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April 1, 2003

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## 2SC4899

## Silicon NPN Epitaxial

## TENESAS

## Application

VHF / UHF wide band amplifier

## Features

- High gain bandwidth product
$\mathrm{f}_{\mathrm{T}}=9 \mathrm{GHz}$ Typ
- High gain, low noise figure $\mathrm{PG}=14.0 \mathrm{~dB}$ Typ, $\mathrm{NF}=1.2 \mathrm{~dB}$ Typ at $\mathrm{f}=900 \mathrm{MHz}$


## Outline

CMPAK


2

1. Emitter
2. Base
3. Collector

Note: Marking is "YH-".

Attention: This is electrostatic sensitive device.

Absolute Maximum Ratings $\left(\mathrm{Ta}=25^{\circ} \mathrm{C}\right)$

| Item | Symbol | Ratings | Unit |
| :--- | :--- | :--- | :--- |
| Collector to base voltage | $\mathrm{V}_{\text {CBO }}$ | 15 | V |
| Collector to emitter voltage | $\mathrm{V}_{\text {CEO }}$ | 9 | V |
| Emitter to base voltage | $\mathrm{V}_{\text {EBO }}$ | 1.5 | V |
| Collector current | $\mathrm{I}_{\mathrm{C}}$ | 20 | mA |
| Collector power dissipation | $\mathrm{P}_{\mathrm{C}}$ | 100 | mW |
| Junction temperature | Tj | 150 | ${ }^{\circ} \mathrm{C}$ |
| Storage temperature | Tstg | -55 to +150 | ${ }^{\circ} \mathrm{C}$ |

Electrical Characteristics $\left(\mathrm{Ta}=25^{\circ} \mathrm{C}\right)$

| Item | Symbol | Min | Typ | Max | Unit | Test conditions |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Collector cutoff current | $\mathrm{I}_{\mathrm{CBO}}$ | - | - | 10 | $\mu \mathrm{~A}$ | $\mathrm{~V}_{\mathrm{CB}}=15 \mathrm{~V}, \mathrm{I}_{\mathrm{E}}=0$ |
|  | $\mathrm{I}_{\mathrm{CEO}}$ | - | - | 1 | mA | $\mathrm{~V}_{\mathrm{CE}}=9 \mathrm{~V}, \mathrm{R}_{\mathrm{BE}}=$ |
| Emitter cutoff current | $\mathrm{I}_{\mathrm{EBO}}$ | - | - | 10 | $\mu \mathrm{~A}$ | $\mathrm{~V}_{\mathrm{EB}}=1.5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=0$ |
| DC current transfer ratio | $\mathrm{h}_{\mathrm{FE}}$ | 50 | 120 | 250 |  | $\mathrm{~V}_{\mathrm{CE}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=10 \mathrm{~mA}$ |
| Collector output capacitance | Cob | - | 0.5 | 0.85 | pF | $\mathrm{V}_{\mathrm{CB}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{E}}=0, \mathrm{f}=1 \mathrm{MHz}$ |
| Gain bandwidth product | $\mathrm{f}_{\mathrm{T}}$ | 6.0 | 9.0 | - | GHz | $\mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=10 \mathrm{~mA}$ |
| Power gain | PG | 11.0 | 14.0 | - | dB | $\mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=10 \mathrm{~mA}$, <br> $\mathrm{f}=900 \mathrm{MHz}$ |
| Noise figure | NF | - | 1.2 | 2.5 | dB | $\mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=5 \mathrm{~mA}$, <br> $\mathrm{f}=900 \mathrm{MHz}$ |

Maximum Collector Dissipation Curve


Gain Bandwidth Product vs. Collector Current


DC Current Transfer Ratio
vs. Collector Current


Collector Output Capacitance vs. Collector to Base Voltage


Power Gain vs. Collector Current


Noise Figure vs. Collector Current


S21 Parameter vs. Collector Current


## S11 Parameter vs. Frequency



Condition: VCE $=5 \mathrm{~V}, \mathrm{Zo}=50 \Omega$
200 to 2000 MHz ( 200 MHz step)

$$
\begin{array}{ll}
\bigcirc \longrightarrow & (\mathrm{IC}=5 \mathrm{~mA}) \\
\triangle \longrightarrow & (\mathrm{IC}=10 \mathrm{~mA})
\end{array}
$$

S12 Parameter vs. Frequency


Condition: VCE $=5 \mathrm{~V}, \mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step)

$$
\begin{array}{ll}
(O- & (I C=5 \mathrm{~mA}) \\
\Delta & (I C=10 \mathrm{~mA})
\end{array}
$$

S21 Parameter vs. Frequency


Condition: $\mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V}$, $\mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step)

| $\bullet$ | $(I \mathrm{C}=5 \mathrm{~mA})$ |
| :--- | :--- |
| $\triangle$ | $(\mathrm{IC}=10 \mathrm{~mA})$ |

## S22 Parameter vs. Frequency



Condition: VCE $=5 \mathrm{~V}, \mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step)

$$
\begin{array}{ll}
\bullet \longrightarrow & (\mathrm{I} C=5 \mathrm{~mA}) \\
\Delta \longrightarrow & (\mathrm{I} C=10 \mathrm{~mA})
\end{array}
$$

S11 Parameter vs. Frequency


Condition: $\mathrm{VCE}=1 \mathrm{~V}, \mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step)

$$
\begin{array}{ll}
(0 \longmapsto & (I C=0.5 \mathrm{~mA}) \\
\Delta & (\mathrm{IC}=1 \mathrm{~mA})
\end{array}
$$

S12 Parameter vs. Frequency


Condition: $\mathrm{V}_{\mathrm{CE}}=1 \mathrm{~V}, \mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step)
$\begin{array}{ll}\bullet \longrightarrow & (\mathrm{IC}=0.5 \mathrm{~mA}) \\ \Delta \longrightarrow & (\mathrm{IC}=1 \mathrm{~mA})\end{array}$

S21 Parameter vs. Frequency


Condition: V CE $=1 \mathrm{~V}$, $\mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step)

$$
\begin{array}{ll}
(\mathrm{O}- & (\mathrm{IC}=0.5 \mathrm{~mA}) \\
\Delta & (\mathrm{IC}=1 \mathrm{~mA})
\end{array}
$$

S22 Parameter vs. Frequency


Condition: $\mathrm{V}_{\mathrm{CE}}=1 \mathrm{~V}$, $\mathrm{Zo}=50 \Omega$ 200 to 2000 MHz ( 200 MHz step) $\begin{array}{ll}(\bigcirc-\longrightarrow & (\mathrm{IC}=0.5 \mathrm{~mA}) \\ \Delta \longrightarrow & (\mathrm{IC}=1 \mathrm{~mA})\end{array}$

S Parameter $\left(\mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=5 \mathrm{~mA}, \mathrm{Z}_{\mathrm{O}}=50 \Omega\right.$, Emitter Common)

| Freq. <br> (MHz) | S11 |  | S21 |  | S12 |  | S22 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| 100 | 0.814 | -20.5 | 13.23 | 163.0 | 0.0214 | 79.4 | 0.961 | -11.8 |
| 200 | 0.740 | -39.5 | 11.84 | 147.6 | 0.0403 | 70.6 | 0.878 | -22.3 |
| 300 | 0.648 | -56.3 | 10.34 | 134.9 | 0.0550 | 64.1 | 0.780 | -29.7 |
| 400 | 0.563 | -69.7 | 8.99 | 125.2 | 0.0653 | 60.6 | 0.694 | -34.9 |
| 500 | 0.499 | -80.8 | 7.81 | 117.6 | 0.0744 | 58.4 | 0.626 | -38.1 |
| 600 | 0.439 | -90.8 | 6.81 | 111.1 | 0.0821 | 57.9 | 0.571 | -40.3 |
| 700 | 0.393 | -99.1 | 6.11 | 106.0 | 0.0888 | 57.8 | 0.528 | -41.8 |
| 800 | 0.356 | -107.0 | 5.44 | 101.6 | 0.0956 | 58.1 | 0.497 | -42.6 |
| 900 | 0.322 | -115.5 | 4.93 | 97.7 | 0.102 | 58.3 | 0.469 | -43.0 |
| 1000 | 0.303 | -123.2 | 4.51 | 94.6 | 0.109 | 59.2 | 0.452 | -43.7 |
| 1100 | 0.275 | -129.7 | 4.17 | 91.6 | 0.116 | 60.3 | 0.442 | -43.8 |
| 1200 | 0.263 | -135.1 | 3.86 | 88.7 | 0.125 | 59.8 | 0.435 | -46.3 |
| 1300 | 0.253 | -141.7 | 3.61 | 85.9 | 0.130 | 60.2 | 0.414 | -47.3 |
| 1400 | 0.242 | -148.6 | 3.37 | 83.5 | 0.137 | 60.6 | 0.399 | -47.4 |
| 1500 | 0.237 | -154.2 | 3.17 | 81.1 | 0.144 | 61.2 | 0.360 | -47.8 |
| 1600 | 0.232 | -160.0 | 3.00 | 78.7 | 0.151 | 61.5 | 0.383 | -48.1 |
| 1700 | 0.224 | -166.4 | 2.83 | 77.0 | 0.158 | 61.8 | 0.376 | -48.8 |
| 1800 | 0.225 | -171.0 | 2.70 | 74.9 | 0.165 | 62.0 | 0.370 | -49.5 |
| 1900 | 0.228 | -176.5 | 2.59 | 73.0 | 0.172 | 62.2 | 0.363 | -50.2 |
| 2000 | 0.223 | 179.7 | 2.47 | 71.3 | 0.180 | 62.3 | 0.359 | -51.4 |

S Parameter $\left(\mathrm{V}_{\mathrm{CE}}=5 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=10 \mathrm{~mA}, \mathrm{Z}_{\mathrm{O}}=50 \Omega\right.$, Emitter Common)

| Freq. <br> (MHz) | S11 |  | S21 |  | S12 |  | S22 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| 100 | 0.688 | -29.6 | 20.06 | 156.3 | 0.0201 | 76.3 | 0.921 | -16.8 |
| 200 | 0.582 | -54.7 | 16.54 | 137.5 | 0.0349 | 67.8 | 0.780 | -28.9 |
| 300 | 0.479 | -74.0 | 13.31 | 124.0 | 0.0459 | 64.0 | 0.653 | -35.6 |
| 400 | 0.399 | -89.5 | 10.97 | 114.9 | 0.0544 | 63.0 | 0.564 | -39.0 |
| 500 | 0.345 | -101.3 | 9.20 | 108.4 | 0.0624 | 62.6 | 0.501 | -40.4 |
| 600 | 0.309 | -111.2 | 7.87 | 103.1 | 0.0702 | 63.7 | 0.456 | -41.0 |
| 700 | 0.280 | -120.4 | 6.90 | 98.7 | 0.0782 | 64.3 | 0.424 | -41.1 |
| 800 | 0.257 | -128.5 | 6.09 | 95.2 | 0.0857 | 65.2 | 0.402 | -41.2 |
| 900 | 0.243 | -137.6 | 5.45 | 92.0 | 0.0936 | 66.0 | 0.384 | -41.0 |
| 1000 | 0.227 | -145.3 | 4.97 | 89.3 | 0.102 | 66.6 | 0.375 | -40.8 |
| 1100 | 0.216 | -153.0 | 4.56 | 86.8 | 0.111 | 67.3 | 0.373 | -40.8 |
| 1200 | 0.207 | -156.5 | 4.22 | 84.2 | 0.120 | 66.9 | 0.369 | -43.5 |
| 1300 | 0.206 | -163.1 | 3.93 | 82.2 | 0.126 | 67.1 | 0.350 | -44.4 |
| 1400 | 0.209 | -168.6 | 3.65 | 80.0 | 0.135 | 67.6 | 0.339 | -44.5 |
| 1500 | 0.204 | -176.8 | 3.43 | 77.9 | 0.143 | 67.5 | 0.334 | -44.4 |
| 1600 | 0.203 | 180.0 | 3.24 | 75.9 | 0.151 | 67.7 | 0.330 | -44.6 |
| 1700 | 0.207 | 173.7 | 3.06 | 74.2 | 0.160 | 67.6 | 0.325 | -45.5 |
| 1800 | 0.211 | 169.8 | 2.91 | 72.5 | 0.168 | 67.5 | 0.322 | -46.1 |
| 1900 | 0.215 | 164.6 | 2.78 | 71.1 | 0.177 | 67.4 | 0.317 | -47.2 |
| 2000 | 0.204 | 161.2 | 2.66 | 69.2 | 0.185 | 67.2 | 0.314 | -48.2 |

$\mathbf{S}$ Parameter $\left(\mathrm{V}_{\mathrm{CE}}=1 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=0.5 \mathrm{~mA}, \mathrm{Z}_{\mathrm{O}}=50 \Omega\right.$, Emitter Common)

| Freq. <br> (MHz) | S11 |  | S21 |  | S12 |  | S22 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| 100 | 0.983 | -7.8 | 1.76 | 172.6 | 0.0295 | 85.3 | 0.996 | -4.5 |
| 200 | 0.974 | -16.2 | 1.71 | 165.0 | 0.0604 | 79.3 | 0.987 | -9.1 |
| 300 | 0.958 | -24.3 | 1.69 | 157.1 | 0.0910 | 73.8 | 0.972 | -13.7 |
| 400 | 0.936 | -32.1 | 1.65 | 149.9 | 0.118 | 68.9 | 0.954 | -17.9 |
| 500 | 0.904 | -39.4 | 1.59 | 142.8 | 0.143 | 64.1 | 0.933 | -22.0 |
| 600 | 0.877 | -46.3 | 1.55 | 135.7 | 0.165 | 59.6 | 0.909 | -26.0 |
| 700 | 0.845 | -53.1 | 1.48 | 129.3 | 0.184 | 55.5 | 0.886 | -29.3 |
| 800 | 0.799 | -59.4 | 1.44 | 123.2 | 0.199 | 51.9 | 0.861 | -32.9 |
| 900 | 0.781 | -66.6 | 1.39 | 117.4 | 0.214 | 48.3 | 0.835 | -35.9 |
| 1000 | 0.738 | -72.6 | 1.36 | 112.3 | 0.225 | 45.3 | 0.810 | -38.5 |
| 1100 | 0.714 | -78.0 | 1.32 | 107.2 | 0.235 | 43.5 | 0.791 | -40.9 |
| 1200 | 0.683 | -83.8 | 1.25 | 102.6 | 0.249 | 40.2 | 0.783 | -44.0 |
| 1300 | 0.657 | -89.0 | 1.21 | 98.3 | 0.253 | 37.0 | 0.758 | -46.7 |
| 1400 | 0.626 | -94.6 | 1.18 | 93.8 | 0.256 | 34.8 | 0.734 | -48.7 |
| 1500 | 0.603 | -99.6 | 1.14 | 89.8 | 0.259 | 32.9 | 0.717 | -50.9 |
| 1600 | 0.585 | -104.8 | 1.09 | 85.9 | 0.260 | 31.1 | 0.702 | -52.7 |
| 1700 | 0.567 | -109.5 | 1.06 | 82.5 | 0.261 | 29.6 | 0.687 | -54.7 |
| 1800 | 0.553 | -114.2 | 1.04 | 79.1 | 0.261 | 28.0 | 0.674 | -56.6 |
| 1900 | 0.538 | -119.8 | 1.02 | 76.5 | 0.260 | 27.1 | 0.659 | -58.7 |
| 2000 | 0.524 | -123.9 | 0.994 | 73.7 | 0.258 | 25.6 | 0.647 | -60.5 |

$\mathbf{S}$ Parameter $\left(\mathrm{V}_{\mathrm{CE}}=1 \mathrm{~V}, \mathrm{I}_{\mathrm{C}}=1 \mathrm{~mA}, \mathrm{Z}_{\mathrm{O}}=50 \Omega\right.$, Emitter Common $)$

| Freq. <br> (MHz) | S11 |  | S21 |  | S12 |  | S22 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| 100 | 0.956 | -10.5 | 3.49 | 171.1 | 0.0298 | 83.7 | 0.991 | -6.1 |
| 200 | 0.938 | -20.8 | 3.37 | 162.3 | 0.0596 | 77.0 | 0.972 | -12.0 |
| 300 | 0.912 | -31.1 | 3.26 | 153.2 | 0.0874 | 70.7 | 0.945 | -18.1 |
| 400 | 0.871 | -40.9 | 3.12 | 145.1 | 0.112 | 65.1 | 0.910 | -23.4 |
| 500 | 0.830 | -50.1 | 2.94 | 137.9 | 0.133 | 60.0 | 0.871 | -28.1 |
| 600 | 0.782 | -57.6 | 2.80 | 130.6 | 0.151 | 56.0 | 0.831 | -32.5 |
| 700 | 0.740 | -65.8 | 2.63 | 124.0 | 0.164 | 51.9 | 0.795 | -36.1 |
| 800 | 0.686 | -73.0 | 2.48 | 118.2 | 0.175 | 48.8 | 0.759 | -39.4 |
| 900 | 0.656 | -80.7 | 2.35 | 112.5 | 0.185 | 45.9 | 0.725 | -42.4 |
| 1000 | 0.613 | -87.2 | 2.24 | 107.9 | 0.192 | 43.8 | 0.694 | -44.8 |
| 1100 | 0.582 | -93.3 | 2.13 | 103.8 | 0.200 | 42.8 | 0.672 | -47.0 |
| 1200 | 0.551 | -99.1 | 2.00 | 99.3 | 0.210 | 40.3 | 0.662 | -49.8 |
| 1300 | 0.532 | -104.7 | 1.91 | 95.3 | 0.210 | 38.1 | 0.631 | -52.4 |
| 1400 | 0.505 | -111.4 | 1.82 | 91.6 | 0.213 | 37.2 | 0.606 | -53.8 |
| 1500 | 0.483 | -116.3 | 1.74 | 88.1 | 0.215 | 36.3 | 0.587 | -55.6 |
| 1600 | 0.461 | -121.2 | 1.66 | 84.9 | 0.216 | 35.6 | 0.573 | -57.3 |
| 1700 | 0.445 | -127.2 | 1.59 | 81.9 | 0.217 | 34.9 | 0.558 | -58.6 |
| 1800 | 0.435 | -132.0 | 1.54 | 78.9 | 0.219 | 35.0 | 0.545 | -60.3 |
| 1900 | 0.425 | -137.6 | 1.49 | 76.7 | 0.221 | 34.7 | 0.531 | -61.8 |
| 2000 | 0.413 | -141.4 | 1.45 | 73.9 | 0.221 | 34.6 | 0.519 | -63.5 |

## Package Dimensions

As of January, 2001
Unit: mm


| Hitachi Code | CMPAK |
| :--- | :--- |
| JEDEC | - |
| EIAJ | Conforms |
| Mass (reference value) | 0.006 g |

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| :---: | :---: | :---: |

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