 0.38            | -56.9 |                 |       |

### Common Source S-Parameters

| V <sub>CE</sub> /V | I <sub>C</sub> /mA | f/MHz | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |       |
|--------------------|--------------------|-------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
|                    |                    |       | LIN<br>MAG      | ANG    | LIN<br>MAG      | ANG   | LIN<br>MAG      | ANG  | LIN<br>MAG      | ANG   |
|                    |                    |       |                 | deg    |                 | deg   |                 | deg  |                 | deg   |
| 5                  | 2                  | 100   | 0.82            | -27.87 | 6.31            | 155.8 | 0.03            | 73.8 | 0.95            | -10.2 |
|                    |                    | 300   | 0.59            | -72.7  | 4.66            | 121.6 | 0.06            | 54.0 | 0.80            | -22.1 |
|                    |                    | 500   | 0.41            | -107.7 | 3.49            | 99.9  | 0.08            | 46.7 | 0.70            | -27.0 |
|                    |                    | 800   | 0.30            | -154.9 | 2.474           | 78.0  | 0.10            | 44.9 | 0.63            | -32.3 |
|                    |                    | 1000  | 0.29            | 176.7  | 2.08            | 66.9  | 0.11            | 46.2 | 0.60            | -36.3 |
|                    |                    | 1200  | 0.30            | 153.2  | 1.80            | 56.4  | 0.12            | 47.6 | 0.57            | -40.6 |
|                    |                    | 1500  | 0.35            | 126.8  | 1.50            | 43.1  | 0.15            | 48.9 | 0.54            | -47.6 |
|                    |                    | 1800  | 0.41            | 108.7  | 1.32            | 31.2  | 0.18            | 49.2 | 0.50            | -55.5 |
|                    | 2000               | 0.45  | 99.1            | 1.22   | 24.4            | 0.20  | 48.0            | 0.48 | -61.1           |       |
|                    | 30                 | 100   | 0.18            | -87.0  | 24.23           | 118.5 | 0.01            | 76.0 | 0.64            | -23.6 |
|                    |                    | 300   | 0.10            | -163.4 | 9.42            | 91.4  | 0.04            | 75.5 | 0.48            | -19.7 |
|                    |                    | 500   | 0.11            | 157.7  | 5.83            | 79.4  | 0.07            | 73.0 | 0.45            | -20.4 |
|                    |                    | 800   | 0.14            | 127.7  | 3.73            | 65.9  | 0.11            | 67.9 | 0.43            | -25.3 |
|                    |                    | 1000  | 0.17            | 117.0  | 3.05            | 58.5  | 0.14            | 64.1 | 0.42            | -29.8 |
|                    |                    | 1200  | 0.20            | 108.4  | 2.59            | 50.7  | 0.16            | 59.9 | 0.40            | -34.4 |
|                    |                    | 1500  | 0.25            | 100.0  | 2.14            | 40.2  | 0.20            | 53.9 | 0.36            | -40.8 |
|                    |                    | 1800  | 0.31            | 93.2   | 1.86            | 29.9  | 0.23            | 48.1 | 0.33            | -47.1 |
|                    | 2000               | 0.35  | 88.4            | 1.71   | 23.8            | 0.26  | 43.9            | 0.30 | -51.6           |       |
|                    | 20                 | 100   | 0.26            | -71.1  | 22.95           | 123.4 | 0.01            | 72.4 | 0.68            | -23.9 |
|                    |                    | 300   | 0.11            | -140.3 | 9.39            | 93.8  | 0.04            | 73.2 | 0.49            | -22.0 |
|                    |                    | 500   | 0.09            | 169.9  | 5.84            | 81.1  | 0.07            | 71.5 | 0.46            | -22.0 |
|                    |                    | 800   | 0.13            | 131.1  | 3.75            | 67.3  | 0.11            | 66.9 | 0.43            | -26.7 |
|                    |                    | 1000  | 0.15            | 117.8  | 3.07            | 59.7  | 0.14            | 63.3 | 0.42            | -31.0 |
|                    |                    | 1200  | 0.18            | 109.5  | 2.62            | 51.7  | 0.16            | 59.3 | 0.39            | -35.4 |
|                    |                    | 1500  | 0.24            | 99.5   | 2.16            | 41.1  | 0.20            | 53.3 | 0.36            | -41.8 |
|                    |                    | 1800  | 0.30            | 93.1   | 1.87            | 30.9  | 0.24            | 47.7 | 0.32            | -48.1 |
|                    | 2000               | 0.33  | 87.9            | 1.73   | 24.8            | 0.26  | 43.4            | 0.30 | -52.4           |       |
|                    | 10                 | 100   | 0.45            | -54.6  | 18.55           | 133.7 | 0.02            | 70.4 | 0.79            | -21.5 |
|                    |                    | 300   | 0.19            | -112.5 | 8.73            | 99.4  | 0.04            | 66.6 | 0.55            | -24.7 |
|                    |                    | 500   | 0.12            | -156.4 | 5.54            | 84.5  | 0.07            | 66.8 | 0.49            | -24.9 |
|                    |                    | 800   | 0.12            | 148.7  | 3.60            | 69.5  | 0.11            | 64.0 | 0.46            | -28.7 |
|                    |                    | 1000  | 0.15            | 129.3  | 2.96            | 61.3  | 0.13            | 61.4 | 0.44            | -32.8 |
|                    |                    | 1200  | 0.18            | 117.0  | 2.51            | 53.0  | 0.16            | 58.0 | 0.42            | -37.1 |
|                    |                    | 1500  | 0.24            | 104.4  | 2.08            | 42.1  | 0.19            | 52.8 | 0.38            | -43.5 |
|                    |                    | 1800  | 0.30            | 94.9   | 1.82            | 31.8  | 0.23            | 47.7 | 0.35            | -49.9 |
|                    | 2000               | 0.34  | 89.5            | 1.67   | 25.44           | 0.25  | 43.7            | 0.32 | -54.5           |       |
| 14                 | 100                | 0.35  | -62.6           | 20.95  | 128.4           | 0.02  | 71.4            | 0.73 | -23.2           |       |
|                    | 300                | 0.14  | -124.4          | 9.11   | 96.3            | 0.04  | 70.1            | 0.51 | -23.7           |       |
|                    | 500                | 0.10  | -173.0          | 5.71   | 82.7            | 0.07  | 69.3            | 0.47 | -23.7           |       |
|                    | 800                | 0.12  | 138.3           | 3.70   | 68.2            | 0.11  | 65.5            | 0.44 | -27.7           |       |
|                    | 1000               | 0.15  | 123.3           | 3.03   | 60.4            | 0.13  | 62.5            | 0.42 | -32.1           |       |
|                    | 1200               | 0.18  | 113.2           | 2.58   | 52.3            | 0.16  | 58.7            | 0.40 | -36.5           |       |
|                    | 1500               | 0.24  | 101.6           | 2.13   | 41.7            | 0.20  | 52.8            | 0.36 | -42.9           |       |
|                    | 1800               | 0.30  | 93.2            | 1.85   | 31.4            | 0.23  | 47.4            | 0.33 | -49.2           |       |
|                    | 2000               | 0.33  | 88.4            | 1.72   | 25.0            | 0.26  | 43.3            | 0.30 | -53.6           |       |

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