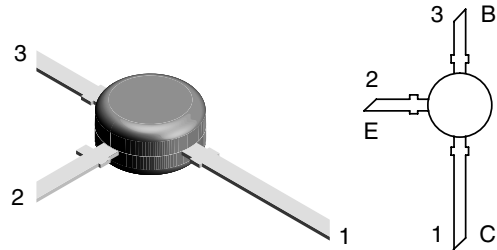




Silicon NPN Planar RF Transistor

Features

- High power gain
- Low noise figure
- High transition frequency
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC



19039



Electrostatic sensitive device. Observe precautions for handling.

Applications

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

Mechanical Data

Case: TO-50 Plastic case

Weight: approx. 111 mg

Marking: BFR90

Pinning: 1 = Collector, 2 = Emitter, 3 = Base

Absolute Maximum Ratings

T_{amb} = 25 °C, unless otherwise specified

| Parameter | Test condition | 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} ≤ 60 °C | P _{tot} | 300 | mW |
| Junction temperature | | T _j | 150 | °C |
| Storage temperature range | | T _{stg} | - 65 to + 150 | °C |

Maximum Thermal Resistance

| Parameter | Test condition | Symbol | Value | Unit |
|------------------|----------------|-------------------|-------|------|
| Junction ambient | 1) | R _{thJA} | 300 | K/W |

1) on glass fibre printed board (40 x 25 x 1.5) mm³ plated with 35 μm Cu

Electrical DC Characteristics

T_{amb} = 25 °C, unless otherwise specified

| Parameter | Test condition | Symbol | Min | Typ. | Max | Unit |
|-------------------------------------|--|----------------------|-----|------|-----|------|
| Collector-emitter cut-off current | V _{CE} = 20 V, V _{BE} = 0 | I _{CES} | | | 100 | μA |
| Collector-base cut-off current | V _{CB} = 20 V, I _E = 0 | I _{CBO} | | | 100 | nA |
| Emitter-base cut-off current | V _{EB} = 2 V, I _C = 0 | I _{EBO} | | | 10 | μA |
| Collector-emitter breakdown voltage | I _C = 1 mA, I _B = 0 | V _{(BR)CEO} | 15 | | | V |
| DC forward current transfer ratio | V _{CE} = 10 V, I _C = 14 mA | h _{FE} | 25 | 50 | 150 | |

Electrical AC Characteristics

T_{amb} = 25 °C, unless otherwise specified

| Parameter | Test condition | Symbol | Min | Typ. | Max | Unit |
|---|---|---------------------------------|-----|------|-----|------|
| Transition frequency | V _{CE} = 10 V, I _C = 14 mA, f = 500 MHz | f _T | | 5 | | GHz |
| Collector-base capacitance | V _{CB} = 10 V, f = 1 MHz | C _{cb} | | 0.35 | | pF |
| Collector-emitter capacitance | V _{CE} = 10 V, f = 1 MHz | C _{ce} | | 0.3 | | pF |
| Emitter-base capacitance | V _{EB} = 0.5 V, f = 1 MHz | C _{eb} | | 1.3 | | pF |
| Noise figure | V _{CE} = 10 V, I _C = 2 mA, f = 500 MHz, Z _S = 50 Ω | F | | 2.2 | | dB |
| Power gain | V _{CE} = 10 V, I _C = 14 mA, Z _L = Z _{Lopt} , f = 500 MHz | G _{pe} | | 19.5 | | dB |
| | V _{CE} = 10 V, I _C = 14 mA, Z _L = Z _{Lopt} , f = 800 MHz | G _{pe} | | 14 | | dB |
| Linear output voltage - two tone intermodulation test | V _{CE} = 10 V, I _C = 14 mA, d _{IM} = 60 dB, f ₁ = 806 MHz, f ₂ = 810 MHz, Z _S = Z _L = 50 Ω | V ₁ = V ₂ | | 100 | | mV |
| Third order intercept point | V _{CE} = 10 V, I _C = 14 mA, f = 800 MHz | IP ₃ | | 23 | | dBm |



Common Emitter S-Parameters

Z₀ = 50 Ω, T_{amb} = 25 °C, unless otherwise specified

| V _{CE} /V | I _C /mA | f/MHz | S11 | | S21 | | S12 | | S22 | |
|--------------------|--------------------|-------|---------|--------|---------|-------|---------|------|---------|-------|
| | | | LIN MAG | ANG | LIN MAG | ANG | LIN MAG | ANG | LIN MAG | ANG |
| | | | | deg | | deg | | deg | | deg |
| 5 | 2 | 100 | 0.82 | -27.8 | 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 |
| 5 | 5 | 100 | 0.65 | -39.9 | 12.44 | 145.2 | 0.02 | 70.3 | 0.88 | -16.2 |
| | | 300 | 0.35 | -91.8 | 7.26 | 108.3 | 0.05 | 58.7 | 0.65 | -25.4 |
| | | 500 | 0.22 | -130.4 | 4.85 | 90.2 | 0.07 | 58.5 | 0.57 | -26.9 |
| | | 800 | 0.16 | 177.4 | 3.22 | 72.6 | 0.10 | 58.2 | 0.52 | -30.6 |
| | | 1000 | 0.18 | 150.9 | 2.66 | 63.4 | 0.12 | 57.3 | 0.50 | -34.5 |
| | | 1200 | 0.21 | 131.6 | 2.28 | 54.4 | 0.14 | 55.5 | 0.47 | -38.6 |
| | | 1500 | 0.27 | 112.7 | 1.89 | 42.8 | 0.18 | 51.9 | 0.44 | -45.2 |
| | | 1800 | 0.33 | 100.1 | 1.65 | 31.8 | 0.21 | 48.2 | 0.40 | -52.1 |
| 5 | 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 |
| 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 |
| 5 | 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 |

| V _{CE} /V | I _C /mA | f/MHz | S11 | | S21 | | S12 | | S22 | |
|--------------------|--------------------|-------|------------|--------|------------|-------|------------|------|------------|-------|
| | | | LIN MAG | ANG | LIN MAG | ANG | LIN MAG | ANG | LIN 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 |
| 10 | 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 |
| 10 | 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 |
| 10 | 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 |

Typical Characteristics ($T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

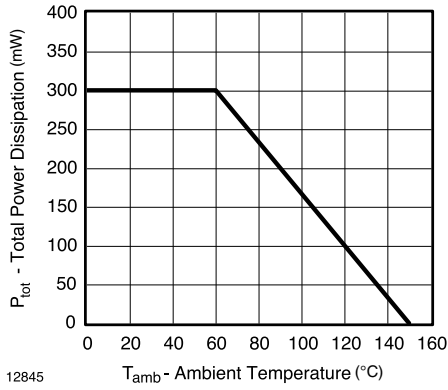


Figure 1. Total Power Dissipation vs. Ambient Temperature

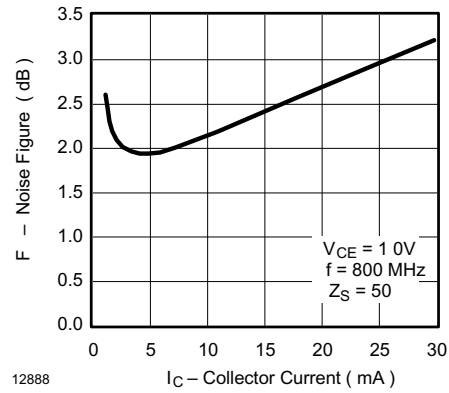


Figure 4. Noise Figure vs. Collector Current

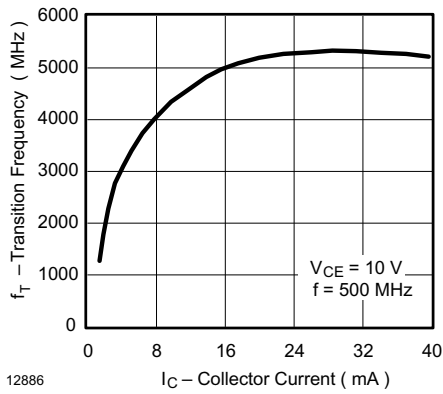


Figure 2. Transition Frequency vs. Collector Current

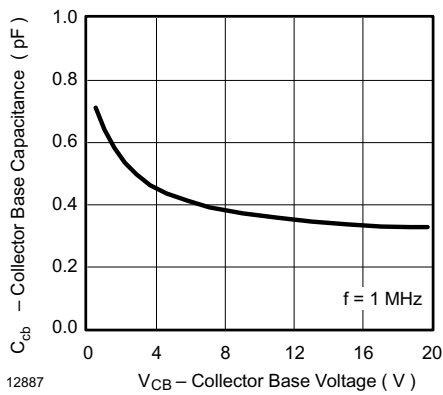


Figure 3. Collector Base Capacitance vs. Collector Base Voltage

$V_{CE} = 10\text{ V}$, $I_C = 14\text{ mA}$, $Z_0 = 50\ \Omega$

S_{11}

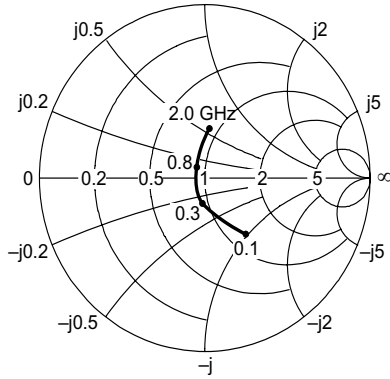


Figure 5. Input Reflection Coefficient

S_{21}

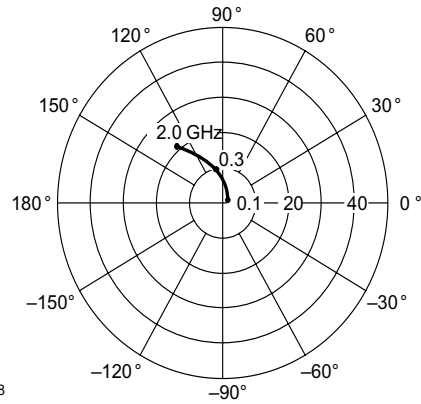


Figure 7. Forward Transmission Coefficient

S_{12}

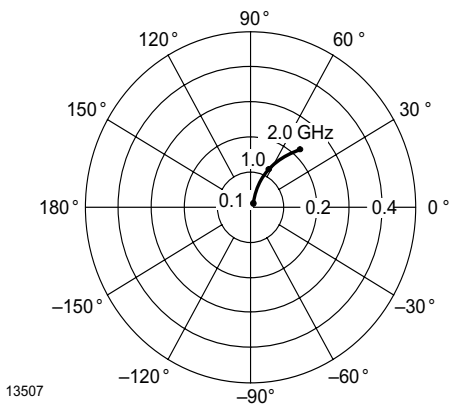


Figure 6. Reverse Transmission Coefficient

S_{22}

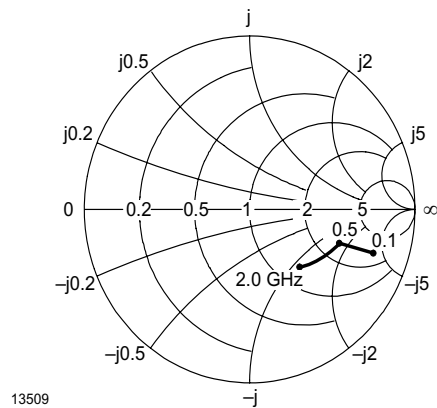
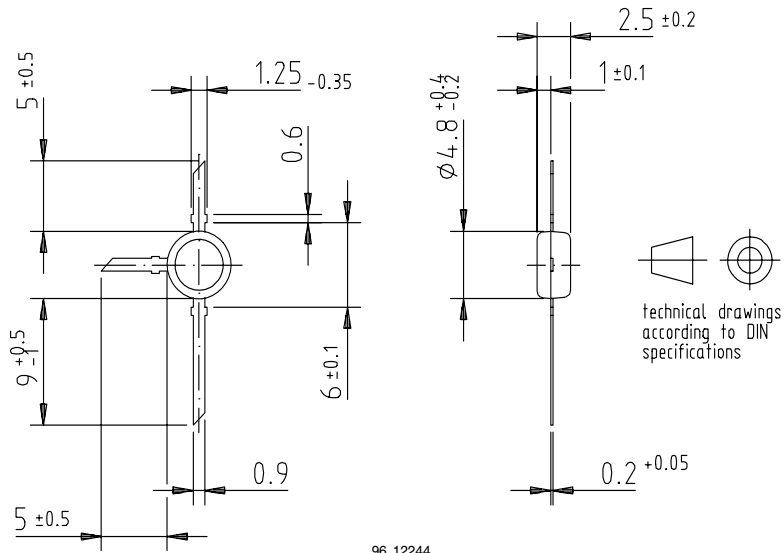


Figure 8. Output Reflection Coefficient

Package Dimensions in mm



96 12244

Ozone Depleting Substances Policy Statement

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design
and may do so without further notice.

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Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany



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