

FEATURES

- **LOW PHASE NOISE DISTORTION**
- **LOW NOISE:** 1.5 dB at 2.0 GHz
- **LOW VOLTAGE OPERATION**
- **LARGE ABSOLUTE MAXIMUM COLLECTOR CURRENT:** I_C MAX = 100 mA
- **AVAILABLE IN SIX LOW COST PLASTIC SURFACE MOUNT PACKAGE STYLES**
- **ALSO AVAILABLE IN CHIP FORM**

DESCRIPTION

NEC's NE688 series of NPN epitaxial silicon transistors are designed for low cost amplifier and oscillator applications. Low noise figures, high gain and high current capability equate to wide dynamic range and excellent linearity. NE688's low phase noise distortion and high f_T make it an excellent choice for oscillator applications up to 5 GHz. The NE688 series is available in six different low cost plastic surface mount package styles, and in chip form.



ELECTRICAL CHARACTERISTICS (TA = 25°C)

| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | PART NUMBER ¹ EIAJ ² REGISTERED NUMBER PACKAGE OUTLINE | | | NE68818 2SC5194 18 | | | NE68819 2SC5195 19 | | | NE68830 2SC5193 30 | | | NE68833 2SC5191 33 | | | NE68839/39R 2SC5192/92R 39 | | |
|--------------------------------|---|-------|--|------|-----|--------------------------|-----|------|--------------------------|------|------|--------------------------|------|------|--------------------------|------|-----|----------------------------------|--|--|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | | | |
| f_T | Gain Bandwidth Product at $V_{CE} = 1V, I_C = 3mA, f = 2.0GHz$ | GHz | 4 | 5 | | 4.5 | 5 | | 4 | 4.5 | | 4 | 4.5 | | 4 | 4.5 | | | | |
| f_T | Gain Bandwidth Product at $V_{CE} = 3V, I_C = 20mA, f = 2.0GHz$ | GHz | | 10 | | | 9.5 | | | 9 | | | 8.5 | | | 9 | | | | |
| NF _{MIN} | Minimum Noise Figure at $V_{CE} = 1V, I_C = 3mA, f = 2.0GHz$ | dB | | 1.7 | 2.5 | | 1.7 | 2.5 | | 1.7 | 2.5 | | 1.7 | 2.5 | | 1.7 | 2.5 | | | |
| NF _{MIN} | Minimum Noise Figure at $V_{CE} = 3V, I_C = 7mA, f = 2.0GHz$ | dB | | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | | 1.5 | | | | |
| IS _{21E} ² | Insertion Power Gain at $V_{CE} = 1V, I_C = 3mA, f = 2.0GHz$ | dB | 3.0 | 4.0 | | 3.0 | 4.0 | | 2.5 | 3.5 | | 2.5 | 3.5 | | 4.0 | 4.5 | | | | |
| IS _{21E} ² | Insertion Power Gain at $V_{CE} = 3V, I_C = 20mA, f = 2.0GHz$ | dB | | 8.5 | | | 8 | | | 6.5 | | | 6.5 | | | 9 | | | | |
| h _{FE} | Forward Current Gain ³ at $V_{CE} = 1V, I_C = 3mA$ | | 80 | | 160 | 80 | | 160 | 80 | | 160 | 80 | | 160 | 80 | | 160 | | | |
| I _{CBO} | Collector Cutoff Current at $V_{CB} = 5V, I_E = 0mA$ | nA | | | 100 | | | 100 | | | 100 | | | 100 | | | 100 | | | |
| I _{EBO} | Emitter Cutoff Current at $V_{EB} = 1V, I_C = 0mA$ | nA | | | 100 | | | 100 | | | 100 | | | 100 | | | 100 | | | |
| C _{RE} ⁴ | Feedback Capacitance at $V_{CB} = 1V, I_E = 0mA, f = 1MHz$ | pF | | 0.65 | 0.8 | | 0.7 | 0.8 | | 0.75 | 0.85 | | 0.75 | 0.85 | | 0.65 | 0.8 | | | |
| P _T | Total Power Dissipation | mW | | | 150 | | | 125 | | | 150 | | | 200 | | | 200 | | | |
| R _{TH(J-A)} | Thermal Resistance (Junction to Ambient) | °C/W | | | 833 | | | 1000 | | | 833 | | | 625 | | | 625 | | | |
| R _{TH(J-C)} | Thermal Resistance (Junction to Case) | °C/W | | | | | | | | | | | | | | | | | | |

Notes:

1. Precaution: Devices are ESD sensitive. Use proper handling procedures.
2. Electronic Industrial Association of Japan.

3. Pulsed measurement, $PW \leq 350 \mu s$, duty cycle $\leq 2\%$.

4. The emitter terminal should be connected to the ground terminal of the 3 terminal capacitance bridge.

NE688 SERIES

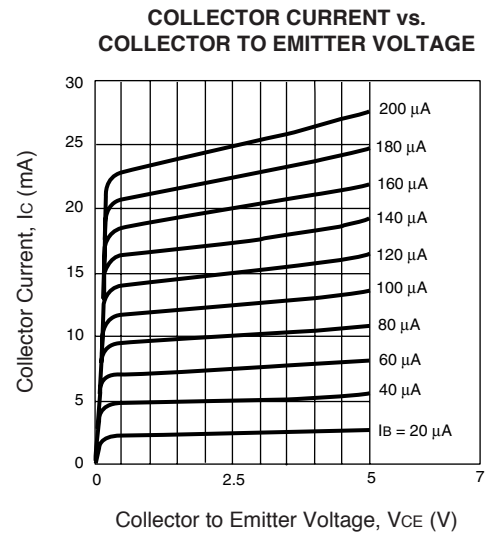
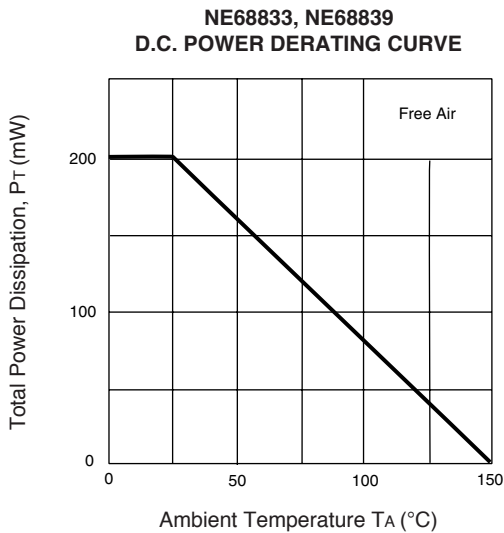
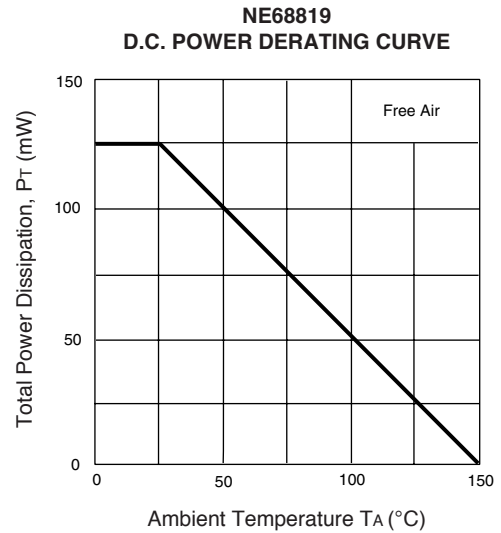
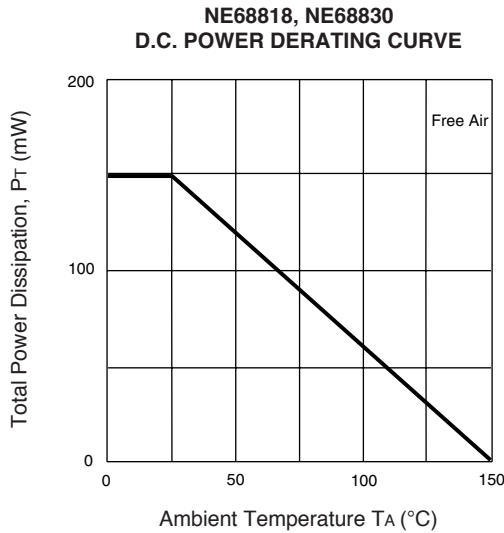
ABSOLUTE MAXIMUM RATINGS¹ ($T_A = 25^\circ\text{C}$)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|--------------------------------|-------|-------------|
| V _{CB0} | Collector to Base Voltage | V | 9 |
| V _{CE0} | Collector to Emitter Voltage | V | 6 |
| V _{EB0} | Emitter to Base Voltage | V | 2.0 |
| I _C | Collector Current | mA | 100 |
| T _J | Operating Junction Temperature | °C | 150 |
| T _{STG} | Storage Temperature | °C | -65 to +150 |

Notes:

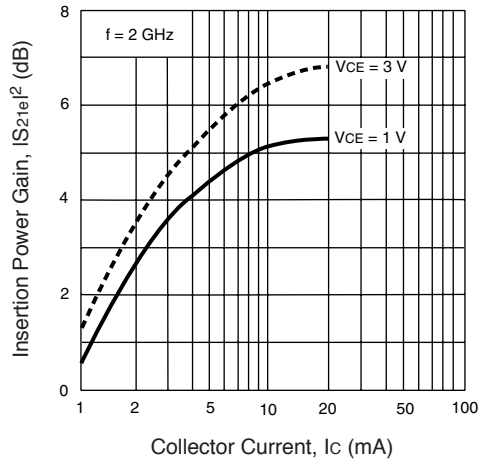
1. Operation in excess of any one of these parameters may result in permanent damage.

TYPICAL PERFORMANCE CURVES ($T_A = 25^\circ\text{C}$)

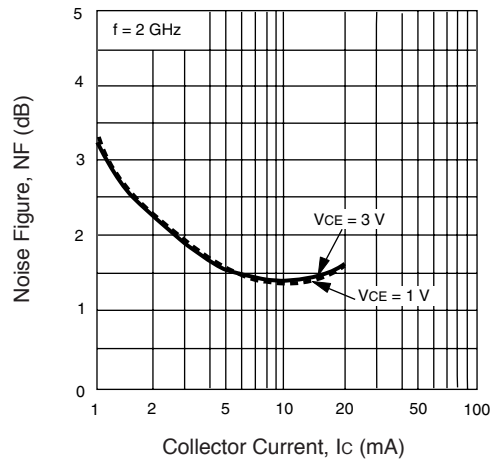


TYPICAL PERFORMANCE CURVES (TA = 25°C)

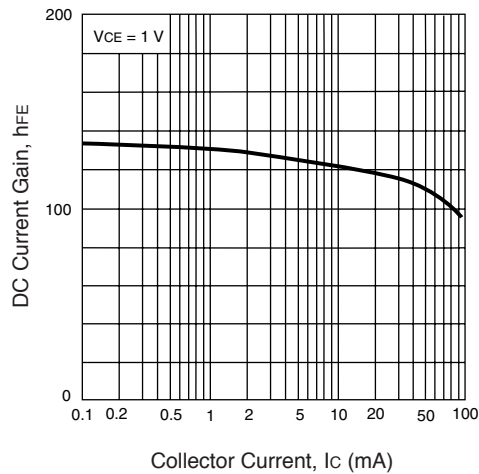
NE68833
INSERTION GAIN vs. COLLECTOR CURRENT



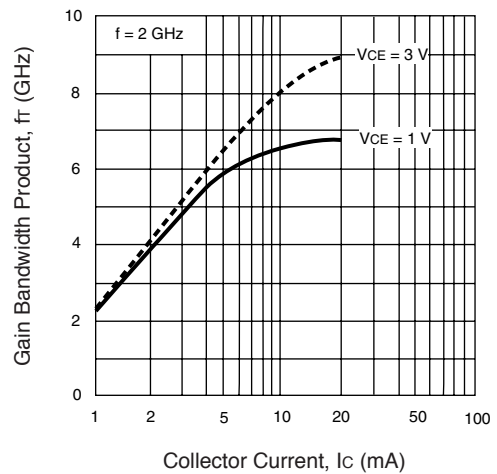
NE68833
NOISE FIGURE vs. COLLECTOR CURRENT



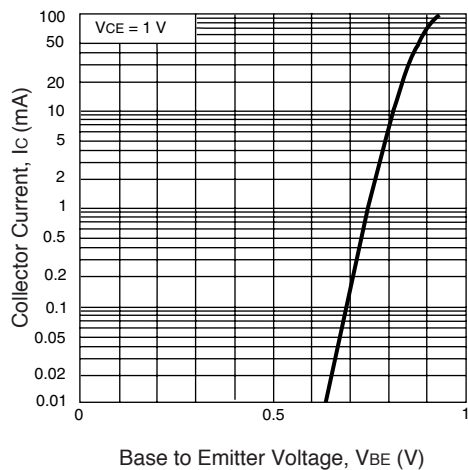
D.C. CURRENT GAIN vs. COLLECTOR CURRENT



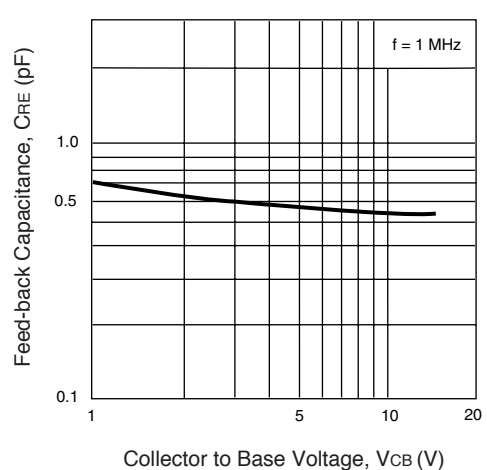
NE68839
GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT



COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE

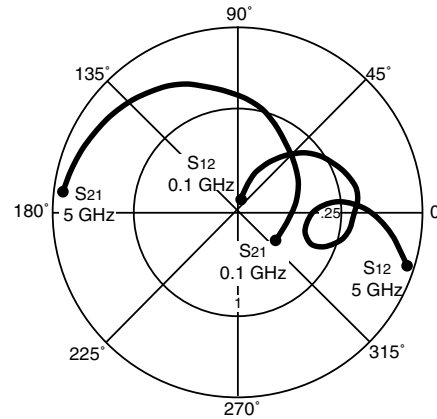
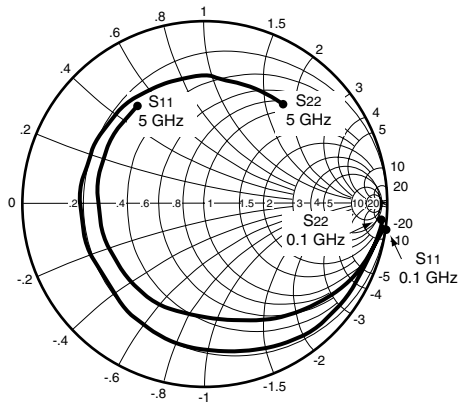


NE68830
FEED-BACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



NE688 SERIES

TYPICAL SCATTERING PARAMETERS (TA = 25°C)



Coordinates in Ohms
Frequency in GHz
(VCE = 0.5 V, IC = 0.5 mA)

NE68819

VCE = 0.5 V, IC = 0.5 mA

| FREQUENCY GHz | S11 | | S21 | | S12 | | S22 | | K | MAG ¹ (dB) |
|------------------|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.976 | -16.300 | 1.892 | 164.300 | 0.061 | 77.700 | 0.990 | -9.700 | 0.096 | 14.916 |
| 0.4 | 0.890 | -62.900 | 1.635 | 125.300 | 0.203 | 47.300 | 0.892 | -34.600 | 0.229 | 9.060 |
| 0.8 | 0.764 | -108.300 | 1.250 | 86.900 | 0.283 | 18.500 | 0.757 | -56.300 | 0.428 | 6.451 |
| 1.0 | 0.726 | -125.500 | 1.098 | 72.100 | 0.294 | 8.100 | 0.716 | -64.300 | 0.518 | 5.723 |
| 1.5 | 0.691 | -159.300 | 0.859 | 43.500 | 0.276 | -10.800 | 0.654 | -81.500 | 0.722 | 4.931 |
| 2.0 | 0.685 | 174.200 | 0.715 | 22.600 | 0.233 | -21.800 | 0.626 | -97.700 | 0.946 | 4.870 |
| 2.5 | 0.689 | 150.800 | 0.618 | 6.500 | 0.184 | -23.000 | 0.607 | -115.400 | 1.257 | 2.208 |
| 3.0 | 0.693 | 129.200 | 0.554 | -5.300 | 0.159 | -8.700 | 0.592 | -136.300 | 1.553 | 1.042 |

VCE = 1.0 V, IC = 1.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.955 | -18.200 | 3.606 | 164.000 | 0.047 | 77.800 | 0.985 | -10.600 | 0.083 | 18.849 |
| 0.4 | 0.846 | -68.100 | 2.975 | 127.000 | 0.153 | 47.200 | 0.851 | -37.000 | 0.197 | 12.888 |
| 0.8 | 0.705 | -114.900 | 2.125 | 92.400 | 0.205 | 21.600 | 0.685 | -58.000 | 0.384 | 10.156 |
| 1.0 | 0.666 | -132.000 | 1.825 | 79.400 | 0.210 | 13.300 | 0.636 | -65.100 | 0.480 | 9.390 |
| 1.5 | 0.624 | -165.000 | 1.363 | 53.900 | 0.200 | 0.700 | 0.565 | -79.600 | 0.727 | 8.335 |
| 2.0 | 0.612 | 169.600 | 1.102 | 34.300 | 0.181 | -3.100 | 0.529 | -92.900 | 1.002 | 7.576 |
| 2.5 | 0.610 | 147.400 | 0.948 | 17.600 | 0.171 | 1.400 | 0.503 | -107.600 | 1.241 | 4.481 |
| 3.0 | 0.612 | 127.000 | 0.850 | 3.100 | 0.189 | 9.500 | 0.478 | -125.400 | 1.295 | 3.271 |
| 4.0 | 0.633 | 87.700 | 0.731 | -22.000 | 0.312 | 7.300 | 0.464 | -175.100 | 1.058 | 2.229 |
| 5.0 | 0.660 | 50.700 | 0.634 | -42.500 | 0.434 | -14.500 | 0.542 | 135.800 | 1.022 | 0.747 |

VCE = 3.0 V, IC = 3.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.902 | -25.000 | 9.548 | 160.300 | 0.035 | 75.900 | 0.964 | -15.500 | 0.085 | 24.358 |
| 0.4 | 0.706 | -86.100 | 6.729 | 119.100 | 0.098 | 44.700 | 0.708 | -47.700 | 0.288 | 18.367 |
| 0.8 | 0.558 | -133.100 | 4.185 | 89.200 | 0.123 | 29.300 | 0.500 | -66.200 | 0.552 | 15.318 |
| 1.0 | 0.528 | -148.700 | 3.477 | 78.800 | 0.129 | 26.300 | 0.448 | -71.400 | 0.673 | 14.306 |
| 1.5 | 0.496 | -177.500 | 2.465 | 57.900 | 0.143 | 23.100 | 0.383 | -80.700 | 0.911 | 12.365 |
| 2.0 | 0.484 | 161.200 | 1.924 | 40.800 | 0.162 | 22.300 | 0.349 | -89.300 | 1.068 | 9.158 |
| 2.5 | 0.480 | 142.700 | 1.613 | 25.100 | 0.189 | 21.100 | 0.324 | -98.900 | 1.127 | 7.147 |
| 3.0 | 0.485 | 125.800 | 1.425 | 10.500 | 0.224 | 17.800 | 0.295 | -112.300 | 1.115 | 5.973 |
| 4.0 | 0.518 | 91.200 | 1.187 | -17.200 | 0.313 | 4.600 | 0.256 | -159.100 | 1.030 | 4.721 |
| 5.0 | 0.579 | 56.600 | 0.985 | -43.600 | 0.396 | -14.900 | 0.342 | 147.600 | 0.973 | 3.957 |

VCE = 3.0 V, IC = 7.0 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.786 | -39.600 | 18.403 | 151.700 | 0.031 | 72.000 | 0.903 | -25.500 | 0.118 | 27.735 |
| 0.4 | 0.542 | -113.500 | 9.834 | 106.700 | 0.073 | 44.700 | 0.506 | -65.400 | 0.487 | 21.294 |
| 0.8 | 0.450 | -156.200 | 5.452 | 82.100 | 0.097 | 40.800 | 0.320 | -82.200 | 0.797 | 17.498 |
| 1.0 | 0.434 | -169.300 | 4.445 | 73.700 | 0.109 | 40.500 | 0.281 | -86.600 | 0.894 | 16.104 |
| 1.5 | 0.420 | 167.100 | 3.072 | 55.700 | 0.143 | 38.100 | 0.231 | -93.200 | 1.016 | 12.550 |
| 2.0 | 0.411 | 149.700 | 2.376 | 40.500 | 0.180 | 33.900 | 0.203 | -99.000 | 1.069 | 9.601 |
| 2.5 | 0.410 | 134.000 | 1.974 | 25.900 | 0.220 | 27.700 | 0.179 | -106.000 | 1.078 | 7.824 |
| 3.0 | 0.413 | 120.000 | 1.726 | 12.000 | 0.262 | 19.900 | 0.154 | -119.300 | 1.067 | 6.606 |
| 4.0 | 0.460 | 89.000 | 1.412 | -14.800 | 0.347 | 1.500 | 0.137 | 177.100 | 1.024 | 5.143 |
| 5.0 | 0.533 | 54.800 | 1.176 | -40.600 | 0.413 | -18.700 | 0.255 | 127.900 | 0.996 | 4.545 |

Note:

1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } MSG = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| S_{21}}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

NE68819

V_{CE} = 3.0 V, I_c = 20 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|---------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.538 | -68.800 | 32.261 | 136.000 | 0.023 | 64.800 | 0.741 | -42.000 | 0.322 | 31.469 |
| 0.4 | 0.385 | -146.900 | 11.973 | 94.900 | 0.053 | 57.300 | 0.302 | -81.000 | 0.818 | 23.539 |
| 0.8 | 0.358 | -179.500 | 6.233 | 76.200 | 0.090 | 57.600 | 0.191 | -94.800 | 0.984 | 18.405 |
| 1.0 | 0.352 | 170.400 | 5.038 | 69.100 | 0.109 | 56.000 | 0.169 | -98.300 | 1.014 | 15.931 |
| 1.5 | 0.345 | 152.000 | 3.447 | 53.400 | 0.157 | 49.400 | 0.139 | -102.200 | 1.040 | 12.192 |
| 2.0 | 0.335 | 137.400 | 2.649 | 39.400 | 0.206 | 41.200 | 0.120 | -104.900 | 1.048 | 9.756 |
| 2.5 | 0.334 | 124.900 | 2.189 | 25.600 | 0.255 | 32.000 | 0.101 | -108.700 | 1.041 | 8.090 |
| 3.0 | 0.334 | 112.100 | 1.904 | 12.300 | 0.302 | 22.000 | 0.081 | -124.300 | 1.036 | 6.829 |
| 4.0 | 0.396 | 83.800 | 1.544 | -13.400 | 0.390 | 0.900 | 0.100 | 147.600 | 1.012 | 5.314 |
| 5.0 | 0.483 | 50.200 | 1.294 | -38.000 | 0.453 | -20.200 | 0.236 | 112.500 | 0.997 | 4.558 |

V_{CE} = 5.0 V, I_c = 10 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.717 | -44.700 | 22.801 | 147.800 | 0.029 | 68.600 | 0.867 | -28.800 | 0.210 | 28.956 |
| 0.4 | 0.466 | -119.600 | 10.924 | 103.000 | 0.063 | 49.200 | 0.442 | -67.400 | 0.609 | 22.390 |
| 0.8 | 0.383 | -161.000 | 5.912 | 80.300 | 0.093 | 48.100 | 0.279 | -81.500 | 0.886 | 18.033 |
| 1.0 | 0.371 | -173.600 | 4.804 | 72.300 | 0.108 | 47.600 | 0.246 | -84.900 | 0.954 | 16.482 |
| 1.5 | 0.356 | 163.800 | 3.304 | 55.300 | 0.149 | 43.800 | 0.206 | -89.800 | 1.029 | 12.415 |
| 2.0 | 0.349 | 146.600 | 2.545 | 40.600 | 0.192 | 37.800 | 0.183 | -94.100 | 1.055 | 9.785 |
| 2.5 | 0.346 | 131.700 | 2.110 | 26.300 | 0.237 | 30.200 | 0.163 | -99.400 | 1.055 | 8.057 |
| 3.0 | 0.349 | 118.200 | 1.842 | 12.700 | 0.282 | 21.500 | 0.140 | -111.400 | 1.045 | 6.851 |
| 4.0 | 0.403 | 87.800 | 1.503 | -13.400 | 0.369 | 1.900 | 0.113 | -179.400 | 1.015 | 5.349 |
| 5.0 | 0.485 | 53.100 | 1.262 | -38.900 | 0.437 | -18.800 | 0.229 | 127.200 | 0.992 | 4.606 |

Note:

1. Gain Calculations:

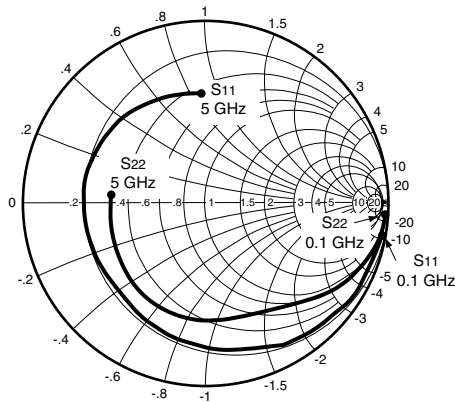
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

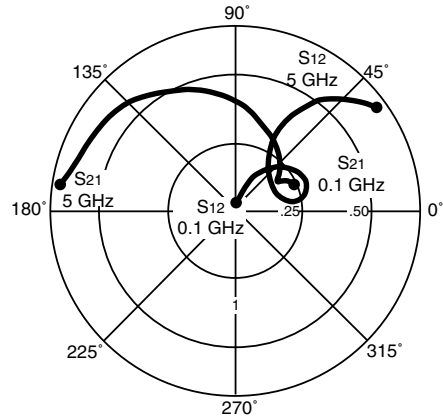
MSG = Maximum Stable Gain

NE688 SERIES

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 0.5 V, I_C = 0.5 mA)



NE68830

V_{CE} = 0.5 V, I_C = 0.5 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|--------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.977 | -15.600 | 1.794 | 165.200 | 0.063 | 78.200 | 0.989 | -8.600 | 0.101 | 14.545 |
| 0.4 | 0.880 | -61.200 | 1.560 | 127.600 | 0.209 | 50.900 | 0.883 | -29.700 | 0.247 | 8.730 |
| 0.8 | 0.749 | -103.800 | 1.199 | 92.400 | 0.282 | 26.900 | 0.745 | -47.000 | 0.457 | 6.286 |
| 1.0 | 0.710 | -119.300 | 1.057 | 79.900 | 0.287 | 19.000 | 0.706 | -53.300 | 0.549 | 5.662 |
| 1.5 | 0.670 | -148.700 | 0.832 | 57.200 | 0.249 | 7.800 | 0.654 | -67.800 | 0.777 | 5.239 |
| 2.0 | 0.667 | -171.700 | 0.691 | 43.200 | 0.185 | 11.100 | 0.641 | -82.200 | 1.079 | 4.012 |
| 2.5 | 0.669 | 168.000 | 0.595 | 35.800 | 0.160 | 39.600 | 0.636 | -97.500 | 1.352 | 2.162 |
| 3.0 | 0.663 | 148.500 | 0.545 | 34.900 | 0.240 | 62.300 | 0.624 | -113.300 | 1.179 | 0.998 |

V_{CE} = 1.0 V, I_C = 1.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.956 | -16.900 | 3.478 | 165.200 | 0.050 | 78.400 | 0.983 | -9.700 | 0.092 | 18.424 |
| 0.4 | 0.824 | -67.100 | 2.847 | 128.900 | 0.157 | 50.900 | 0.834 | -32.200 | 0.224 | 12.585 |
| 0.8 | 0.672 | -110.800 | 2.021 | 97.700 | 0.202 | 31.500 | 0.661 | -48.100 | 0.444 | 10.002 |
| 1.0 | 0.630 | -126.100 | 1.739 | 86.900 | 0.205 | 26.700 | 0.613 | -53.400 | 0.555 | 9.285 |
| 1.5 | 0.583 | -154.600 | 1.306 | 67.000 | 0.188 | 25.000 | 0.550 | -64.600 | 0.849 | 8.418 |
| 2.0 | 0.571 | -176.300 | 1.067 | 53.000 | 0.174 | 36.300 | 0.528 | -75.600 | 1.116 | 5.800 |
| 2.5 | 0.569 | 165.000 | 0.918 | 42.700 | 0.201 | 53.800 | 0.520 | -87.500 | 1.149 | 4.251 |
| 3.0 | 0.562 | 147.100 | 0.821 | 36.200 | 0.274 | 63.000 | 0.513 | -100.100 | 1.056 | 3.316 |
| 4.0 | 0.554 | 115.300 | 0.745 | 28.400 | 0.477 | 56.800 | 0.476 | -128.100 | 0.969 | 1.936 |
| 5.0 | 0.562 | 93.000 | 0.751 | 20.000 | 0.635 | 39.900 | 0.439 | -166.000 | 0.985 | 0.729 |

V_{CE} = 3.0 V, I_C = 3.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.869 | -24.100 | 9.277 | 160.200 | 0.035 | 76.600 | 0.957 | -14.600 | 0.114 | 24.233 |
| 0.4 | 0.635 | -85.100 | 6.331 | 119.900 | 0.097 | 51.200 | 0.673 | -40.700 | 0.380 | 18.147 |
| 0.8 | 0.484 | -127.600 | 3.861 | 94.600 | 0.124 | 45.600 | 0.471 | -51.200 | 0.690 | 14.933 |
| 1.0 | 0.449 | -141.200 | 3.196 | 86.700 | 0.134 | 46.800 | 0.426 | -53.800 | 0.814 | 13.775 |
| 1.5 | 0.415 | -166.200 | 2.270 | 71.200 | 0.162 | 52.300 | 0.371 | -59.200 | 1.003 | 11.109 |
| 2.0 | 0.402 | 174.800 | 1.800 | 59.500 | 0.199 | 57.200 | 0.352 | -65.500 | 1.064 | 8.018 |
| 2.5 | 0.401 | 159.600 | 1.523 | 49.600 | 0.246 | 60.100 | 0.348 | -72.700 | 1.043 | 6.648 |
| 3.0 | 0.396 | 144.900 | 1.339 | 41.200 | 0.304 | 60.300 | 0.347 | -80.800 | 1.005 | 5.989 |
| 4.0 | 0.411 | 118.700 | 1.114 | 27.800 | 0.434 | 54.500 | 0.332 | -100.400 | 0.947 | 4.094 |
| 5.0 | 0.470 | 99.800 | 1.000 | 15.700 | 0.560 | 43.200 | 0.289 | -136.400 | 0.931 | 2.518 |

V_{CE} = 3.0 V, I_C = 7.0 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.721 | -40.400 | 17.900 | 149.800 | 0.032 | 70.700 | 0.873 | -25.700 | 0.206 | 27.477 |
| 0.4 | 0.434 | -111.800 | 8.737 | 106.900 | 0.075 | 55.700 | 0.453 | -55.300 | 0.650 | 20.663 |
| 0.8 | 0.350 | -150.000 | 4.773 | 87.500 | 0.112 | 60.000 | 0.293 | -61.900 | 0.915 | 16.296 |
| 1.0 | 0.336 | -161.700 | 3.890 | 81.400 | 0.132 | 61.700 | 0.263 | -63.300 | 0.973 | 14.694 |
| 1.5 | 0.318 | -178.800 | 2.710 | 69.200 | 0.184 | 63.300 | 0.230 | -67.100 | 1.035 | 10.542 |
| 2.0 | 0.315 | 163.400 | 2.124 | 59.100 | 0.240 | 62.700 | 0.221 | -71.900 | 1.035 | 8.321 |
| 2.5 | 0.313 | 150.200 | 1.779 | 50.200 | 0.297 | 60.700 | 0.222 | -77.600 | 1.021 | 6.882 |
| 3.0 | 0.310 | 137.900 | 1.559 | 42.400 | 0.355 | 57.600 | 0.226 | -84.600 | 1.004 | 6.059 |
| 4.0 | 0.322 | 116.200 | 1.305 | 29.000 | 0.470 | 49.300 | 0.220 | -103.900 | 0.973 | 4.435 |
| 5.0 | 0.397 | 102.200 | 1.160 | 16.500 | 0.570 | 38.800 | 0.194 | -144.300 | 0.954 | 3.086 |

See notes on previous page.

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

NE68830

V_{CE} = 3.0 V, I_C = 20 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|--------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.472 | -66.200 | 29.896 | 134.700 | 0.024 | 69.600 | 0.707 | -41.100 | 0.408 | 30.954 |
| 0.4 | 0.313 | -143.700 | 10.607 | 97.700 | 0.061 | 67.800 | 0.276 | -66.500 | 0.884 | 22.403 |
| 0.8 | 0.289 | -171.000 | 5.532 | 83.500 | 0.110 | 70.700 | 0.173 | -70.800 | 0.994 | 17.015 |
| 1.0 | 0.285 | -179.400 | 4.472 | 78.800 | 0.135 | 70.500 | 0.154 | -72.100 | 1.012 | 14.543 |
| 1.5 | 0.283 | -165.900 | 3.076 | 68.600 | 0.196 | 68.100 | 0.134 | -75.600 | 1.025 | 10.998 |
| 2.0 | 0.280 | -153.300 | 2.400 | 59.900 | 0.256 | 64.400 | 0.129 | -79.500 | 1.022 | 8.816 |
| 2.5 | 0.278 | -143.200 | 2.003 | 51.900 | 0.314 | 60.300 | 0.132 | -83.700 | 1.013 | 7.348 |
| 3.0 | 0.271 | -131.700 | 1.747 | 44.400 | 0.371 | 55.800 | 0.138 | -89.700 | 1.006 | 6.272 |
| 4.0 | 0.285 | -114.200 | 1.440 | 31.100 | 0.473 | 45.900 | 0.134 | -110.400 | 0.992 | 4.835 |
| 5.0 | 0.365 | -103.100 | 1.272 | 18.100 | 0.553 | 35.300 | 0.124 | -169.400 | 0.981 | 3.618 |

V_{CE} = 5.0 V, I_C = 10 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.656 | -44.300 | 22.050 | 146.100 | 0.029 | 70.900 | 0.835 | -29.100 | 0.264 | 28.810 |
| 0.4 | 0.380 | -119.100 | 9.847 | 104.200 | 0.067 | 59.500 | 0.400 | -57.400 | 0.732 | 21.672 |
| 0.8 | 0.311 | -155.500 | 5.283 | 86.600 | 0.107 | 64.100 | 0.258 | -62.400 | 0.949 | 16.935 |
| 1.0 | 0.299 | -166.800 | 4.287 | 81.100 | 0.129 | 65.200 | 0.232 | -63.600 | 0.989 | 15.216 |
| 1.5 | 0.291 | -173.200 | 2.964 | 69.500 | 0.183 | 65.300 | 0.204 | -67.100 | 1.028 | 11.073 |
| 2.0 | 0.289 | -157.500 | 2.315 | 60.200 | 0.239 | 63.500 | 0.197 | -71.700 | 1.028 | 8.840 |
| 2.5 | 0.289 | -145.100 | 1.932 | 51.600 | 0.294 | 60.600 | 0.201 | -76.800 | 1.016 | 7.393 |
| 3.0 | 0.285 | -131.600 | 1.686 | 43.900 | 0.349 | 57.000 | 0.207 | -83.200 | 1.006 | 6.382 |
| 4.0 | 0.307 | -110.900 | 1.388 | 30.500 | 0.453 | 48.400 | 0.205 | -100.900 | 0.982 | 4.863 |
| 5.0 | 0.385 | -98.500 | 1.225 | 17.800 | 0.543 | 38.300 | 0.173 | -142.100 | 0.965 | 3.533 |

Note:

1. Gain Calculations:

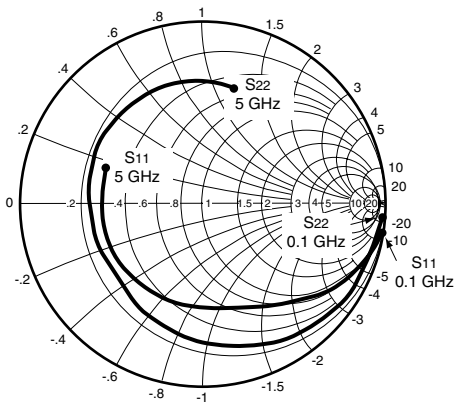
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

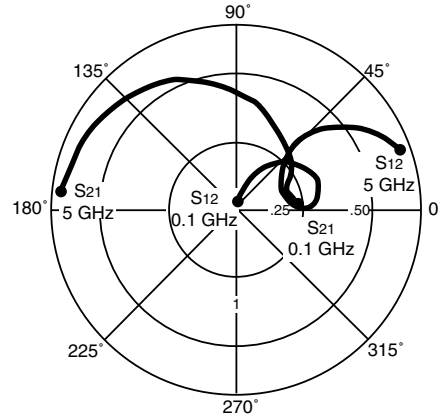
MSG = Maximum Stable Gain

NE688 SERIES

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 0.5 V, I_c = 0.5 mA)



NE68833

V_{CE} = 0.5 V, I_c = 0.5 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|--------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.971 | -15.100 | 1.775 | 164.000 | 0.065 | 79.000 | 0.989 | -8.700 | 0.117 | 14.363 |
| 0.4 | 0.877 | -59.900 | 1.588 | 127.800 | 0.215 | 50.900 | 0.883 | -30.200 | 0.261 | 8.684 |
| 0.8 | 0.723 | -105.400 | 1.237 | 90.500 | 0.295 | 25.300 | 0.729 | -48.600 | 0.491 | 6.225 |
| 1.0 | 0.683 | -122.900 | 1.101 | 76.900 | 0.303 | 16.500 | 0.682 | -55.300 | 0.581 | 5.603 |
| 1.5 | 0.640 | -158.100 | 0.871 | 51.800 | 0.265 | 2.900 | 0.609 | -71.400 | 0.824 | 5.168 |
| 2.0 | 0.644 | 174.400 | 0.717 | 35.000 | 0.199 | 3.900 | 0.584 | -88.400 | 1.167 | 3.092 |
| 2.5 | 0.669 | 151.300 | 0.612 | 25.500 | 0.171 | 27.800 | 0.578 | -107.300 | 1.428 | 1.649 |
| 3.0 | 0.682 | 131.300 | 0.544 | 22.100 | 0.243 | 47.700 | 0.580 | -126.900 | 1.244 | 0.525 |

V_{CE} = 1.0 V, I_c = 1.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.960 | -16.300 | 3.468 | 165.600 | 0.051 | 78.200 | 0.983 | -9.800 | 0.098 | 18.325 |
| 0.4 | 0.821 | -66.100 | 2.890 | 128.500 | 0.163 | 51.000 | 0.835 | -33.200 | 0.235 | 12.487 |
| 0.8 | 0.650 | -112.800 | 2.090 | 95.600 | 0.215 | 30.000 | 0.649 | -50.700 | 0.459 | 9.877 |
| 1.0 | 0.602 | -130.600 | 1.803 | 83.800 | 0.219 | 24.200 | 0.592 | -56.500 | 0.571 | 9.156 |
| 1.5 | 0.555 | -165.100 | 1.360 | 61.400 | 0.203 | 20.000 | 0.508 | -69.500 | 0.865 | 8.260 |
| 2.0 | 0.556 | 168.200 | 1.106 | 44.800 | 0.190 | 28.300 | 0.474 | -83.200 | 1.122 | 5.529 |
| 2.5 | 0.576 | 146.900 | 0.938 | 32.500 | 0.215 | 41.900 | 0.464 | -99.100 | 1.162 | 3.959 |
| 3.0 | 0.592 | 128.400 | 0.826 | 24.000 | 0.282 | 48.500 | 0.468 | -116.200 | 1.068 | 3.074 |
| 4.0 | 0.618 | 98.100 | 0.724 | 13.600 | 0.459 | 40.800 | 0.483 | -151.100 | 0.968 | 1.979 |
| 5.0 | 0.626 | 75.400 | 0.700 | 4.000 | 0.593 | 24.000 | 0.500 | 174.500 | 0.990 | 0.720 |

V_{CE} = 1.0 V, I_c = 3.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.877 | -28.400 | 9.241 | 157.900 | 0.048 | 73.200 | 0.937 | -19.300 | 0.128 | 22.845 |
| 0.4 | 0.607 | -94.900 | 5.850 | 113.900 | 0.122 | 46.800 | 0.599 | -53.600 | 0.411 | 16.808 |
| 0.8 | 0.462 | -141.800 | 3.462 | 87.200 | 0.154 | 40.500 | 0.382 | -70.400 | 0.731 | 13.518 |
| 1.0 | 0.437 | -157.700 | 2.859 | 78.500 | 0.166 | 40.900 | 0.331 | -75.500 | 0.853 | 12.361 |
| 1.5 | 0.423 | 173.800 | 2.032 | 61.200 | 0.202 | 43.700 | 0.265 | -87.200 | 1.029 | 8.987 |
| 2.0 | 0.437 | 152.600 | 1.616 | 47.500 | 0.246 | 45.300 | 0.239 | -100.400 | 1.079 | 6.461 |
| 2.5 | 0.461 | 136.300 | 1.361 | 35.700 | 0.299 | 44.700 | 0.237 | -115.600 | 1.062 | 5.066 |
| 3.0 | 0.481 | 121.800 | 1.197 | 26.300 | 0.356 | 42.000 | 0.250 | -131.300 | 1.033 | 4.151 |
| 4.0 | 0.523 | 98.200 | 1.005 | 10.500 | 0.473 | 32.300 | 0.294 | -162.400 | 0.981 | 3.273 |
| 5.0 | 0.571 | 78.400 | 0.882 | -2.600 | 0.566 | 19.400 | 0.349 | 167.000 | 0.974 | 1.927 |

V_{CE} = 3.0 V, I_c = 3.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.892 | -23.800 | 9.321 | 160.400 | 0.037 | 75.000 | 0.954 | -15.000 | 0.137 | 24.013 |
| 0.4 | 0.629 | -83.800 | 6.328 | 118.600 | 0.102 | 51.000 | 0.666 | -42.700 | 0.399 | 17.927 |
| 0.8 | 0.446 | -129.900 | 3.868 | 91.300 | 0.133 | 44.500 | 0.454 | -55.000 | 0.719 | 14.636 |
| 1.0 | 0.409 | -146.800 | 3.204 | 82.400 | 0.144 | 44.900 | 0.403 | -58.200 | 0.841 | 13.473 |
| 1.5 | 0.379 | -178.400 | 2.277 | 65.100 | 0.177 | 48.200 | 0.336 | -65.900 | 1.017 | 10.300 |
| 2.0 | 0.389 | 158.300 | 1.797 | 51.400 | 0.218 | 50.600 | 0.305 | -75.600 | 1.066 | 7.588 |
| 2.5 | 0.410 | 140.300 | 1.507 | 39.500 | 0.270 | 50.800 | 0.293 | -88.100 | 1.043 | 6.192 |
| 3.0 | 0.432 | 125.000 | 1.315 | 29.800 | 0.327 | 48.500 | 0.293 | -102.600 | 1.009 | 5.474 |
| 4.0 | 0.484 | 100.300 | 1.087 | 13.600 | 0.449 | 39.400 | 0.310 | -134.200 | 0.945 | 3.840 |
| 5.0 | 0.533 | 79.800 | 0.947 | -0.100 | 0.558 | 26.400 | 0.342 | -168.400 | 0.939 | 2.297 |

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

NE68833

V_{CE} = 3.0 V, I_C = 7.0 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|--------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.738 | -38.900 | 17.561 | 148.600 | 0.035 | 72.200 | 0.874 | -25.500 | 0.226 | 27.005 |
| 0.4 | 0.422 | -108.100 | 8.799 | 106.000 | 0.078 | 55.800 | 0.453 | -55.900 | 0.661 | 20.523 |
| 0.8 | 0.317 | -152.000 | 4.793 | 85.000 | 0.119 | 58.000 | 0.283 | -63.900 | 0.921 | 16.051 |
| 1.0 | 0.304 | -166.400 | 3.908 | 78.000 | 0.140 | 58.700 | 0.248 | -66.300 | 0.978 | 14.458 |
| 1.5 | 0.302 | 168.000 | 2.707 | 64.000 | 0.196 | 57.900 | 0.202 | -74.100 | 1.033 | 10.291 |
| 2.0 | 0.317 | 148.300 | 2.120 | 52.100 | 0.254 | 55.100 | 0.180 | -84.800 | 1.036 | 8.051 |
| 2.5 | 0.342 | 133.600 | 1.769 | 41.800 | 0.311 | 50.900 | 0.173 | -99.100 | 1.022 | 6.632 |
| 3.0 | 0.358 | 121.600 | 1.541 | 32.300 | 0.368 | 45.900 | 0.177 | -115.100 | 1.008 | 5.662 |
| 4.0 | 0.406 | 101.800 | 1.282 | 16.200 | 0.471 | 34.800 | 0.204 | -148.600 | 0.976 | 4.349 |
| 5.0 | 0.471 | 83.500 | 1.117 | 1.100 | 0.557 | 22.300 | 0.252 | 175.600 | 0.964 | 3.022 |

V_{CE} = 3.0 V, I_C = 20 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.479 | -65.600 | 29.593 | 133.500 | 0.026 | 65.900 | 0.692 | -41.600 | 0.448 | 30.562 |
| 0.4 | 0.276 | -141.300 | 10.351 | 95.700 | 0.066 | 67.400 | 0.266 | -67.200 | 0.898 | 21.954 |
| 0.8 | 0.252 | -176.800 | 5.382 | 80.200 | 0.119 | 68.300 | 0.165 | -73.600 | 0.999 | 16.554 |
| 1.0 | 0.251 | 171.500 | 4.352 | 74.600 | 0.146 | 67.100 | 0.146 | -77.100 | 1.014 | 14.006 |
| 1.5 | 0.265 | 151.700 | 2.993 | 62.700 | 0.212 | 62.500 | 0.121 | -88.700 | 1.024 | 10.543 |
| 2.0 | 0.289 | 136.500 | 2.324 | 52.200 | 0.275 | 56.900 | 0.110 | -104.300 | 1.021 | 8.387 |
| 2.5 | 0.313 | 124.100 | 1.932 | 42.400 | 0.335 | 50.800 | 0.114 | -122.300 | 1.012 | 6.930 |
| 3.0 | 0.332 | 113.100 | 1.678 | 33.800 | 0.390 | 44.500 | 0.130 | -139.600 | 1.007 | 5.840 |
| 4.0 | 0.378 | 96.000 | 1.384 | 17.900 | 0.486 | 32.000 | 0.175 | -170.800 | 0.992 | 4.545 |
| 5.0 | 0.445 | 80.700 | 1.201 | 3.100 | 0.556 | 19.400 | 0.231 | 160.200 | 0.983 | 3.345 |

V_{CE} = 5.0 V, I_C = 10 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.686 | -44.200 | 22.023 | 145.500 | 0.030 | 67.500 | 0.828 | -29.500 | 0.293 | 28.658 |
| 0.4 | 0.356 | -115.200 | 9.698 | 102.500 | 0.071 | 59.600 | 0.390 | -57.900 | 0.756 | 21.354 |
| 0.8 | 0.271 | -158.000 | 5.191 | 83.500 | 0.116 | 62.500 | 0.246 | -64.000 | 0.958 | 16.508 |
| 1.0 | 0.262 | -172.200 | 4.212 | 77.100 | 0.139 | 62.400 | 0.217 | -66.100 | 0.997 | 14.815 |
| 1.5 | 0.266 | 161.900 | 2.912 | 64.000 | 0.199 | 60.200 | 0.178 | -73.800 | 1.028 | 10.631 |
| 2.0 | 0.285 | 143.600 | 2.269 | 52.800 | 0.258 | 56.100 | 0.158 | -84.900 | 1.029 | 8.398 |
| 2.5 | 0.312 | 129.300 | 1.886 | 42.600 | 0.316 | 51.300 | 0.153 | -99.700 | 1.017 | 6.962 |
| 3.0 | 0.332 | 117.100 | 1.639 | 33.700 | 0.370 | 45.800 | 0.158 | -116.500 | 1.008 | 5.901 |
| 4.0 | 0.381 | 97.900 | 1.351 | 17.500 | 0.469 | 34.200 | 0.187 | -150.600 | 0.986 | 4.595 |
| 5.0 | 0.449 | 81.900 | 1.175 | 2.500 | 0.548 | 22.000 | 0.230 | 176.200 | 0.970 | 3.313 |

Note:

1. Gain Calculations:

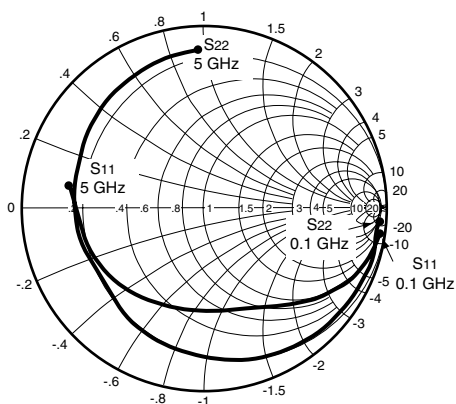
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} \left(K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

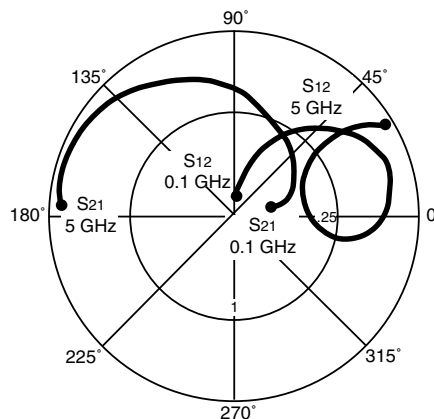
MSG = Maximum Stable Gain

NE688 SERIES

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 0.5 V, I_C = 0.5 mA)



NE68839

V_{CE} = 0.5 V, I_C = 0.5 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|---------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.989 | -15.100 | 1.756 | 167.700 | 0.057 | 80.500 | 0.990 | -7.000 | 0.047 | 14.886 |
| 0.4 | 0.899 | -58.000 | 1.616 | 131.900 | 0.205 | 53.400 | 0.898 | -26.300 | 0.227 | 8.967 |
| 0.8 | 0.768 | -105.900 | 1.310 | 95.000 | 0.303 | 26.900 | 0.746 | -43.100 | 0.419 | 6.358 |
| 1.0 | 0.727 | -125.800 | 1.169 | 80.700 | 0.319 | 16.700 | 0.690 | -49.600 | 0.493 | 5.640 |
| 1.5 | 0.694 | -164.800 | 0.921 | 52.700 | 0.300 | -2.200 | 0.595 | -65.200 | 0.669 | 4.871 |
| 2.0 | 0.716 | 167.500 | 0.735 | 32.300 | 0.239 | -13.100 | 0.569 | -82.500 | 0.859 | 4.879 |
| 2.5 | 0.755 | 147.100 | 0.601 | 18.900 | 0.168 | -10.700 | 0.570 | -102.800 | 1.140 | 3.262 |
| 3.0 | 0.788 | 131.400 | 0.490 | 11.300 | 0.136 | 13.200 | 0.593 | -123.900 | 1.430 | 1.669 |

V_{CE} = 1.0 V, I_C = 1.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.968 | -17.300 | 3.482 | 166.900 | 0.047 | 79.200 | 0.986 | -8.600 | 0.054 | 18.697 |
| 0.4 | 0.847 | -65.200 | 3.022 | 132.100 | 0.159 | 52.200 | 0.850 | -30.300 | 0.199 | 12.789 |
| 0.8 | 0.697 | -115.200 | 2.251 | 98.700 | 0.220 | 28.700 | 0.656 | -47.500 | 0.386 | 10.100 |
| 1.0 | 0.660 | -134.900 | 1.936 | 86.400 | 0.229 | 20.900 | 0.587 | -53.700 | 0.470 | 9.271 |
| 1.5 | 0.631 | -173.000 | 1.448 | 62.300 | 0.213 | 9.900 | 0.477 | -67.500 | 0.704 | 8.324 |
| 2.0 | 0.655 | 160.900 | 1.129 | 43.900 | 0.184 | 8.800 | 0.438 | -83.000 | 0.955 | 7.879 |
| 2.5 | 0.692 | 142.400 | 0.933 | 30.100 | 0.166 | 18.400 | 0.433 | -101.400 | 1.147 | 5.168 |
| 3.0 | 0.728 | 127.900 | 0.770 | 19.800 | 0.179 | 31.500 | 0.451 | -121.300 | 1.194 | 3.675 |
| 4.0 | 0.790 | 106.200 | 0.588 | 8.600 | 0.271 | 39.000 | 0.534 | -157.100 | 0.985 | 3.364 |
| 5.0 | 0.828 | 90.000 | 0.502 | 3.700 | 0.360 | 30.600 | 0.624 | 175.200 | 0.947 | 1.444 |

V_{CE} = 3.0 V, I_C = 3.0 mA

| | | | | | | | | | | |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.894 | -24.500 | 9.342 | 161.900 | 0.035 | 76.700 | 0.961 | -13.600 | 0.087 | 24.264 |
| 0.4 | 0.682 | -84.100 | 6.782 | 122.300 | 0.100 | 50.000 | 0.693 | -41.400 | 0.324 | 18.314 |
| 0.8 | 0.524 | -135.700 | 4.250 | 93.900 | 0.129 | 38.200 | 0.455 | -56.300 | 0.606 | 15.178 |
| 1.0 | 0.501 | -154.100 | 3.523 | 84.500 | 0.136 | 36.700 | 0.390 | -60.700 | 0.724 | 14.134 |
| 1.5 | 0.503 | 172.800 | 2.472 | 66.200 | 0.154 | 37.500 | 0.295 | -71.900 | 0.938 | 12.055 |
| 2.0 | 0.542 | 151.200 | 1.886 | 51.600 | 0.174 | 39.900 | 0.251 | -87.400 | 1.052 | 8.957 |
| 2.5 | 0.586 | 135.700 | 1.542 | 39.500 | 0.201 | 41.700 | 0.239 | -106.600 | 1.068 | 7.260 |
| 3.0 | 0.626 | 123.800 | 1.297 | 29.300 | 0.233 | 42.000 | 0.254 | -126.500 | 1.049 | 6.108 |
| 4.0 | 0.704 | 105.600 | 0.988 | 13.200 | 0.303 | 38.000 | 0.335 | -159.600 | 0.959 | 5.133 |
| 5.0 | 0.766 | 90.900 | 0.799 | 0.700 | 0.366 | 30.000 | 0.442 | 176.400 | 0.901 | 3.391 |

V_{CE} = 3.0 V, I_C = 7.0 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.763 | -36.500 | 18.110 | 153.100 | 0.029 | 72.400 | 0.901 | -22.600 | 0.164 | 27.955 |
| 0.4 | 0.501 | -110.300 | 9.906 | 110.000 | 0.072 | 51.400 | 0.496 | -55.500 | 0.544 | 21.386 |
| 0.8 | 0.421 | -157.600 | 5.514 | 87.400 | 0.101 | 50.300 | 0.288 | -68.500 | 0.835 | 17.371 |
| 1.0 | 0.418 | -172.900 | 4.478 | 80.100 | 0.115 | 51.100 | 0.239 | -73.600 | 0.918 | 15.904 |
| 1.5 | 0.449 | 161.400 | 3.060 | 65.400 | 0.151 | 51.200 | 0.171 | -90.700 | 1.016 | 12.285 |
| 2.0 | 0.494 | 144.100 | 2.319 | 53.100 | 0.188 | 49.600 | 0.148 | -116.000 | 1.047 | 9.591 |
| 2.5 | 0.539 | 131.600 | 1.887 | 42.300 | 0.224 | 46.700 | 0.159 | -141.800 | 1.043 | 7.985 |
| 3.0 | 0.583 | 121.700 | 1.583 | 33.100 | 0.258 | 43.300 | 0.193 | -161.300 | 1.032 | 6.790 |
| 4.0 | 0.662 | 105.800 | 1.216 | 17.100 | 0.319 | 35.300 | 0.284 | -174.500 | 0.986 | 5.811 |
| 5.0 | 0.732 | 92.400 | 0.988 | 3.800 | 0.367 | 26.600 | 0.384 | 158.700 | 0.940 | 4.301 |

See notes on previous page.

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)

NE68839

VCE = 5.0 V, Ic = 5.0 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|------------------|-----------------|----------|-----------------|---------|-----------------|--------|-----------------|----------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.1 | 0.840 | -29.900 | 14.218 | 158.000 | 0.029 | 74.900 | 0.937 | -17.100 | 0.114 | 26.904 |
| 0.4 | 0.574 | -94.600 | 9.003 | 116.400 | 0.078 | 51.400 | 0.598 | -46.200 | 0.444 | 20.623 |
| 0.8 | 0.440 | -144.900 | 5.274 | 91.200 | 0.105 | 46.300 | 0.372 | -58.000 | 0.750 | 17.010 |
| 1.0 | 0.425 | -162.500 | 4.315 | 83.200 | 0.116 | 46.700 | 0.315 | -61.700 | 0.854 | 15.705 |
| 1.5 | 0.443 | 167.400 | 2.978 | 67.400 | 0.147 | 47.900 | 0.232 | -72.500 | 0.991 | 13.066 |
| 2.0 | 0.489 | 147.700 | 2.263 | 54.300 | 0.178 | 47.900 | 0.190 | -89.500 | 1.045 | 9.746 |
| 2.5 | 0.534 | 133.000 | 1.846 | 43.100 | 0.211 | 46.500 | 0.177 | -111.500 | 1.048 | 8.074 |
| 3.0 | 0.575 | 122.900 | 1.549 | 33.600 | 0.244 | 44.400 | 0.190 | -133.600 | 1.040 | 6.802 |
| 4.0 | 0.660 | 106.200 | 1.190 | 17.500 | 0.308 | 38.000 | 0.264 | -166.000 | 0.974 | 5.870 |
| 5.0 | 0.728 | 92.400 | 0.962 | 4.100 | 0.362 | 29.700 | 0.365 | 172.800 | 0.925 | 4.245 |

VCE = 5.0 V, Ic = 10 mA

| | | | | | | | | | | |
|-----|-------|----------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.703 | -41.700 | 22.638 | 149.200 | 0.027 | 69.700 | 0.865 | -26.400 | 0.232 | 29.235 |
| 0.4 | 0.441 | -117.800 | 11.095 | 106.400 | 0.064 | 54.500 | 0.432 | -59.100 | 0.640 | 22.389 |
| 0.8 | 0.378 | -163.300 | 6.015 | 85.900 | 0.095 | 55.900 | 0.246 | -71.500 | 0.901 | 18.015 |
| 1.0 | 0.383 | -177.500 | 4.863 | 79.200 | 0.112 | 56.300 | 0.203 | -77.000 | 0.956 | 16.377 |
| 1.5 | 0.418 | 158.400 | 3.313 | 65.600 | 0.153 | 55.200 | 0.145 | -97.200 | 1.020 | 12.494 |
| 2.0 | 0.468 | 142.100 | 2.505 | 53.900 | 0.193 | 52.200 | 0.133 | -126.000 | 1.035 | 9.985 |
| 2.5 | 0.512 | 130.300 | 2.034 | 43.700 | 0.231 | 48.300 | 0.153 | -152.300 | 1.034 | 8.325 |
| 3.0 | 0.559 | 120.900 | 1.708 | 34.800 | 0.265 | 44.100 | 0.191 | -170.400 | 1.024 | 7.135 |
| 4.0 | 0.638 | 105.400 | 1.312 | 19.300 | 0.325 | 35.200 | 0.282 | 168.100 | 0.993 | 6.061 |
| 5.0 | 0.712 | 92.600 | 1.066 | 5.700 | 0.370 | 26.100 | 0.377 | 154.100 | 0.954 | 4.596 |

Note:

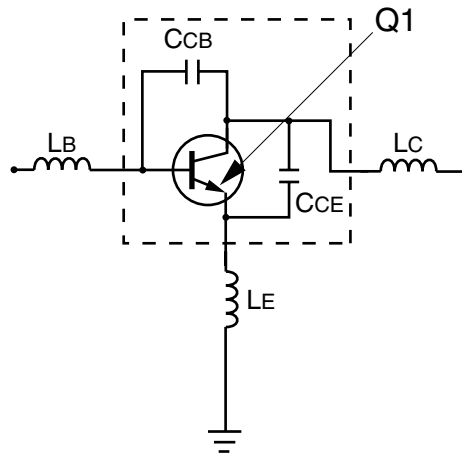
1. Gain Calculations:

$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|------------|-----------|------------|----------|
| IS | 3.8e-16 | MJC | 0.48 |
| BF | 135.7 | XCJC | 0.56 |
| NF | 1 | CJS | 0 |
| VAF | 28 | VJS | 0.75 |
| IKF | 0.6 | MJS | 0 |
| ISE | 3.8e-15 | FC | 0.75 |
| NE | 1.49 | TF | 11.0e-12 |
| BR | 12.3 | XTF | 0.36 |
| NR | 1.1 | VTF | 0.65 |
| VAR | 3.5 | ITF | 0.61 |
| IKR | 0.06 | PTF | 50 |
| ISC | 3.5e-16 | TR | 0.032e-9 |
| NC | 1.62 | EG | 1.11 |
| RE | 0.4 | XTB | 0 |
| RB | 6.14 | XTI | 3 |
| RBM | 3.5 | KF | 0 |
| IRB | 0.001 | AF | 1 |
| RC | 4.2 | | |
| CJE | 0.796e-12 | | |
| VJE | 0.71 | | |
| MJE | 0.38 | | |
| CJC | 0.549e-12 | | |
| VJC | 0.65 | | |

(1) Gummel-Poon Model

UNITS

| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

ADDITIONAL PARAMETERS

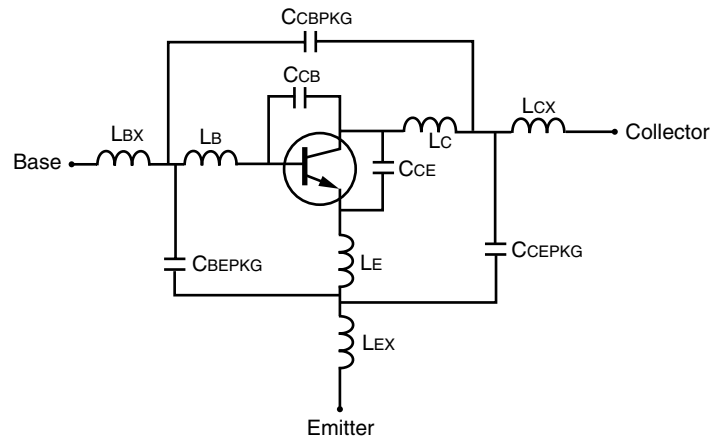
| Parameters | 68800 |
|------------|----------|
| CCB | 0.24e-12 |
| CCE | 0.27e-12 |
| LB | 0.72e-9 |
| Lc | 0.51e-9 |
| LE | 0.19e-9 |

MODEL RANGE

Frequency: 0.1 to 10.0 GHz
 Bias: VCE = 1 V to 3 V, IC = 1 mA to 10 mA
 P1dB: 12.5 dBm at VCE = 3 V, IC = 10 mA, 2 GHz
 Date: 10/3/96

NE68818 NONLINEAR MODEL

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|------------|-----------|------------|---------|
| IS | 3.8e-16 | MJC | 0.48 |
| BF | 135.7 | XCJC | 0.56 |
| NF | 1 | CJS | 0 |
| VAF | 28 | VJS | 0.75 |
| IKF | 0.6 | MJS | 0 |
| ISE | 3.8e-15 | FC | 0.75 |
| NE | 1.49 | TF | 11e-12 |
| BR | 12.3 | XTF | 0.36 |
| NR | 1.1 | VTF | 0.65 |
| VAR | 3.5 | ITF | 0.61 |
| IKR | 0.06 | PTF | 50 |
| ISC | 3.5e-16 | TR | 32e-12 |
| NC | 1.62 | EG | 1.11 |
| RE | 0.4 | XTB | 0 |
| RB | 6.14 | XTI | 3 |
| RBM | 3.5 | KF | 1.5e-14 |
| IRB | 0.001 | AF | 1.22 |
| RC | 4.2 | | |
| CJE | 0.796e-12 | | |
| VJE | 0.71 | | |
| MJE | 0.38 | | |
| CJC | 0.549e-12 | | |
| VJC | 0.65 | | |

(1) Gummel-Poon Model

UNITS

| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

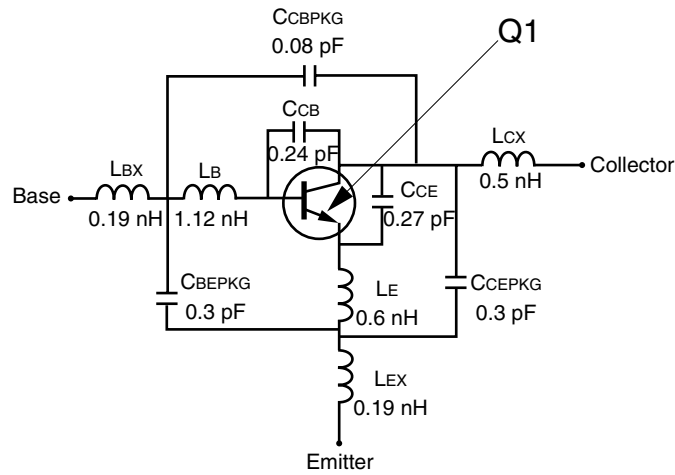
ADDITIONAL PARAMETERS

| Parameters | 68818 |
|------------|-----------|
| CCB | 0.24e-12 |
| CCE | 0.27e-12 |
| LB | 0.9e-9 |
| LC | 0.52e-9 |
| LE | 0.7e-9 |
| CCBPKG | 0.001e-12 |
| CCEPKG | 0.07e-12 |
| CBEPKG | 0.11e-12 |
| LBX | 0.18e-9 |
| LCX | 0.18e-9 |
| LEX | 0.09e-9 |

MODEL RANGE

Frequency: 0.5 to 6.0 GHz
 Bias: VCE = 1 V to 5 V, IC = 1 mA to 10 mA
 Date: 5/97

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|------------|-----------|------------|----------|
| IS | 3.8e-16 | MJC | 0.48 |
| BF | 135.7 | XCJC | 0.56 |
| NF | 1 | CJS | 0 |
| VAF | 28 | VJS | 0.75 |
| IKF | 0.6 | MJS | 0 |
| ISE | 3.8e-15 | FC | 0.75 |
| NE | 1.49 | TF | 11.0e-12 |
| BR | 12.3 | XTF | 0.36 |
| NR | 1.1 | VTF | 0.65 |
| VAR | 3.5 | ITF | 0.61 |
| IKR | 0.06 | PTF | 50 |
| ISC | 3.5e-16 | TR | 32e-12 |
| NC | 1.62 | EG | 1.11 |
| RE | 0.4 | XTB | 0 |
| RB | 6.14 | XTI | 3 |
| RBM | 3.5 | KF | 1.5e-14 |
| IRB | 0.001 | AF | 1.22 |
| RC | 4.2 | | |
| CJE | 0.796e-12 | | |
| VJE | 0.71 | | |
| MJE | 0.38 | | |
| CJC | 0.549e-12 | | |
| VJC | 0.65 | | |

(1) Gummel-Poon Model

UNITS

| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

ADDITIONAL PARAMETERS

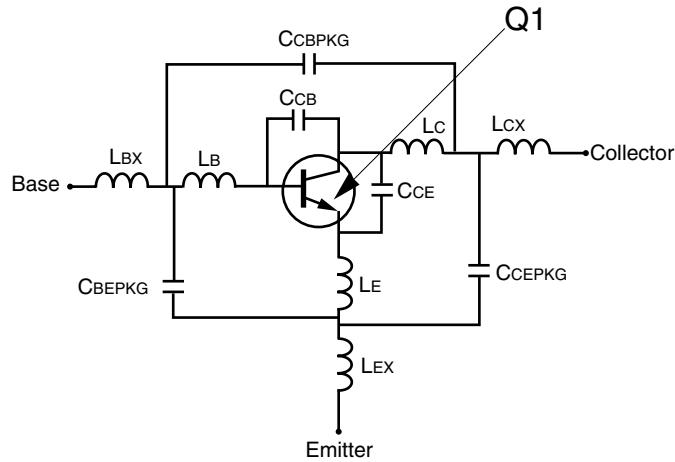
| Parameters | 68819 |
|------------|----------|
| CCB | 0.24e-12 |
| CCE | 0.27e-12 |
| LB | 1.12e-9 |
| LE | 0.6e-9 |
| CCBPKG | 0.08e-12 |
| CCEPKG | 0.3e-12 |
| CBEPKG | 0.3e-12 |
| LBX | 0.19e-9 |
| LCX | 0.5e-9 |
| LEX | 0.19e-9 |

MODEL RANGE

Frequency: 0.1 to 3 GHz
 Bias: VCE = 1 V to 3 V, IC = 1 mA to 10 mA
 Date: 3/20/97

NE68830 NONLINEAR MODEL

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|------------|-----------|------------|--------|
| IS | 3.8e-16 | MJC | 0.48 |
| BF | 135.7 | XCJC | 0.56 |
| NF | 1 | CJS | 0 |
| VAF | 28 | VJS | 0.75 |
| IKF | 0.6 | MJS | 0 |
| ISE | 3.8e-15 | FC | 0.75 |
| NE | 1.49 | TF | 11e-12 |
| BR | 12.3 | XTF | 0.36 |
| NR | 1.1 | VTF | 0.65 |
| VAR | 3.5 | ITF | 0.61 |
| IKR | 0.06 | PTF | 50 |
| ISC | 3.5e-16 | TR | 32e-12 |
| NC | 1.62 | EG | 1.11 |
| RE | 0.4 | XTB | 0 |
| RB | 6.14 | XTI | 3 |
| RBM | 3.5 | KF | 0 |
| IRB | 0.001 | AF | 1 |
| RC | 4.2 | | |
| CJE | 0.796e-12 | | |
| VJE | 0.71 | | |
| MJE | 0.38 | | |
| CJC | 0.549e-12 | | |
| VJC | 0.65 | | |

(1) Gummel-Poon Model

UNITS

| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

ADDITIONAL PARAMETERS

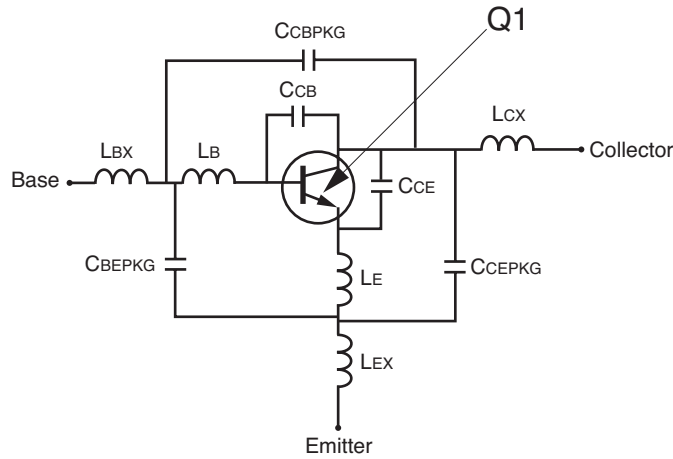
| Parameters | 68830 |
|------------|----------|
| CCB | 0.24e-12 |
| CCE | 0.27e-12 |
| LB | 0.5e-9 |
| LE | 0.86e-9 |
| CCBPKG | 0.08e-12 |
| CCEPKG | 0.04e-12 |
| CBEPKG | 0.04e-12 |
| LBX | 0.2e-9 |
| LCX | 0.1e-9 |
| LEX | 0.2e-9 |

MODEL RANGE

Frequency: 0.05 to 3.0 GHz
 Bias: VCE = 1 V to 5 V, IC = 1 mA to 10 mA
 Date: 10/11/96

NE68833 NONLINEAR MODEL

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|------------|-----------|------------|---------|
| IS | 3.8e-16 | MJC | 0.48 |
| BF | 135.7 | XCJC | 0.56 |
| NF | 1 | CJS | 0 |
| VAF | 28 | VJS | 0.75 |
| IKF | 0.6 | MJS | 0 |
| ISE | 3.8e-15 | FC | 0.75 |
| NE | 1.49 | TF | 11e-12 |
| BR | 12.3 | XTF | 0.36 |
| NR | 1.1 | VTF | 0.65 |
| VAR | 3.5 | ITF | 0.61 |
| IKR | 0.06 | PTF | 50 |
| ISC | 3.5e-16 | TR | 32e-12 |
| NC | 1.62 | EG | 1.11 |
| RE | 0.4 | XTB | 0 |
| RB | 6.14 | XTI | 3 |
| RBM | 3.5 | KF | 1.5e-14 |
| IRB | 0.001 | AF | 1.22 |
| RC | 4.2 | | |
| CJE | 0.796e-12 | | |
| VJE | 0.71 | | |
| MJE | 0.38 | | |
| CJC | 0.549e-12 | | |
| VJC | 0.65 | | |

(1) Gummel-Poon Model

UNITS

| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

ADDITIONAL PARAMETERS

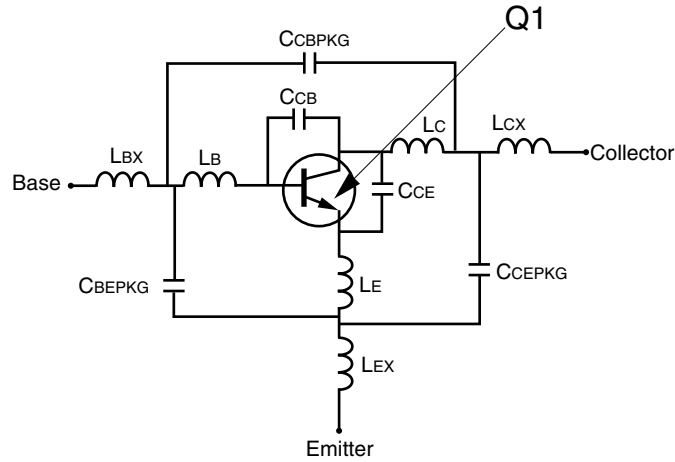
| Parameters | 68833 |
|------------|----------|
| CCB | 0.24e-12 |
| CCE | 0.27e-12 |
| LB | 0.77e-9 |
| LE | 0.95e-9 |
| CCBPKG | 0.15e-12 |
| CCEPKG | 0.1e-12 |
| CBEPKG | 0.1e-12 |
| LBX | 0.3e-9 |
| LCX | 0.4e-9 |
| LEX | 0.3e-9 |

MODEL RANGE

Frequency: 0.05 to 5.0 GHz
 Bias: $V_{CE} = 1\text{ V to }5\text{ V}$, $I_C = 1\text{ mA to }10\text{ mA}$
 Date: 8/03

NE68839 NONLINEAR MODEL

SCHEMATIC



BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|------------|-----------|------------|----------|
| IS | 3.8e-16 | MJC | 0.48 |
| BF | 135.7 | XCJC | 0.56 |
| NF | 1 | CJS | 0 |
| VAF | 28 | VJS | 0.75 |
| IKF | 0.6 | MJS | 0 |
| ISE | 3.8e-15 | FC | 0.75 |
| NE | 1.49 | TF | 11e-12 |
| BR | 12.3 | XTF | 0.36 |
| NR | 1.1 | VTF | 0.65 |
| VAR | 3.5 | ITF | 0.61 |
| IKR | 0.06 | PTF | 50 |
| ISC | 3.5e-16 | TR | 0.032e-9 |
| NC | 1.62 | EG | 1.11 |
| RE | 0.4 | XTB | 0 |
| RB | 6.14 | XTI | 3 |
| RBM | 3.5 | KF | 0 |
| IRB | 0.001 | AF | 1 |
| RC | 4.2 | | |
| CJE | 0.796e-12 | | |
| VJE | 0.71 | | |
| MJE | 0.38 | | |
| CJC | 0.549e-12 | | |
| VJC | 0.65 | | |

(1) Gummel-Poon Model

UNITS

| Parameter | Units |
|-------------|---------|
| time | seconds |
| capacitance | farads |
| inductance | henries |
| resistance | ohms |
| voltage | volts |
| current | amps |

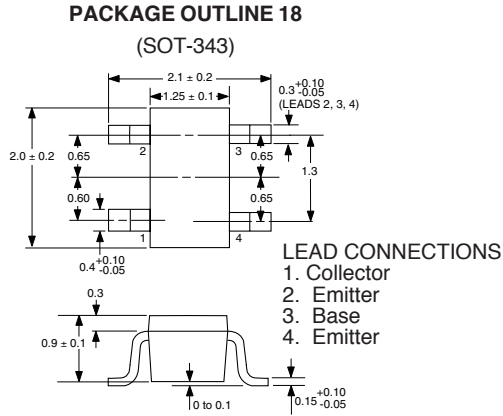
ADDITIONAL PARAMETERS

| Parameters | 68839 |
|------------|-----------|
| CcB | 0.24e-12 |
| CcE | 0.27e-12 |
| Lb | 0.9e-9 |
| Lc | 0.47e-9 |
| Le | 0.6e-9 |
| CcBPKG | 0.085e-12 |
| CcEPKG | 0.07e-12 |
| CbEPKG | 0.01e-12 |
| LbX | 0.39e-9 |
| LcX | 0.39e-9 |
| LEx | 0.2e-9 |

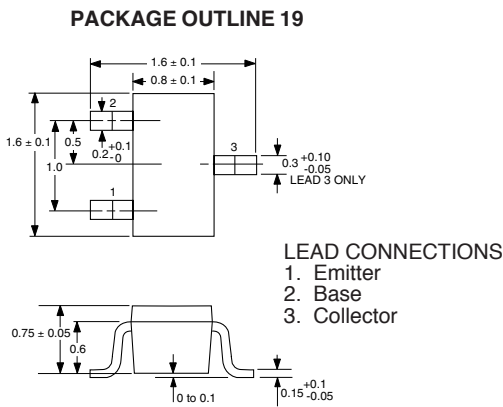
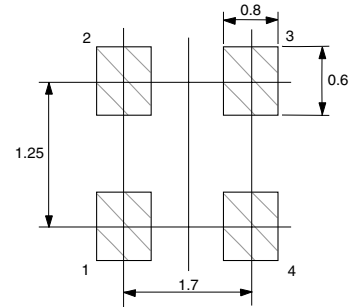
MODEL RANGE

Frequency: 0.05 to 5.0 GHz
 Bias: VCE = 0.5 V to 5 V, IC = 0.5 mA to 10 mA
 Date: 10/3/96

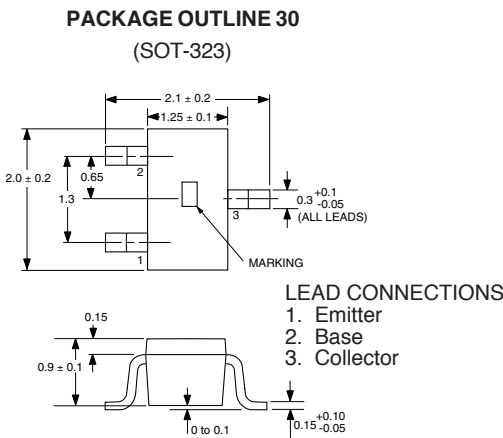
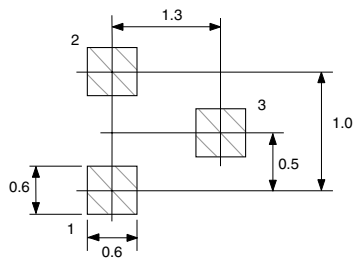
OUTLINE DIMENSIONS (Units in mm)



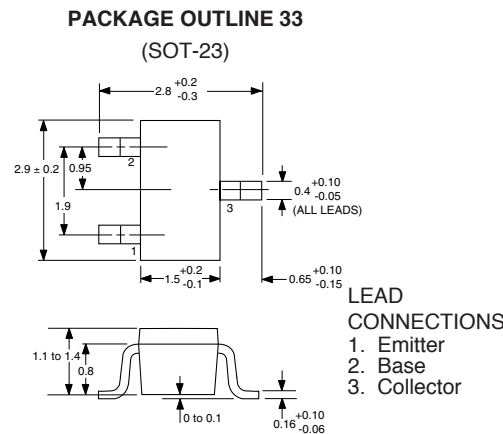
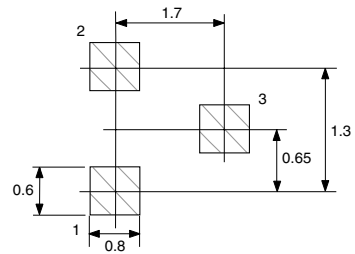
OUTLINE 18
RECOMMENDED P.C.B. LAYOUT



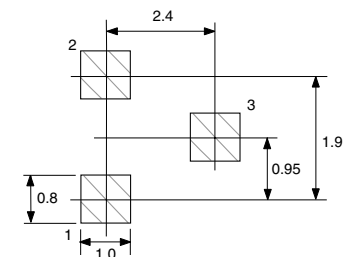
OUTLINE 19
RECOMMENDED P.C.B. LAYOUT



OUTLINE 30
RECOMMENDED P.C.B. LAYOUT

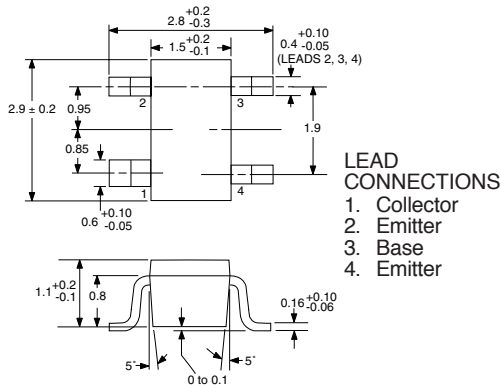


OUTLINE 33
RECOMMENDED P.C.B. LAYOUT



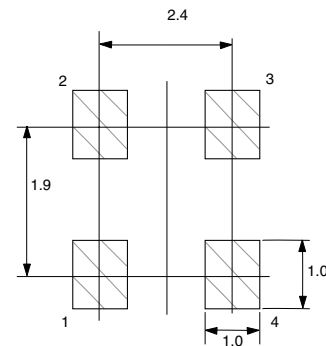
OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE 39
(SOT-143)

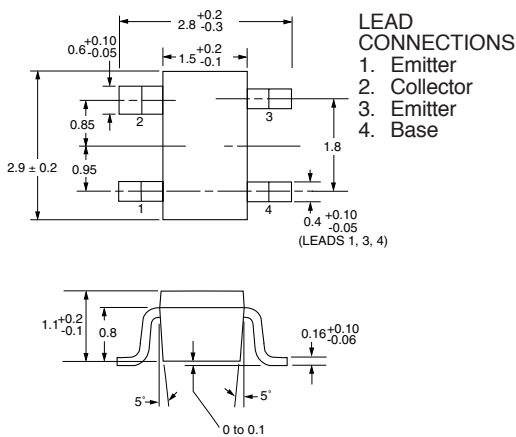


- LEAD CONNECTIONS**
1. Collector
 2. Emitter
 3. Base
 4. Emitter

OUTLINE 39
RECOMMENDED P.C.B. LAYOUT

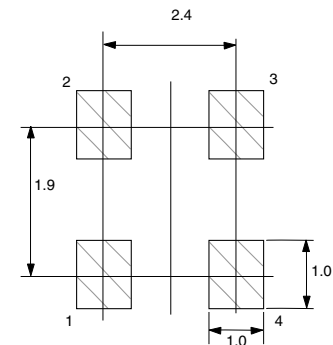


PACKAGE OUTLINE 39R



- LEAD CONNECTIONS**
1. Emitter
 2. Collector
 3. Emitter
 4. Base

OUTLINE 39R
RECOMMENDED P.C.B. LAYOUT



ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKAGING |
|-------------|----------|-------------|
| NE68800 | 100 | Waffle Pack |
| NE68818-T1 | 3000 | Tape & Reel |
| NE68819-T1 | 3000 | Tape & Reel |
| NE68830-T1 | 3000 | Tape & Reel |
| NE68833-T1 | 3000 | Tape & Reel |
| NE68839-T1 | 3000 | Tape & Reel |
| NE68839R-T1 | 3000 | Tape & Reel |

Note:

1. Lead material: Cu
Lead plating: PbSn

Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

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