

## NPN SILICON HIGH FREQUENCY TRANSISTOR

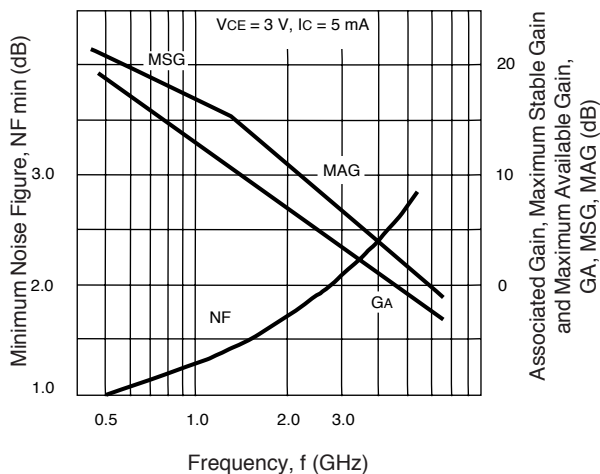
### FEATURES

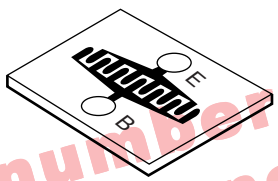
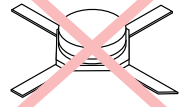
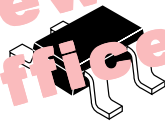
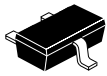
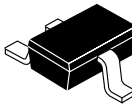
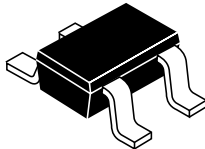
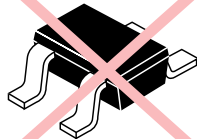
- **HIGH GAIN BANDWIDTH PRODUCT:**  $f_T = 8 \text{ GHz}$
- **LOW NOISE FIGURE:**  
1.2 dB at 1 GHz  
1.6 dB at 2 GHz
- **HIGH ASSOCIATED GAIN:**  
15 dB at 1 GHz  
12 dB at 2 GHz
- **LOW COST**

### DESCRIPTION

The NE681 series of NPN epitaxial silicon transistors are designed for low noise, high gain, low cost amplifier applications. Both the chip and micro-x versions are suitable for amplifier applications up to 4 GHz. The NE681 die is also available in six different low cost plastic surface mount package styles. NE681's unique device characteristics allow you to use a single matching point to simultaneously achieve both low noise and high gain.

**NOISE FIGURE, GAIN MSG  
AND MAG vs. FREQUENCY**



|                                                                                                            |                                                                                                                         |
|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <br>00 (CHIP)            | <br>35 (MICRO-X)                     |
| <br>18 (SOT 343 STYLE)   | <br>19 (3 PIN ULTRA SUPER MINI MOLD) |
| <br>30 (SOT 323 STYLE) | <br>33 (SOT 23 STYLE)              |
| <br>39 (SOT 143 STYLE) | <br>39R (SOT 143R STYLE)           |

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**ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C)

| PART NUMBER<br>EIAJ <sup>1</sup> REGISTERED NUMBER<br>PACKAGE OUTLINE |                                                                                                                                                |            | NE68100<br>00 (CHIP) |          |     | NE68118<br>2SC5012<br>18 |         |     | NE68119<br>2SC5007<br>19 |         |      | NE68130<br>2SC4227<br>30 |           |     |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------|----------|-----|--------------------------|---------|-----|--------------------------|---------|------|--------------------------|-----------|-----|
| SYMBOLS                                                               | PARAMETERS AND CONDITIONS                                                                                                                      | UNITS      | MIN                  | TYP      | MAX | MIN                      | TYP     | MAX | MIN                      | TYP     | MAX  | MIN                      | TYP       | MAX |
| f <sub>T</sub>                                                        | Gain Bandwidth Product at<br>V <sub>CE</sub> = 8 V, I <sub>C</sub> = 20 mA<br>V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA                     | GHz<br>GHz |                      | 9.0      |     |                          | 9.0     |     |                          | 7.0     |      |                          | 7.0       |     |
| NF                                                                    | Noise Figure at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 7 mA,<br>f = 1 GHz<br>f = 2 GHz                                                        | dB<br>dB   |                      | 1.6      | 2.3 |                          | 1.2     | 2.5 |                          | 1.4     | 1.8  |                          | 1.5       | 1.6 |
| GNF                                                                   | Associated Gain at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 7 mA,<br>f = 1 GHz<br>f = 2 GHz                                                     | dB<br>dB   |                      | 12       |     |                          | 14      |     |                          | 14      | 10   |                          | 13.5      | 9   |
| IS <sub>21EI</sub> <sup>2</sup>                                       | Insertion Power Gain at<br>V <sub>CE</sub> = 8 V, I <sub>C</sub> = 20 mA, f = 1 GHz<br>f = 2 GHz                                               | dB<br>dB   | 9                    | 17<br>11 |     | 13                       | 15<br>9 |     |                          | 14<br>8 |      |                          | 13<br>7.5 |     |
| h <sub>FE</sub>                                                       | Forward Current Gain <sup>2</sup> at<br>V <sub>CE</sub> = 8 V, I <sub>C</sub> = 20 mA<br>V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA          |            | 50                   | 100      | 250 | 50                       | 100     | 250 | 80                       |         | 160  | 40                       |           | 240 |
| I <sub>CBO</sub>                                                      | Collector Cutoff Current at<br>V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0 mA                                                                   | μA         |                      |          | 1.0 |                          |         | 1.0 |                          |         | 1.0  |                          |           | 1.0 |
| I <sub>EBO</sub>                                                      | Emitter Cutoff Current at<br>V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA                                                                      | μA         |                      |          | 1.0 |                          |         | 1.0 |                          |         | 1.0  |                          |           | 1.0 |
| C <sub>RE</sub> <sup>3</sup>                                          | Feedback Capacitance at<br>V <sub>CB</sub> = 3 V, I <sub>E</sub> = 0 mA, f = 1 MHz<br>V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0 mA, f = 1 MHz | pF<br>pF   |                      | 0.2      | 0.7 |                          | 0.25    | 0.8 |                          | 0.45    | 0.9  |                          | 0.45      | 0.9 |
| R <sub>TH</sub> (J-A)                                                 | Thermal Resistance (Junction to Ambient)                                                                                                       | °C/W       |                      |          | 80  |                          |         | 833 |                          |         | 1000 |                          |           | 833 |
| P <sub>T</sub>                                                        | Total Power Dissipation                                                                                                                        | mW         |                      |          | 600 |                          |         | 150 |                          |         | 100  |                          |           | 150 |

**ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C)

| PART NUMBER<br>EIAJ <sup>1</sup> REGISTERED NUMBER<br>PACKAGE OUTLINE |                                                                                                                                    |            | NE68133<br>2SC3583<br>33 |      |           | NE68135<br>2SC3604<br>35 |     |     | NE68139/39R<br>2SC4094<br>39 |           |     |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------------|------|-----------|--------------------------|-----|-----|------------------------------|-----------|-----|
| SYMBOLS                                                               | PARAMETERS AND CONDITIONS                                                                                                          | UNITS      | MIN                      | TYP  | MAX       | MIN                      | TYP | MAX | MIN                          | TYP       | MAX |
| f <sub>T</sub>                                                        | Gain Bandwidth Product at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 20 mA<br>V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA            | GHz<br>GHz |                          | 9.0  |           |                          | 9.0 |     |                              | 9.0       |     |
| NF                                                                    | Noise Figure at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 7 mA, f = 1 GHz<br>f = 2 GHz                                               | dB<br>dB   |                          | 1.2  | 2         |                          | 1.6 | 2.3 |                              | 1.2       | 2   |
| GNF                                                                   | Associated Gain at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 7 mA,<br>f = 1 GHz<br>f = 2 GHz                                         | dB<br>dB   |                          | 13   |           |                          | 12  |     |                              | 13.5      |     |
| IS <sub>21EI</sub> <sup>2</sup>                                       | Insertion Power Gain at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 20 mA,<br>f = 1 GHz<br>f = 2 GHz                                   | dB<br>dB   |                          | 11   | 12.5<br>7 | 9                        | 11  |     |                              | 15<br>8.5 |     |
| h <sub>FE</sub>                                                       | Forward Current Gain <sup>2</sup> at V <sub>CE</sub> = 8 V, I <sub>C</sub> = 20 mA<br>V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA |            | 50                       | 100  | 250       | 50                       | 100 | 250 | 50                           | 100       | 200 |
| I <sub>CBO</sub>                                                      | Collector Cutoff Current at V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0 mA                                                          | μA         |                          |      | 1.0       |                          |     | 1.0 |                              |           | 1.0 |
| I <sub>EBO</sub>                                                      | Emitter Cutoff Current at V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA                                                             | μA         |                          |      | 1.0       |                          |     | 1.0 |                              |           | 1.0 |
| C <sub>RE</sub> <sup>3</sup>                                          | Feedback Capacitance at<br>V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0 mA, f = 1 MHz                                                | pF         |                          | 0.35 | 0.9       |                          | 0.2 | 0.7 |                              | 0.25      | 0.8 |
| R <sub>TH</sub> (J-A)                                                 | Thermal Resistance (Junction to Ambient)                                                                                           | °C/W       |                          |      | 625       |                          |     | 590 |                              |           | 625 |
| P <sub>T</sub>                                                        | Total Power Dissipation                                                                                                            | mW         |                          |      | 200       |                          |     | 295 |                              |           | 200 |

## Notes:

- Electronic Industrial Association of Japan.
- Pulsed (PW ≤ 350 ms, duty cycle ≤ 2 %).
- The emitter terminal should be connected to the ground terminal of the 3 terminal capacitance bridge.

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** ( $T_A = 25^\circ\text{C}$ )

| SYMBOLS          | PARAMETERS                     | UNITS | RATINGS                  |
|------------------|--------------------------------|-------|--------------------------|
| V <sub>CB0</sub> | Collector to Base Voltage      | V     | 20                       |
| V <sub>CE0</sub> | Collector to Emitter Voltage   | V     | 10                       |
| V <sub>EB0</sub> | Emitter to Base Voltage        | V     | 1.5                      |
| I <sub>C</sub>   | Collector Current              | mA    | 65                       |
| T <sub>J</sub>   | Operating Junction Temperature | °C    | 150 <sup>2</sup>         |
| T <sub>STG</sub> | Storage Temperature            | °C    | -55 to +150 <sup>3</sup> |

Notes:

1. Operation in excess of any one of these parameters may result in permanent damage.
2. T<sub>J</sub> for NE68135 and NE68100 is 200°C.
3. Maximum storage temperature for the NE68135 is -65 to +150°C.

**NE68119****TYPICAL NOISE PARAMETERS** ( $T_A = 25^\circ\text{C}$ )

| FREQ.<br>(MHz)           | NF <sub>OPT</sub><br>(dB) | GA<br>(dB) | Γ <sub>OPT</sub> |      | Rn/50 |
|--------------------------|---------------------------|------------|------------------|------|-------|
|                          |                           |            | MAG              | ANG  |       |
| VCE = 2.5 V, IC = 0.3 mA |                           |            |                  |      |       |
| 500                      | 1.24                      | 9.26       | 0.73             | 42   | 1.70  |
| 800                      | 1.67                      | 6.95       | 0.74             | 72   | 1.01  |
| 1000                     | 2.18                      | 6.02       | 0.70             | 90   | 0.78  |
| VCE = 2.5 V, IC = 1 mA   |                           |            |                  |      |       |
| 500                      | 0.97                      | 13.86      | 0.66             | 43   | 0.46  |
| 800                      | 1.19                      | 9.12       | 0.59             | 48   | 0.35  |
| 1000                     | 1.31                      | 10.09      | 0.56             | 89   | 0.30  |
| 1500                     | 1.71                      | 7.99       | 0.50             | 131  | 0.16  |
| VCE = 2.5 V, IC = 3 mA   |                           |            |                  |      |       |
| 500                      | 0.92                      | 17.19      | 0.49             | 39   | 0.28  |
| 800                      | 1.02                      | 14.23      | 0.40             | 68   | 0.17  |
| 1000                     | 1.11                      | 12.78      | 0.38             | 87   | 0.14  |
| 1500                     | 1.42                      | 10.30      | 0.39             | 134  | 0.08  |
| 2000                     | 1.82                      | 8.24       | 0.36             | 165  | 0.11  |
| VCE = 3 V, IC = 5 mA     |                           |            |                  |      |       |
| 500                      | 1.00                      | 19.00      | 0.37             | 43   | 0.20  |
| 800                      | 1.10                      | 15.57      | 0.31             | 71   | 0.15  |
| 1000                     | 1.19                      | 13.91      | 0.30             | 89   | 0.13  |
| 1500                     | 1.40                      | 11.25      | 0.33             | 139  | 0.09  |
| 2000                     | 1.70                      | 9.08       | 0.32             | 166  | 0.11  |
| 2500                     | 2.05                      | 7.62       | 0.36             | -163 | 0.13  |
| VCE = 8 V, IC = 7 mA     |                           |            |                  |      |       |
| 500                      | 1.10                      | 20.30      | 0.36             | 39   | 0.22  |
| 800                      | 1.20                      | 16.82      | 0.28             | 64   | 0.16  |
| 1000                     | 1.30                      | 15.10      | 0.28             | 81   | 0.14  |
| 1500                     | 1.50                      | 12.35      | 0.28             | 130  | 0.11  |
| 2000                     | 1.77                      | 10.21      | 0.28             | 158  | 0.12  |
| 2500                     | 2.10                      | 8.85       | 0.33             | -166 | 0.14  |
| 3000                     | 2.40                      | 7.86       | 0.44             | -141 | 0.16  |

**NE68100****TYPICAL NOISE PARAMETERS** ( $T_A = 25^\circ\text{C}$ )

| FREQ.<br>(MHz)                               | N <sub>F<sub>OPT</sub></sub><br>(dB) | G <sub>A</sub><br>(dB) | Γ <sub>OPT</sub> |      | Rn/50 |
|----------------------------------------------|--------------------------------------|------------------------|------------------|------|-------|
|                                              |                                      |                        | MAG              | ANG  |       |
| V <sub>CE</sub> = 8 V, I <sub>c</sub> = 7 mA |                                      |                        |                  |      |       |
| 500                                          | 1.3                                  | 26.42                  | 0.20             | 91   | 0.20  |
| 1000                                         | 1.45                                 | 20.54                  | 0.20             | 148  | 0.21  |
| 2000                                         | 2.1                                  | 14.41                  | 0.22             | 178  | 0.51  |
| 4000                                         | 3.25                                 | 7.76                   | 0.42             | -115 | 0.85  |

**NE68130****TYPICAL NOISE PARAMETERS** ( $T_A = 25^\circ\text{C}$ )

| FREQ.<br>(MHz)           | NFOPT<br>(dB) | GA<br>(dB) | ΓOPT |      | Rn/50 |
|--------------------------|---------------|------------|------|------|-------|
|                          |               |            | MAG  | ANG  |       |
| VCE = 2.5 V, IC = 0.3 mA |               |            |      |      |       |
| 500                      | 1.48          | 10.23      | 0.74 | 43   | 1.35  |
| 800                      | 1.90          | 10.15      | 0.72 | 79   | 0.92  |
| 1000                     | 2.15          | 9.00       | 0.69 | 99   | 0.60  |
| 1500                     | 2.70          | 4.46       | 0.66 | 126  | 0.38  |
| VCE = 2.5 V, IC = 1 mA   |               |            |      |      |       |
| 500                      | 1.10          | 14.69      | 0.65 | 45   | 0.42  |
| 800                      | 1.26          | 12.73      | 0.60 | 80   | 0.30  |
| 1000                     | 1.40          | 11.29      | 0.56 | 99   | 0.24  |
| 1500                     | 1.80          | 7.40       | 0.53 | 123  | 0.17  |
| 2000                     | 2.22          | 6.14       | 0.47 | 166  | 0.12  |
| 2500                     | 2.75          | 4.89       | 0.49 | -166 | 0.08  |
| VCE = 2.5 V, IC = 3 mA   |               |            |      |      |       |
| 500                      | 1.00          | 17.28      | 0.47 | 44   | 0.25  |
| 800                      | 1.06          | 14.35      | 0.44 | 83   | 0.21  |
| 1000                     | 1.16          | 12.69      | 0.43 | 100  | 0.17  |
| 1500                     | 1.46          | 9.50       | 0.39 | 130  | 0.12  |
| 2000                     | 1.80          | 7.70       | 0.35 | 177  | 0.11  |
| 2500                     | 2.15          | 6.03       | 0.35 | -177 | 0.09  |
| VCE = 8 V, IC = 7mA      |               |            |      |      |       |
| 500                      | 1.30          | 20.34      | 0.29 | 50   | 0.27  |
| 1000                     | 1.40          | 13.96      | 0.25 | 84   | 0.18  |
| 2000                     | 1.80          | 8.56       | 0.25 | 155  | 0.16  |
| 3000                     | 2.50          | 5.64       | 0.48 | -167 | 0.10  |
| 4000                     | 3.60          | 4.50       | 0.67 | -135 | 0.20  |

**NE68135****TYPICAL NOISE PARAMETERS** ( $T_A = 25^\circ\text{C}$ )

| FREQ.<br>(MHz)                               | NF <sub>OPT</sub><br>(dB) | G <sub>A</sub><br>(dB) | Γ <sub>OPT</sub> |      | Rn/50 |
|----------------------------------------------|---------------------------|------------------------|------------------|------|-------|
|                                              |                           |                        | MAG              | ANG  |       |
| V <sub>CE</sub> = 8 V, I <sub>c</sub> = 7 mA |                           |                        |                  |      |       |
| 1000                                         | 1.1                       | 17.33                  | 0.28             | 71   | 0.22  |
| 2000                                         | 1.6                       | 13.60                  | 0.37             | 160  | 0.15  |
| 4000                                         | 3.4                       | 9.25                   | 0.51             | -139 | 0.27  |

## NE68133

TYPICAL NOISE PARAMETERS ( $T_A = 25^\circ\text{C}$ )

| FREQ.<br>(MHz)                                   | NF <sub>OPT</sub><br>(dB) | GA<br>(dB) | Γ <sub>OPT</sub> |     | Rn/50 |
|--------------------------------------------------|---------------------------|------------|------------------|-----|-------|
|                                                  |                           |            | MAG              | ANG |       |
| V <sub>CE</sub> = 2.5 V, I <sub>c</sub> = 0.3 mA |                           |            |                  |     |       |
| 500                                              | 1.21                      | 12.45      | 0.75             | 47  | 1.15  |
| 800                                              | 1.69                      | 7.72       | 0.74             | 72  | 0.97  |
| 1000                                             | 1.95                      | 5.96       | 0.68             | 88  | 0.71  |
| 1500                                             | 2.52                      | 3.12       | 0.63             | 122 | 0.34  |
| V <sub>CE</sub> = 2.5 V, I <sub>c</sub> = 1.0 mA |                           |            |                  |     |       |
| 500                                              | .92                       | 14.52      | 0.68             | 47  | 0.42  |
| 800                                              | 1.20                      | 10.57      | 0.63             | 70  | 0.34  |
| 1000                                             | 1.35                      | 9.29       | 0.57             | 87  | 0.30  |
| 1500                                             | 1.71                      | 6.53       | 0.50             | 120 | 0.17  |
| 2000                                             | 2.00                      | 5.53       | 0.44             | 168 | 0.11  |
| V <sub>CE</sub> = 2.5 V, I <sub>c</sub> = 3 mA   |                           |            |                  |     |       |
| 500                                              | 0.86                      | 16.37      | 0.54             | 47  | 0.24  |
| 800                                              | 1.00                      | 12.41      | 0.51             | 67  | 0.20  |
| 1000                                             | 1.08                      | 11.07      | 0.46             | 86  | 0.18  |
| 1500                                             | 1.25                      | 8.61       | 0.36             | 128 | 0.12  |
| 2000                                             | 1.40                      | 6.99       | 0.35             | 172 | 0.10  |

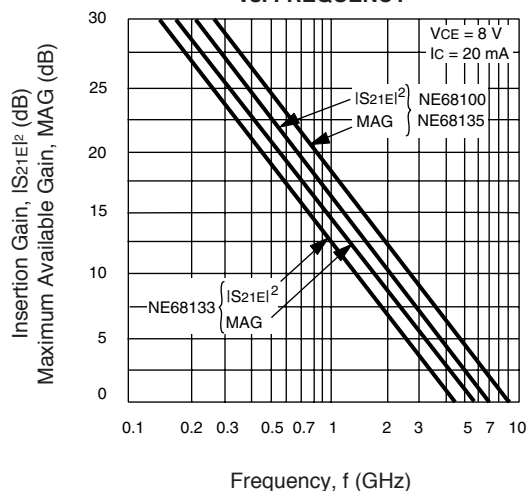
## NE68139

TYPICAL NOISE PARAMETERS ( $T_A = 25^\circ\text{C}$ )

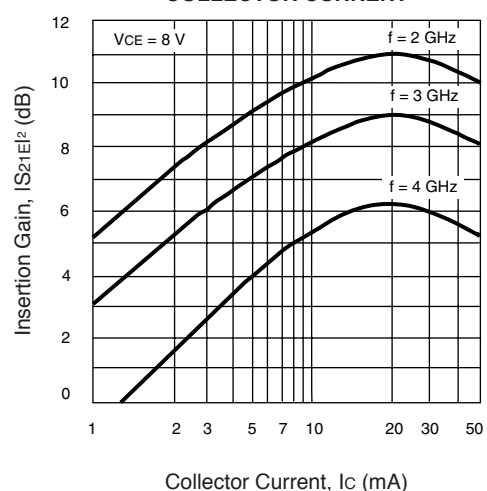
| FREQ.<br>(MHz)                                   | NF <sub>OPT</sub><br>(dB) | GA<br>(dB) | Γ <sub>OPT</sub> |      | Rn/50 |
|--------------------------------------------------|---------------------------|------------|------------------|------|-------|
|                                                  |                           |            | MAG              | ANG  |       |
| V <sub>CE</sub> = 2.5 V, I <sub>C</sub> = 0.3 mA |                           |            |                  |      |       |
| 500                                              | 1.20                      | 14.10      | 0.78             | 47   | 1.28  |
| 800                                              | 1.45                      | 8.42       | 0.75             | 72   | 0.84  |
| 1000                                             | 1.67                      | 8.37       | 0.68             | 95   | 0.56  |
| V <sub>CE</sub> = 2.5 V, I <sub>C</sub> = 1 mA   |                           |            |                  |      |       |
| 500                                              | 0.90                      | 15.71      | 0.63             | 44   | 0.43  |
| 800                                              | 1.10                      | 12.30      | 0.56             | 72   | 0.26  |
| 1000                                             | 1.26                      | 11.66      | 0.53             | 98   | 0.20  |
| 1500                                             | 1.70                      | 8.85       | 0.49             | 145  | 0.12  |
| 2000                                             | 2.20                      | 7.12       | 0.57             | 178  | 0.07  |
| V <sub>CE</sub> = 2.5 V, I <sub>C</sub> = 3 mA   |                           |            |                  |      |       |
| 500                                              | 0.88                      | 18.20      | 0.45             | 44   | 0.25  |
| 800                                              | 1.00                      | 14.62      | 0.39             | 73   | 0.19  |
| 1000                                             | 1.08                      | 13.29      | 0.37             | 99   | 0.16  |
| 1500                                             | 1.30                      | 10.54      | 0.35             | 151  | 0.09  |
| 2000                                             | 1.80                      | 8.60       | 0.43             | -177 | 0.07  |
| V <sub>CE</sub> = 8 V, I <sub>C</sub> = 7 mA     |                           |            |                  |      |       |
| 500                                              | 1.15                      | 20.50      | 0.26             | 42   | 0.17  |
| 1000                                             | 1.25                      | 15.62      | 0.16             | 133  | 0.14  |
| 1500                                             | 1.4                       | 12.49      | 0.20             | 176  | 0.09  |
| 2000                                             | 1.6                       | 10.48      | 0.31             | -165 | 0.14  |
| 3000                                             | 2.15                      | 8.00       | 0.53             | -123 | 0.48  |
| 4000                                             | 3.0                       | 6.81       | 0.71             | -101 | 0.90  |

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

FORWARD INSERTION GAIN  
AND MAXIMUM AVAILABLE GAIN  
vs. FREQUENCY

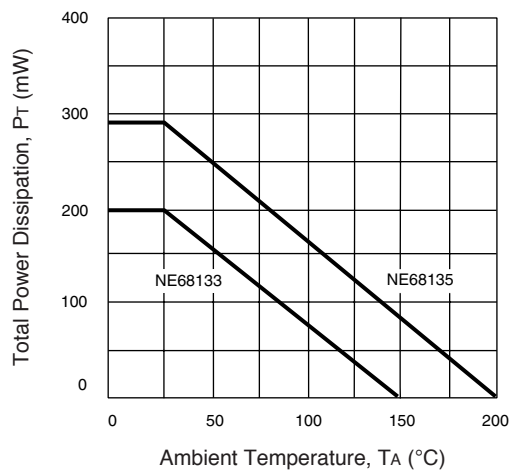


NE68100 & NE68135  
INSERTION GAIN vs.  
COLLECTOR CURRENT

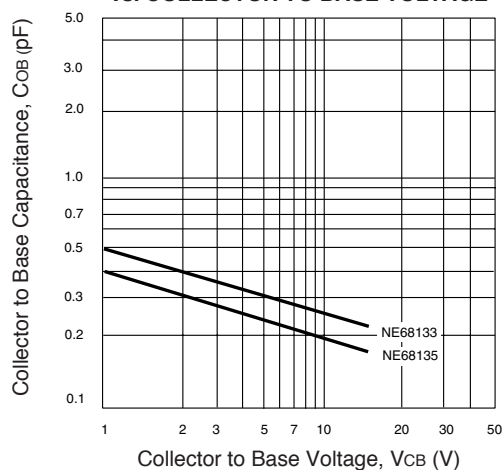


**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )

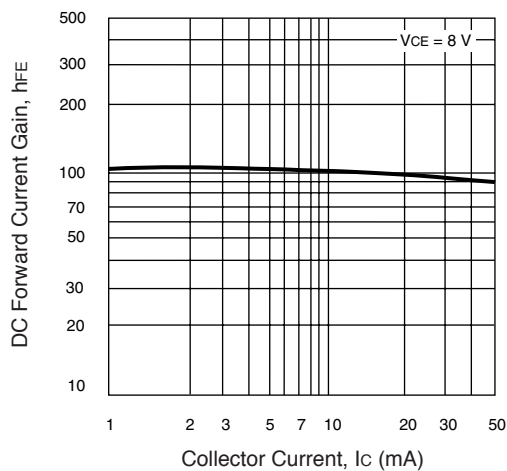
**DC POWER DERATING CURVES**



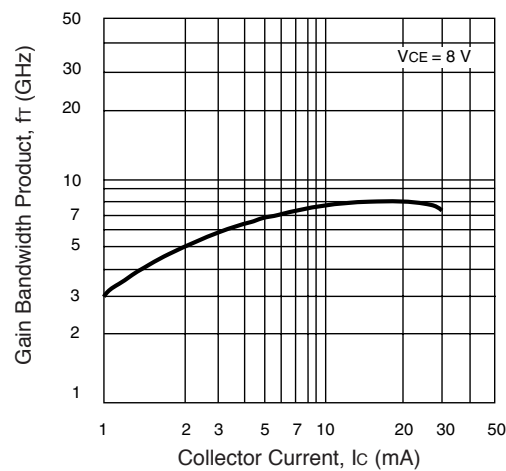
**COLLECTOR TO BASE CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE**



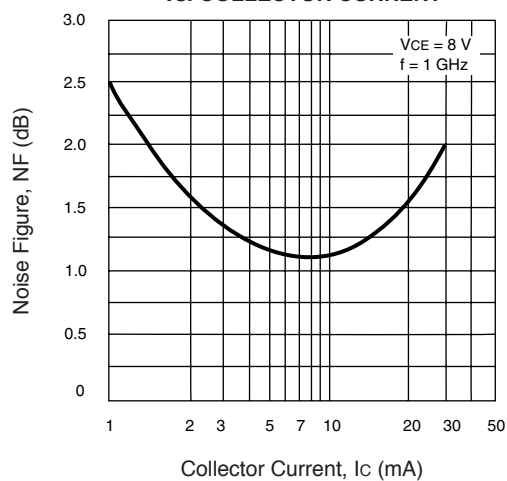
**FORWARD CURRENT GAIN vs. COLLECTOR CURRENT**



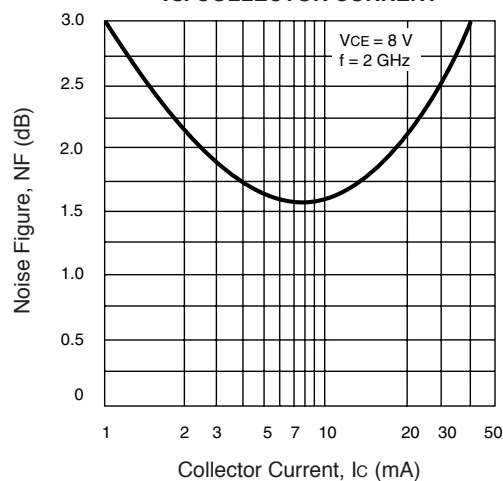
**GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT**



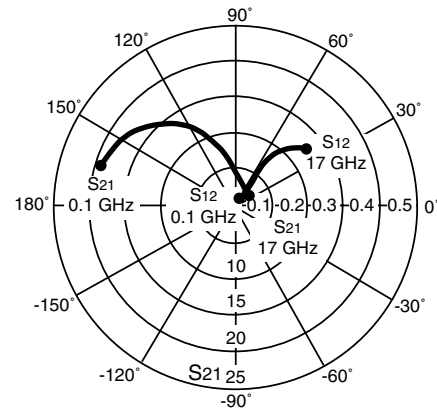
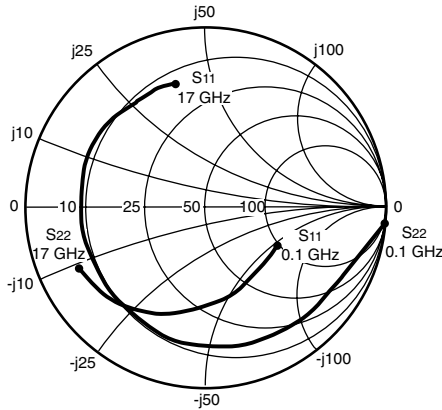
**NE68133 NOISE FIGURE vs. COLLECTOR CURRENT**



**NE68100 & NE68135 NOISE FIGURE vs. COLLECTOR CURRENT**



## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



## NE68100

VCE = 8 V, IC = 7 mA

| FREQUENCY | S11   |        | S21    |       | S12   |      | S22   |        | K    | MAG <sup>1</sup> |
|-----------|-------|--------|--------|-------|-------|------|-------|--------|------|------------------|
| (MHz)     | MAG   | ANG    | MAG    | ANG   | MAG   | ANG  | MAG   | ANG    |      | (dB)             |
| 100       | 0.827 | -20.8  | 19.513 | 163.9 | 0.012 | 88.3 | 0.964 | -7.0   | 0.03 | 32.1             |
| 200       | 0.809 | -49.5  | 17.981 | 151.0 | 0.022 | 65.5 | 0.894 | -16.8  | 0.13 | 29.1             |
| 500       | 0.742 | -101.1 | 12.631 | 123.0 | 0.038 | 42.2 | 0.691 | -27.4  | 0.28 | 25.2             |
| 1000      | 0.701 | -139.2 | 7.498  | 101.5 | 0.047 | 36.7 | 0.536 | -29.0  | 0.47 | 22.0             |
| 1500      | 0.689 | -156.6 | 5.182  | 90.4  | 0.049 | 33.0 | 0.483 | -28.6  | 0.71 | 20.2             |
| 2000      | 0.686 | -167.2 | 3.959  | 82.0  | 0.053 | 35.0 | 0.461 | -29.2  | 0.88 | 18.7             |
| 3000      | 0.687 | 179.8  | 2.687  | 69.7  | 0.061 | 45.9 | 0.447 | -33.6  | 1.11 | 14.4             |
| 4000      | 0.693 | 172.2  | 2.048  | 59.1  | 0.071 | 48.7 | 0.449 | -40.6  | 1.21 | 11.8             |
| 5000      | 0.699 | 166.6  | 1.662  | 49.8  | 0.081 | 53.2 | 0.454 | -48.0  | 1.27 | 10.0             |
| 6000      | 0.708 | 162.1  | 1.431  | 41.1  | 0.096 | 57.0 | 0.473 | -57.1  | 1.15 | 9.4              |
| 7000      | 0.717 | 157.0  | 1.250  | 31.7  | 0.116 | 56.6 | 0.490 | -66.8  | 0.99 | 10.3             |
| 8000      | 0.721 | 151.7  | 1.105  | 23.3  | 0.125 | 56.9 | 0.519 | -76.0  | 0.97 | 9.5              |
| 9000      | 0.725 | 145.5  | 0.989  | 14.2  | 0.146 | 55.9 | 0.549 | -86.4  | 0.83 | 8.3              |
| 10000     | 0.726 | 137.6  | 0.868  | 5.9   | 0.169 | 54.9 | 0.582 | -96.0  | 0.74 | 7.1              |
| 11000     | 0.724 | 131.2  | 0.773  | -2.0  | 0.179 | 51.9 | 0.621 | -104.8 | 0.71 | 6.4              |
| 12000     | 0.722 | 123.6  | 0.673  | -9.7  | 0.192 | 49.0 | 0.663 | -114.1 | 0.69 | 5.4              |

## VCE = 8 V, IC = 20 mA

|       |       |        |        |       |       |      |       |        |      |      |
|-------|-------|--------|--------|-------|-------|------|-------|--------|------|------|
| 100   | 0.665 | -47.0  | 38.130 | 154.1 | 0.011 | 90.0 | 0.885 | -15.0  | 0.01 | 35.4 |
| 200   | 0.664 | -85.3  | 31.089 | 135.9 | 0.017 | 70.3 | 0.753 | -26.0  | 0.12 | 32.6 |
| 500   | 0.663 | -135.8 | 16.975 | 108.9 | 0.025 | 45.4 | 0.504 | -30.8  | 0.45 | 28.3 |
| 1000  | 0.663 | -161.1 | 9.066  | 93.2  | 0.028 | 49.5 | 0.404 | -27.0  | 0.82 | 25.1 |
| 1500  | 0.667 | -171.7 | 6.113  | 84.9  | 0.036 | 49.6 | 0.377 | -26.3  | 0.97 | 22.3 |
| 2000  | 0.669 | -178.4 | 4.627  | 78.3  | 0.042 | 53.2 | 0.369 | -26.6  | 1.10 | 18.5 |
| 3000  | 0.676 | 172.7  | 3.112  | 67.9  | 0.054 | 59.2 | 0.361 | -31.6  | 1.25 | 14.6 |
| 4000  | 0.686 | 167.3  | 2.361  | 58.6  | 0.071 | 62.6 | 0.362 | -38.5  | 1.21 | 12.5 |
| 5000  | 0.693 | 162.6  | 1.913  | 50.1  | 0.086 | 63.5 | 0.372 | -45.8  | 1.19 | 10.8 |
| 6000  | 0.705 | 159.0  | 1.643  | 42.2  | 0.103 | 65.1 | 0.386 | -55.5  | 1.08 | 10.3 |
| 7000  | 0.719 | 154.5  | 1.433  | 33.3  | 0.123 | 63.2 | 0.405 | -65.0  | 0.94 | 10.7 |
| 8000  | 0.727 | 149.4  | 1.266  | 25.4  | 0.133 | 60.6 | 0.433 | -74.2  | 0.91 | 9.8  |
| 9000  | 0.726 | 143.5  | 1.134  | 16.7  | 0.153 | 60.4 | 0.464 | -84.5  | 0.84 | 8.7  |
| 10000 | 0.733 | 135.9  | 1.001  | 8.4   | 0.171 | 57.3 | 0.500 | -94.4  | 0.76 | 7.7  |
| 11000 | 0.732 | 129.4  | 0.897  | 0.5   | 0.185 | 53.9 | 0.546 | -103.2 | 0.71 | 6.9  |
| 12000 | 0.728 | 122.1  | 0.787  | -7.1  | 0.197 | 51.8 | 0.587 | -112.6 | 0.72 | 6.0  |

S-Parameters include bond wires.

BASE: Total 1 wire (s), 1 per bond pad, 0.0122" (309 μm) long each wire.

COLLECTOR: Total 1 wire (s), 1 per bond pad, 0.008" (203 μm) long each wire.

EMITTER: Total 2 wire (s), 1 per side, 0.0194" (494 μm) long each wire.

WIRE: 0.0007" (17.7 μm) dia., gold.

Note:

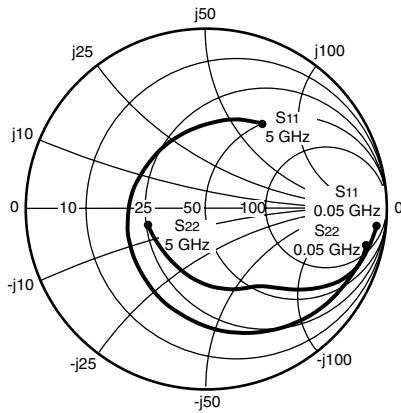
1. Gain Calculations:

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

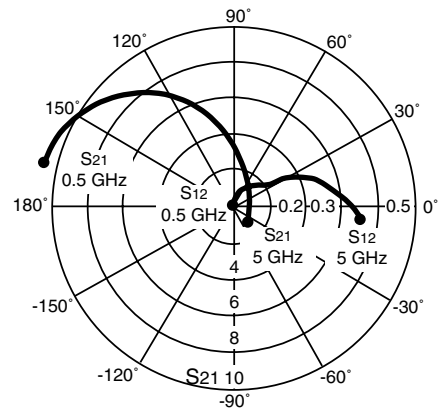
MAG = Maximum Available Gain

MSG = Maximum Stable Gain

## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms  
Frequency in GHz  
(V<sub>CE</sub> = 2.5 V, I<sub>C</sub> = 3 mA)



## NE68119

V<sub>CE</sub> = 2.5 V, I<sub>C</sub> = 0.3 mA

| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |       | S <sub>22</sub> |       | K    | MAG <sup>1</sup> |
|-----------|-----------------|--------|-----------------|-------|-----------------|-------|-----------------|-------|------|------------------|
| (MHz)     | MAG             | ANG    | MAG             | ANG   | MAG             | ANG   | MAG             | ANG   |      | (dB)             |
| 50        | 0.995           | -6.1   | 1.283           | 174.1 | 0.017           | 88.1  | 0.997           | -1.1  | 0.02 | 18.8             |
| 100       | 0.992           | -11.9  | 1.081           | 170.4 | 0.027           | 80.9  | 0.995           | -4.5  | 0.06 | 16.0             |
| 200       | 0.981           | -23.5  | 1.038           | 158.4 | 0.052           | 74.0  | 0.991           | -9.3  | 0.11 | 13.0             |
| 300       | 0.967           | -35.3  | 1.021           | 149.2 | 0.078           | 65.0  | 0.989           | -14.3 | 0.15 | 11.2             |
| 400       | 0.950           | -46.1  | 0.985           | 139.2 | 0.096           | 58.4  | 0.979           | -18.2 | 0.20 | 10.1             |
| 500       | 0.929           | -57.0  | 0.952           | 130.0 | 0.114           | 52.4  | 0.962           | -22.5 | 0.23 | 9.2              |
| 600       | 0.915           | -67.0  | 0.936           | 121.0 | 0.130           | 44.5  | 0.948           | -26.4 | 0.30 | 8.6              |
| 700       | 0.892           | -77.0  | 0.888           | 112.7 | 0.144           | 38.5  | 0.937           | -30.1 | 0.33 | 7.9              |
| 800       | 0.874           | -86.0  | 0.869           | 105.0 | 0.153           | 32.7  | 0.928           | -33.9 | 0.36 | 7.5              |
| 900       | 0.853           | -94.5  | 0.808           | 97.2  | 0.160           | 27.3  | 0.916           | -37.1 | 0.42 | 7.0              |
| 1000      | 0.838           | -102.9 | 0.784           | 90.6  | 0.165           | 21.8  | 0.908           | -40.5 | 0.45 | 6.8              |
| 1500      | 0.770           | -139.2 | 0.652           | 61.2  | 0.169           | 1.6   | 0.869           | -54.5 | 0.66 | 5.9              |
| 2000      | 0.723           | -170.6 | 0.564           | 39.0  | 0.146           | -12.7 | 0.842           | -66.5 | 0.95 | 5.9              |
| 3000      | 0.693           | 132.2  | 0.441           | 9.0   | 0.085           | 6.0   | 0.803           | -91.2 | 1.98 | 1.5              |

V<sub>CE</sub> = 2.5 V, I<sub>C</sub> = 1.0 mA

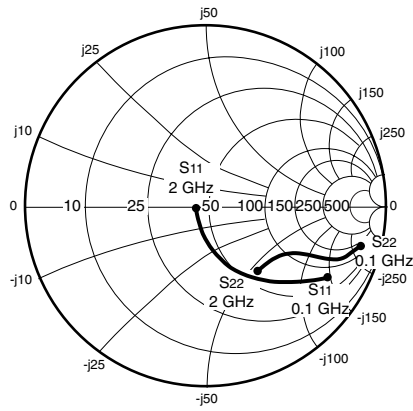
| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |       | K    | MAG <sup>1</sup> |
|-----------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|------|------------------|
| (MHz)     | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG   |      | (dB)             |
| 50        | 0.979           | -8.4   | 4.317           | 172.8 | 0.016           | 87.7 | 0.990           | -1.3  | 0.04 | 24.3             |
| 100       | 0.965           | -15.9  | 3.510           | 166.3 | 0.026           | 77.4 | 0.986           | -7.5  | 0.10 | 21.3             |
| 200       | 0.944           | -30.0  | 3.384           | 155.6 | 0.049           | 71.9 | 0.971           | -13.0 | 0.09 | 18.4             |
| 300       | 0.915           | -44.6  | 3.234           | 145.3 | 0.069           | 60.3 | 0.949           | -19.4 | 0.15 | 16.7             |
| 400       | 0.877           | -57.8  | 3.069           | 134.8 | 0.090           | 54.9 | 0.918           | -24.6 | 0.17 | 15.3             |
| 500       | 0.836           | -70.1  | 2.855           | 125.6 | 0.104           | 45.7 | 0.883           | -29.1 | 0.25 | 14.4             |
| 600       | 0.802           | -81.8  | 2.671           | 116.9 | 0.115           | 40.8 | 0.850           | -33.4 | 0.28 | 13.7             |
| 700       | 0.770           | -92.3  | 2.502           | 109.0 | 0.122           | 34.6 | 0.822           | -37.2 | 0.33 | 13.1             |
| 800       | 0.741           | -102.0 | 2.341           | 102.0 | 0.127           | 29.9 | 0.798           | -40.6 | 0.38 | 12.7             |
| 900       | 0.714           | -110.7 | 2.195           | 95.1  | 0.133           | 25.9 | 0.778           | -43.4 | 0.43 | 12.2             |
| 1000      | 0.694           | -118.7 | 2.041           | 89.4  | 0.135           | 21.6 | 0.762           | -46.4 | 0.48 | 11.8             |
| 1500      | 0.616           | -153.7 | 1.547           | 63.8  | 0.132           | 9.1  | 0.706           | -58.1 | 0.75 | 10.7             |
| 2000      | 0.572           | 177.3  | 1.255           | 43.4  | 0.124           | 6.7  | 0.672           | -68.2 | 1.07 | 8.4              |
| 3000      | 0.555           | 125.5  | 0.940           | 10.4  | 0.132           | 20.2 | 0.627           | -89.7 | 1.41 | 4.7              |

V<sub>CE</sub> = 2.5 V, I<sub>C</sub> = 3 mA

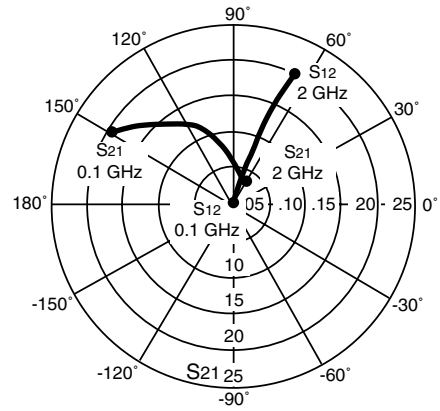
| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |       | K    | MAG <sup>1</sup> |
|-----------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|------|------------------|
| (MHz)     | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG   |      | (dB)             |
| 50        | 0.937           | -13.0  | 10.816          | 167.8 | 0.014           | 85.2 | 0.970           | -5.3  | 0.08 | 28.9             |
| 100       | 0.904           | -22.9  | 9.618           | 161.4 | 0.023           | 76.5 | 0.955           | -12.0 | 0.10 | 26.2             |
| 200       | 0.839           | -44.6  | 8.856           | 145.9 | 0.044           | 65.5 | 0.907           | -21.5 | 0.16 | 23.0             |
| 300       | 0.771           | -63.4  | 7.858           | 133.0 | 0.061           | 55.3 | 0.830           | -29.5 | 0.25 | 21.1             |
| 400       | 0.699           | -79.9  | 6.982           | 121.6 | 0.071           | 48.3 | 0.761           | -35.9 | 0.32 | 19.9             |
| 500       | 0.642           | -93.8  | 6.172           | 112.2 | 0.080           | 42.4 | 0.699           | -39.7 | 0.41 | 18.9             |
| 600       | 0.598           | -106.0 | 5.458           | 104.1 | 0.086           | 38.7 | 0.651           | -43.3 | 0.48 | 18.0             |
| 700       | 0.564           | -116.4 | 4.898           | 97.3  | 0.089           | 36.7 | 0.613           | -46.0 | 0.55 | 17.4             |
| 800       | 0.534           | -125.9 | 4.429           | 91.1  | 0.093           | 34.0 | 0.587           | -48.2 | 0.62 | 16.8             |
| 900       | 0.511           | -134.1 | 4.032           | 85.5  | 0.095           | 33.3 | 0.565           | -50.1 | 0.69 | 16.3             |
| 1000      | 0.494           | -141.6 | 3.696           | 80.6  | 0.099           | 32.1 | 0.549           | -52.3 | 0.74 | 15.7             |
| 1500      | 0.438           | -172.6 | 2.618           | 59.5  | 0.113           | 29.1 | 0.508           | -59.9 | 0.99 | 13.6             |
| 2000      | 0.409           | 162.4  | 2.042           | 41.8  | 0.130           | 28.7 | 0.485           | -67.6 | 1.15 | 9.6              |
| 3000      | 0.410           | 117.0  | 1.474           | 11.1  | 0.187           | 24.2 | 0.448           | -85.5 | 1.16 | 6.5              |

See note on next page.

## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms  
Frequency in GHz  
(V<sub>CE</sub> = 8 V, I<sub>C</sub> = 10 mA)



## NE68133

V<sub>CE</sub> = 8 V, I<sub>C</sub> = 7 mA

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |       | K    | MAG <sup>1</sup><br>(dB) |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|------|--------------------------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG   |      |                          |
| 100                | 0.802           | -27.1  | 17.578          | 153.8 | 0.023           | 68.7 | 0.918           | -12.7 | 0.37 | 28.8                     |
| 200                | 0.639           | -49.2  | 14.213          | 134.2 | 0.039           | 69.8 | 0.783           | -19.9 | 0.46 | 25.6                     |
| 500                | 0.344           | -83.3  | 7.671           | 105.5 | 0.065           | 67.8 | 0.579           | -21.5 | 0.81 | 20.7                     |
| 1000               | 0.170           | -113.4 | 4.126           | 86.7  | 0.109           | 73.5 | 0.491           | -17.7 | 1.01 | 15.2                     |
| 1500               | 0.115           | -144.1 | 2.870           | 75.3  | 0.160           | 74.8 | 0.454           | -17.8 | 1.05 | 11.2                     |
| 2000               | 0.098           | -176.3 | 2.254           | 66.2  | 0.212           | 74.7 | 0.438           | -16.9 | 1.04 | 9.0                      |
| 3000               | 0.137           | 137.6  | 1.669           | 53.2  | 0.313           | 73.2 | 0.409           | -21.0 | 0.99 | 7.3                      |

V<sub>CE</sub> = 8 V, I<sub>C</sub> = 10 mA

|      |       |        |        |       |       |      |       |       |      |      |
|------|-------|--------|--------|-------|-------|------|-------|-------|------|------|
| 100  | 0.744 | -31.7  | 21.212 | 148.4 | 0.017 | 57.9 | 0.896 | -14.6 | 0.50 | 31.0 |
| 200  | 0.553 | -54.5  | 16.031 | 127.9 | 0.037 | 69.0 | 0.737 | -21.7 | 0.54 | 26.4 |
| 500  | 0.277 | -87.1  | 8.093  | 102.0 | 0.061 | 72.6 | 0.540 | -20.9 | 0.88 | 21.2 |
| 1000 | 0.134 | -115.8 | 4.284  | 85.3  | 0.109 | 76.3 | 0.461 | -17.0 | 1.04 | 14.7 |
| 1500 | 0.092 | -146.2 | 2.981  | 75.2  | 0.165 | 75.9 | 0.430 | -16.5 | 1.04 | 11.3 |
| 2000 | 0.079 | 180.0  | 2.350  | 66.5  | 0.217 | 75.2 | 0.413 | -16.8 | 1.03 | 9.3  |
| 3000 | 0.122 | 134.2  | 1.736  | 53.9  | 0.320 | 73.7 | 0.380 | -21.3 | 0.99 | 7.3  |

V<sub>CE</sub> = 8 V, I<sub>C</sub> = 20 mA

|      |       |        |        |       |       |      |       |       |      |      |
|------|-------|--------|--------|-------|-------|------|-------|-------|------|------|
| 100  | 0.594 | -43.3  | 29.285 | 138.1 | 0.013 | 61.2 | 0.792 | -19.4 | 0.57 | 33.5 |
| 200  | 0.389 | -66.3  | 19.280 | 117.5 | 0.035 | 73.1 | 0.614 | -22.6 | 0.69 | 27.4 |
| 500  | 0.175 | -95.5  | 8.683  | 96.1  | 0.057 | 74.0 | 0.481 | -16.5 | 0.98 | 21.8 |
| 1000 | 0.089 | -127.5 | 4.512  | 82.3  | 0.110 | 79.6 | 0.440 | -13.2 | 1.03 | 15.1 |
| 1500 | 0.064 | -160.8 | 3.078  | 73.3  | 0.167 | 78.9 | 0.416 | -13.9 | 1.04 | 11.4 |
| 2000 | 0.070 | 167.0  | 2.406  | 64.9  | 0.221 | 74.9 | 0.404 | -13.8 | 1.02 | 9.5  |
| 3000 | 0.120 | 132.5  | 1.774  | 53.1  | 0.322 | 72.4 | 0.379 | -19.4 | 0.98 | 7.4  |

V<sub>CE</sub> = 8 V, I<sub>C</sub> = 30 mA

|      |       |        |        |       |       |      |       |       |      |      |
|------|-------|--------|--------|-------|-------|------|-------|-------|------|------|
| 100  | 0.557 | -46.9  | 30.197 | 135.2 | 0.017 | 65.9 | 0.836 | -17.4 | 0.50 | 32.5 |
| 200  | 0.354 | -70.7  | 19.196 | 115.1 | 0.029 | 73.4 | 0.664 | -22.2 | 0.67 | 28.2 |
| 500  | 0.158 | -100.5 | 8.499  | 94.8  | 0.059 | 77.7 | 0.503 | -17.7 | 0.95 | 21.6 |
| 1000 | 0.080 | -136.1 | 4.363  | 81.7  | 0.111 | 80.7 | 0.455 | -14.3 | 1.03 | 14.9 |
| 1500 | 0.065 | -175.0 | 3.009  | 72.7  | 0.167 | 80.1 | 0.428 | -14.2 | 1.03 | 11.5 |
| 2000 | 0.076 | 156.0  | 2.348  | 65.0  | 0.219 | 77.1 | 0.415 | -14.2 | 1.03 | 9.2  |
| 3000 | 0.127 | 128.4  | 1.742  | 53.0  | 0.325 | 74.2 | 0.387 | -19.7 | 0.98 | 7.3  |

Note:

1. Gain Calculations:

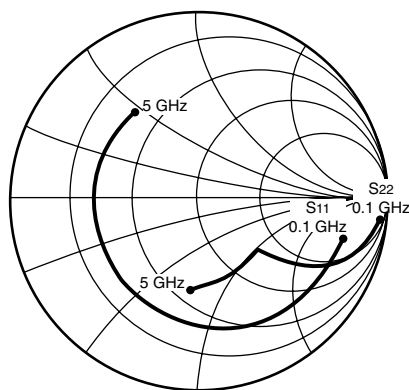
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} \left( K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

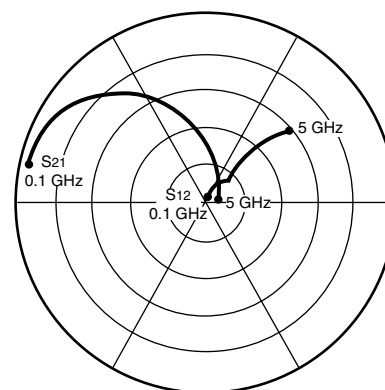
MSG = Maximum Stable Gain



## TYPICAL COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms  
Frequency in GHz  
(V<sub>CE</sub> = 8 V, I<sub>c</sub> = 10 mA)



## NE68135

V<sub>CE</sub> = 8 V, I<sub>c</sub> = 7 mA

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |       | K    | MAG <sup>1</sup><br>(dB) |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|------|--------------------------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG   |      |                          |
| 100                | .836            | -26.1  | 18.427          | 160.4 | .014            | 73.6 | .959            | -11.3 | 0.16 | 31.1                     |
| 500                | .659            | -105.0 | 11.481          | 114.7 | .041            | 44.3 | .654            | -33.2 | 0.38 | 24.4                     |
| 1000               | .585            | -146.1 | 6.625           | 90.3  | .051            | 38.3 | .512            | -38.5 | 0.68 | 21.1                     |
| 1500               | .557            | -167.0 | 4.555           | 75.5  | .058            | 39.3 | .472            | -43.1 | 0.93 | 18.9                     |
| 2000               | .562            | -180.0 | 3.507           | 63.9  | .068            | 41.3 | .462            | -49.4 | 1.02 | 16.4                     |
| 3000               | .561            | 159.6  | 2.413           | 43.4  | .088            | 43.1 | .468            | -64.3 | 1.11 | 12.4                     |
| 4000               | .562            | 142.8  | 1.854           | 25.1  | .113            | 41.9 | .490            | -80.4 | 1.07 | 10.6                     |
| 5000               | .563            | 127.0  | 1.516           | 8.0   | .142            | 38.7 | .522            | -96.0 | 0.98 | 10.3                     |

V<sub>CE</sub> = 8 V, I<sub>c</sub> = 10 mA

|      |      |        |        |       |      |      |      |       |      |      |
|------|------|--------|--------|-------|------|------|------|-------|------|------|
| 100  | .781 | -32.1  | 24.097 | 157.2 | .013 | 73.4 | .937 | -13.9 | 0.15 | 32.6 |
| 500  | .609 | -117.6 | 13.015 | 109.6 | .036 | 44.6 | .582 | -35.2 | 0.47 | 25.6 |
| 1000 | .558 | -154.7 | 7.233  | 87.5  | .045 | 43.2 | .457 | -38.5 | 0.79 | 22.0 |
| 1500 | .540 | -173.1 | 4.925  | 73.9  | .055 | 45.8 | .425 | -42.6 | 1.00 | 19.4 |
| 2000 | .547 | 175.3  | 3.778  | 62.9  | .067 | 47.6 | .420 | -48.8 | 1.05 | 16.1 |
| 3000 | .549 | 156.5  | 2.590  | 43.3  | .091 | 47.4 | .428 | -63.7 | 1.09 | 12.7 |
| 4000 | .551 | 140.6  | 1.990  | 25.5  | .119 | 44.2 | .452 | -79.7 | 1.05 | 10.9 |
| 5000 | .551 | 125.2  | 1.629  | 8.7   | .149 | 39.4 | .486 | -95.2 | 0.96 | 10.4 |

V<sub>CE</sub> = 8 V, I<sub>c</sub> = 20 mA

|      |      |        |        |       |      |      |      |       |      |      |
|------|------|--------|--------|-------|------|------|------|-------|------|------|
| 100  | .654 | -49.9  | 36.807 | 149.3 | .012 | 67.4 | .877 | -19.2 | 0.21 | 35.0 |
| 500  | .547 | -139.7 | 14.980 | 101.5 | .027 | 49.0 | .475 | -34.9 | 0.66 | 27.5 |
| 1000 | .535 | -168.1 | 7.916  | 83.2  | .038 | 53.7 | .392 | -35.7 | 0.95 | 23.2 |
| 1500 | .527 | -177.7 | 5.328  | 71.3  | .051 | 56.2 | .375 | -39.9 | 1.08 | 18.4 |
| 2000 | .534 | 168.5  | 4.072  | 61.1  | .065 | 56.6 | .376 | -46.5 | 1.09 | 16.2 |
| 3000 | .541 | 151.9  | 2.780  | 42.7  | .094 | 53.4 | .389 | -61.9 | 1.07 | 13.1 |
| 4000 | .544 | 137.2  | 2.131  | 25.5  | .124 | 47.8 | .415 | -78.1 | 1.01 | 11.6 |
| 5000 | .544 | 122.7  | 1.745  | 9.0   | .156 | 41.3 | .451 | -93.7 | 0.94 | 10.5 |

V<sub>CE</sub> = 8 V, I<sub>c</sub> = 30 mA

|      |      |        |        |       |      |      |      |       |      |      |
|------|------|--------|--------|-------|------|------|------|-------|------|------|
| 100  | .575 | -64.1  | 43.452 | 144.0 | .010 | 64.1 | .831 | -21.9 | 0.26 | 36.3 |
| 500  | .539 | -150.2 | 15.238 | 97.9  | .023 | 52.7 | .441 | -32.3 | 0.77 | 28.2 |
| 1000 | .537 | -173.7 | 7.926  | 81.2  | .036 | 58.9 | .381 | -32.9 | 1.01 | 22.7 |
| 1500 | .532 | 173.7  | 5.318  | 69.9  | .049 | 60.7 | .370 | -37.8 | 1.11 | 18.3 |
| 2000 | .541 | 165.5  | 4.058  | 60.1  | .064 | 60.2 | .374 | -44.9 | 1.09 | 16.1 |
| 3000 | .549 | 149.8  | 2.767  | 41.9  | .094 | 55.9 | .390 | -60.9 | 1.06 | 13.2 |
| 4000 | .552 | 135.7  | 2.118  | 24.9  | .125 | 49.8 | .416 | -77.4 | 1.00 | 12.1 |
| 5000 | .553 | 121.2  | 1.731  | 8.5   | .157 | 42.9 | .453 | -93.3 | 0.92 | 10.4 |

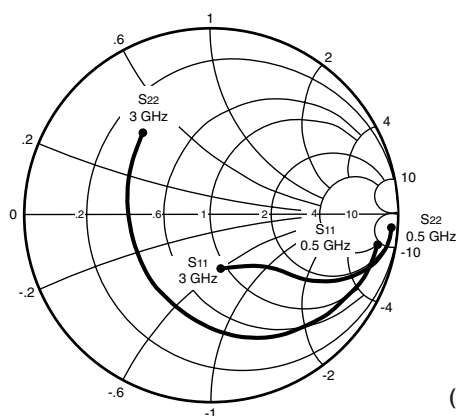
Note:

1. Gain Calculations:

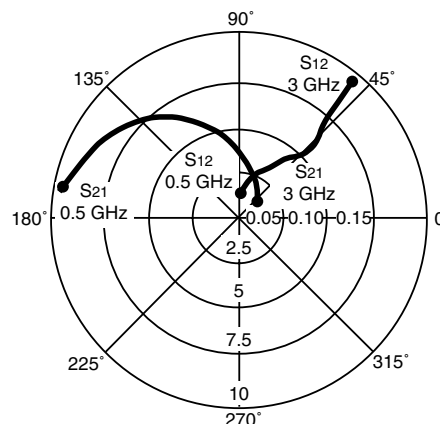
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} \left( K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

TYPICAL COMMON EMITTER SCATTERING PARAMETERS ( $T_A = 25^\circ\text{C}$ )

Coordinates in Ohms  
Frequency in GHz  
( $V_{CE} = 2.5\text{ V}$ ,  $I_C = 3\text{ mA}$ )



## NE68139

 $V_{CE} = 2.5\text{ V}$ ,  $I_C = 0.3\text{ mA}$ 

| FREQUENCY<br>(MHz) | S11   |        | S21   |       | S12   |      | S22   |       | K    | MAG <sup>1</sup><br>(dB) |
|--------------------|-------|--------|-------|-------|-------|------|-------|-------|------|--------------------------|
|                    | MAG   | ANG    | MAG   | ANG   | MAG   | ANG  | MAG   | ANG   |      |                          |
| 50                 | 0.996 | -3.4   | 1.089 | 175.2 | 0.014 | 83.2 | 0.995 | -1.1  | 0.13 | 18.9                     |
| 100                | 0.995 | -11.4  | 1.079 | 173.1 | 0.027 | 80.3 | 0.993 | -2.7  | 0.06 | 16.0                     |
| 200                | 0.990 | -20.3  | 1.071 | 161.9 | 0.050 | 74.5 | 0.989 | -5.7  | 0.16 | 13.3                     |
| 300                | 0.973 | -30.7  | 1.032 | 153.6 | 0.075 | 68.7 | 0.985 | -8.7  | 0.19 | 11.4                     |
| 400                | 0.953 | -41.2  | 0.993 | 145.9 | 0.098 | 64.3 | 0.976 | -11.4 | 0.19 | 10.1                     |
| 500                | 0.931 | -50.3  | 0.991 | 137.2 | 0.122 | 59.3 | 0.965 | -13.8 | 0.25 | 9.1                      |
| 600                | 0.909 | -60.5  | 1.008 | 129.9 | 0.138 | 53.5 | 0.949 | -16.4 | 0.28 | 8.6                      |
| 800                | 0.862 | -79.9  | 0.908 | 114.3 | 0.167 | 42.7 | 0.918 | -21.0 | 0.37 | 7.4                      |
| 1000               | 0.819 | -98.5  | 0.871 | 101.2 | 0.184 | 33.4 | 0.888 | -25.0 | 0.45 | 6.8                      |
| 1500               | 0.744 | -140.0 | 0.729 | 72.2  | 0.192 | 14.1 | 0.828 | -35.2 | 0.66 | 5.8                      |
| 2000               | 0.732 | -173.0 | 0.632 | 51.7  | 0.155 | 3.4  | 0.802 | -46.3 | 0.85 | 5.0                      |
| 3000               | 0.762 | 142.1  | 0.438 | 28.5  | 0.089 | 8.4  | 0.770 | -76.7 | 1.62 | 2.3                      |

 $V_{CE} = 2.5\text{ V}$ ,  $I_C = 1.0\text{ mA}$ 

|      |       |        |       |       |       |      |       |       |      |      |
|------|-------|--------|-------|-------|-------|------|-------|-------|------|------|
| 50   | 0.985 | -6.8   | 3.763 | 175.3 | 0.016 | 86.4 | 0.989 | -2.8  | 0.01 | 23.7 |
| 100  | 0.971 | -14.8  | 3.648 | 171.0 | 0.029 | 82.4 | 0.980 | -4.8  | 0.01 | 21.0 |
| 200  | 0.942 | -27.5  | 3.497 | 159.1 | 0.050 | 74.3 | 0.963 | -9.5  | 0.10 | 18.4 |
| 300  | 0.914 | -40.4  | 3.346 | 149.4 | 0.070 | 65.4 | 0.946 | -13.9 | 0.17 | 16.8 |
| 400  | 0.876 | -53.8  | 3.184 | 140.6 | 0.092 | 58.7 | 0.916 | -17.8 | 0.20 | 15.4 |
| 500  | 0.828 | -65.2  | 3.043 | 131.8 | 0.106 | 53.8 | 0.884 | -20.9 | 0.25 | 14.6 |
| 600  | 0.790 | -76.9  | 2.880 | 124.1 | 0.119 | 47.7 | 0.845 | -24.1 | 0.30 | 13.8 |
| 800  | 0.715 | -98.4  | 2.516 | 109.8 | 0.137 | 38.9 | 0.778 | -28.6 | 0.40 | 12.6 |
| 1000 | 0.663 | -117.6 | 2.237 | 98.4  | 0.145 | 32.3 | 0.726 | -31.9 | 0.49 | 11.9 |
| 1500 | 0.596 | -157.8 | 1.686 | 74.8  | 0.145 | 23.5 | 0.631 | -39.8 | 0.75 | 10.7 |
| 2000 | 0.600 | 173.8  | 1.346 | 56.9  | 0.130 | 24.6 | 0.583 | -48.9 | 1.04 | 8.9  |
| 3000 | 0.660 | 136.9  | 0.941 | 30.9  | 0.144 | 47.4 | 0.538 | -75.9 | 1.21 | 5.4  |

 $V_{CE} = 2.5\text{ V}$ ,  $I_C = 3\text{ mA}$ 

|      |       |        |        |       |       |      |       |       |      |      |
|------|-------|--------|--------|-------|-------|------|-------|-------|------|------|
| 50   | 0.916 | -10.7  | 10.426 | 172.1 | 0.015 | 84.7 | 0.975 | -4.6  | 0.07 | 28.4 |
| 100  | 0.895 | -23.5  | 9.954  | 164.8 | 0.027 | 79.0 | 0.972 | -9.6  | 0.05 | 25.7 |
| 200  | 0.829 | -42.0  | 9.011  | 148.6 | 0.046 | 67.6 | 0.910 | -18.1 | 0.19 | 22.9 |
| 300  | 0.755 | -60.3  | 8.067  | 136.2 | 0.061 | 57.7 | 0.826 | -24.5 | 0.29 | 21.2 |
| 400  | 0.694 | -76.4  | 7.165  | 125.8 | 0.074 | 52.4 | 0.754 | -29.3 | 0.35 | 19.9 |
| 500  | 0.619 | -90.0  | 6.329  | 117.1 | 0.083 | 49.8 | 0.690 | -32.3 | 0.43 | 18.8 |
| 600  | 0.574 | -103.0 | 5.660  | 109.8 | 0.089 | 46.7 | 0.634 | -34.4 | 0.50 | 18.0 |
| 800  | 0.500 | -125.0 | 4.558  | 97.8  | 0.099 | 43.3 | 0.552 | -37.1 | 0.65 | 16.6 |
| 1000 | 0.470 | -143.4 | 3.815  | 88.7  | 0.106 | 42.0 | 0.496 | -38.6 | 0.77 | 15.6 |
| 1500 | 0.453 | -178.4 | 2.684  | 70.7  | 0.123 | 43.6 | 0.412 | -43.3 | 0.99 | 13.4 |
| 2000 | 0.481 | 159.4  | 2.078  | 56.4  | 0.141 | 47.3 | 0.362 | -51.3 | 1.11 | 9.7  |
| 3000 | 0.567 | 130.6  | 1.442  | 34.1  | 0.197 | 49.7 | 0.302 | -78.6 | 1.08 | 6.9  |

Note:

1. Gain Calculations:

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

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

TYPICAL COMMON EMITTER SCATTERING PARAMETERS ( $T_A = 25^\circ\text{C}$ )

NE68139

 $V_{CE} = 8\text{ V}$ ,  $I_C = 7\text{ mA}$ 

| FREQUENCY<br>(MHz) | S <sub>11</sub> |      | S <sub>21</sub> |     | S <sub>12</sub> |     | S <sub>22</sub> |      | K    | MAG <sup>1</sup><br>(dB) |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|------|------|--------------------------|
|                    | MAG             | ANG  | MAG             | ANG | MAG             | ANG | MAG             | ANG  |      |                          |
| 100                | 0.764           | -28  | 17.806          | 156 | 0.002           | 53  | 0.944           | -12  | 0.91 | 39.5                     |
| 200                | 0.675           | -55  | 15.233          | 138 | 0.008           | 70  | 0.855           | -19  | 0.54 | 32.8                     |
| 300                | 0.569           | -76  | 12.659          | 126 | 0.018           | 61  | 0.734           | -22  | 0.69 | 28.5                     |
| 400                | 0.481           | -94  | 10.620          | 116 | 0.025           | 59  | 0.698           | -25  | 0.74 | 26.3                     |
| 500                | 0.432           | -110 | 8.886           | 107 | 0.035           | 59  | 0.602           | -24  | 0.86 | 24.0                     |
| 600                | 0.398           | -120 | 7.696           | 102 | 0.043           | 58  | 0.589           | -24  | 0.86 | 22.5                     |
| 700                | 0.374           | -133 | 6.888           | 97  | 0.046           | 59  | 0.530           | -26  | 0.99 | 21.8                     |
| 800                | 0.354           | -141 | 6.073           | 93  | 0.056           | 59  | 0.522           | -25  | 0.97 | 20.4                     |
| 900                | 0.339           | -152 | 5.422           | 88  | 0.055           | 60  | 0.493           | -28  | 1.13 | 17.7                     |
| 1000               | 0.332           | -159 | 4.963           | 85  | 0.066           | 61  | 0.493           | -25  | 1.05 | 17.4                     |
| 1100               | 0.333           | -166 | 4.576           | 81  | 0.069           | 62  | 0.488           | -28  | 1.08 | 16.5                     |
| 1200               | 0.343           | -174 | 4.264           | 78  | 0.076           | 62  | 0.457           | -27  | 1.09 | 15.7                     |
| 1300               | 0.332           | 180  | 3.912           | 76  | 0.080           | 63  | 0.467           | -29  | 1.12 | 14.8                     |
| 1400               | 0.343           | 173  | 3.656           | 73  | 0.089           | 63  | 0.449           | -29  | 1.09 | 14.3                     |
| 1500               | 0.348           | 171  | 3.433           | 71  | 0.098           | 66  | 0.447           | -29  | 1.06 | 13.9                     |
| 2000               | 0.414           | 150  | 2.656           | 56  | 0.129           | 60  | 0.388           | -40  | 1.04 | 11.9                     |
| 3000               | 0.502           | 126  | 1.829           | 38  | 0.192           | 60  | 0.323           | -63  | 1.00 | 9.8                      |
| 4000               | 0.595           | 110  | 1.426           | 17  | 0.256           | 50  | 0.302           | -95  | 0.88 | 7.5                      |
| 5000               | 0.650           | 97   | 1.119           | 1   | 0.317           | 44  | 0.343           | -126 | 0.83 | 5.5                      |

Note:

1. Gain Calculations:

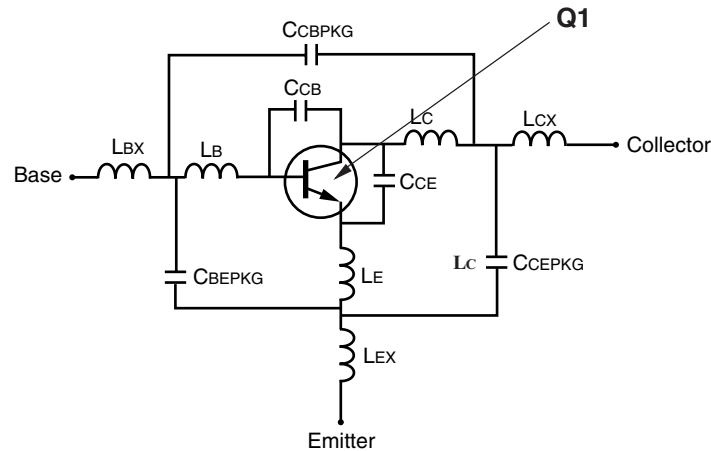
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} \left( K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } \text{MSG} = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

## NE68118 NONLINEAR MODEL

## SCHEMATIC

BJT NONLINEAR MODEL PARAMETERS<sup>(1)</sup>

| Parameters | Q1       | Parameters | Q1     |
|------------|----------|------------|--------|
| IS         | 2.7e-16  | MJC        | 0.56   |
| BF         | 185      | XCJC       | 0      |
| NF         | 1.02     | CJS        | 0      |
| VAF        | 15       | VJS        | 0.75   |
| IKF        | 0.055    | MJS        | 0      |
| ISE        | 1.77e-11 | FC         | 0.5    |
| NE         | 2.1      | TF         | 14e-12 |
| BR         | 1        | XTF        | 3      |
| NR         | 1        | VTF        | 25     |
| VAR        | Infinity | ITF        | 0.1    |
| IKR        | Infinity | PTF        | 0      |
| ISC        | 0        | TR         | 0.3e-9 |
| NC         | 2        | EG         | 1.11   |
| RE         | 0.6      | XTB        | 0      |
| RB         | 12       | XTI        | 3      |
| RBM        | 3.7      | KF         | 0      |
| IRB        | 1.2e-5   | AF         | 1      |
| RC         | 8        |            |        |
| CJE        | 1.2e-12  |            |        |
| VJE        | 0.77     |            |        |
| MJE        | 0.5      |            |        |
| CJC        | 0.8e-12  |            |        |
| VJC        | 0.27     |            |        |

(1) Gummel-Poon Model

## UNITS

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

## ADDITIONAL PARAMETERS

| Parameters | 68118    |
|------------|----------|
| CCB        | 0.07e-12 |
| CCE        | 0.01e-12 |
| LB         | 1.16e-9  |
| LC         | 1.54e-9  |
| LE         | 0.83e-9  |
| CBBPKG     | 0.09e-12 |
| CCEPKG     | 0.51e-12 |
| CBEPKG     | 0.25e-12 |
| LBX        | 0.18e-9  |
| LCX        | 0.8e-9   |
| LEX        | 0.09e-9  |

## MODEL RANGE

Frequency: 0.05 to 5.0 GHz

Bias:  $V_{CE} = 2.5 \text{ V to } 8.0 \text{ V}$ ,  $I_C = 3 \text{ mA to } 10 \text{ mA}$ 

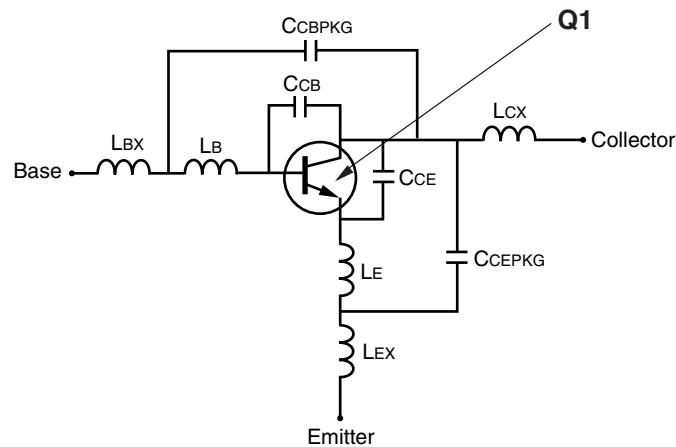
Date: 5/29/96

Note:

1. This nonlinear model utilized the latest data available. See our Design Parameter Library at [www.cel.com](http://www.cel.com) for this data.

## NE68119 NONLINEAR MODEL

## SCHEMATIC

BJT NONLINEAR MODEL PARAMETERS<sup>(1)</sup>

| Parameters | Q1       | Parameters | Q1       |
|------------|----------|------------|----------|
| IS         | 2.7e-16  | MJC        | 0.56     |
| BF         | 185.0    | XCJC       | 0        |
| NF         | 1.02     | CJS        | 0        |
| VAF        | 15.0     | VJS        | 0.75     |
| IKF        | 0.055    | MJS        | 0        |
| ISE        | 1.77e-11 | FC         | 0.5      |
| NE         | 2.1      | TF         | 14.0e-12 |
| BR         | 1        | XTF        | 3        |
| NR         | 1        | VTF        | 25       |
| VAR        | Infinity | ITF        | 0.1      |
| IKR        | Infinity | PTF        | 0        |
| ISC        | 0        | TR         | 0.3e-9   |
| NC         | 2        | EG         | 1.11     |
| RE         | 0.6      | XTB        | 0        |
| RB         | 12       | XTI        | 3        |
| RBM        | 3.7      | KF         | 0        |
| IRB        | 1.2e-5   | AF         | 1        |
| RC         | 8        |            |          |
| CJE        | 1.2e-12  |            |          |
| VJE        | 0.77     |            |          |
| MJE        | 0.5      |            |          |
| CJC        | 0.8e-12  |            |          |
| VJC        | 0.27     |            |          |

(1) Gummel-Poon Model

## UNITS

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

## ADDITIONAL PARAMETERS

| Parameters | 68119    |
|------------|----------|
| CCB        | 0.07e-12 |
| CCE        | 0.01e-12 |
| LB         | 1.13e-9  |
| LE         | 0.85e-9  |
| CCEPKG     | 0.18e-12 |
| CCEPKG     | 0.21e-12 |
| LBX        | 0.19e-9  |
| LCX        | 0.19e-9  |
| LEX        | 0.19e-9  |

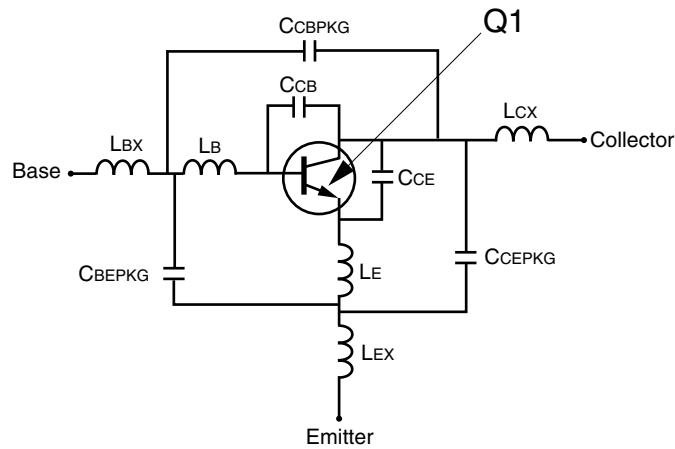
## MODEL RANGE

Frequency: 0.05 to 3.0 GHz

Bias:  $V_{CE} = 2.5 \text{ V to } 8.0 \text{ V}$ ,  $I_C = 0.3 \text{ mA to } 10 \text{ mA}$

## NE68130 NONLINEAR MODEL

## SCHEMATIC

BJT NONLINEAR MODEL PARAMETERS <sup>(1)</sup>

| Parameters | Q1       | Parameters | Q1     |
|------------|----------|------------|--------|
| IS         | 2.7e-16  | MJC        | 0.56   |
| BF         | 185      | XCJC       | 0      |
| NF         | 1.02     | CJS        | 0      |
| VAF        | 15       | VJS        | 0.75   |
| IKF        | 0.055    | MJS        | 0      |
| ISE        | 1.77e-11 | FC         | 0.5    |
| NE         | 2.1      | TF         | 14e-12 |
| BR         | 1        | XTF        | 3      |
| NR         | 1        | VTF        | 25     |
| VAR        | Infinity | ITF        | 0.1    |
| IKR        | Infinity | PTF        | 0      |
| ISC        | 0        | TR         | 0.3e-9 |
| NC         | 2        | EG         | 1.11   |
| RE         | 0.6      | XTB        | 0      |
| RB         | 12       | XTI        | 3      |
| RBM        | 3.7      | KF         | 0      |
| IRB        | 1.2e-5   | AF         | 1      |
| RC         | 8        |            |        |
| CJE        | 1.2e-12  |            |        |
| VJE        | 0.77     |            |        |
| MJE        | 0.5      |            |        |
| CJC        | 0.8e-12  |            |        |
| VJC        | 0.27     |            |        |

(1) Gummel-Poon Model

## UNITS

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

## ADDITIONAL PARAMETERS

| Parameters | 68130    |
|------------|----------|
| CCB        | 0.07e-12 |
| CCE        | 0.01e-12 |
| LB         | 0.52e-9  |
| LE         | 1.18e-9  |
| CCBPKG     | 0.12e-12 |
| CCEPKG     | 0.16e-12 |
| CBEPKG     | 0.04e-12 |
| LBX        | 0.2e-9   |
| LCX        | 0.8e-9   |
| LEX        | 0.2e-9   |

## MODEL RANGE

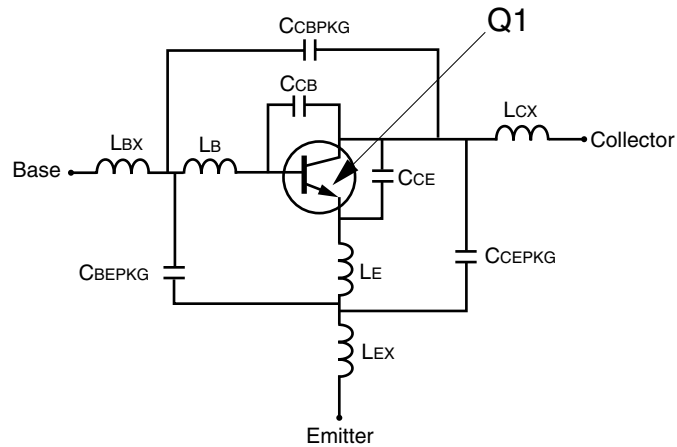
Frequency: 0.05 to 3.0 GHz  
 Bias:  $V_{CE} = 2.5 \text{ V to } 8 \text{ V}$ ,  $I_C = 0.3 \text{ mA to } 10 \text{ mA}$   
 Date: 10/11/96

Note:

This nonlinear model utilized the latest data available. See our Design Parameter Library at [www.cel.com](http://www.cel.com) for this data.

## NE68133 NONLINEAR MODEL

## SCHEMATIC

BJT NONLINEAR MODEL PARAMETERS <sup>(1)</sup>

| Parameters | Q1       | Parameters | Q1     |
|------------|----------|------------|--------|
| IS         | 2.7e-16  | MJC        | 0.56   |
| BF         | 185      | XCJC       | 0      |
| NF         | 1.02     | CJS        | 0      |
| VAF        | 15       | VJS        | 0.75   |
| IKF        | 0.055    | MJS        | 0      |
| ISE        | 1.77e-11 | FC         | 0.5    |
| NE         | 2.1      | TF         | 14e-12 |
| BR         | 1        | XTF        | 3      |
| NR         | 1        | VTF        | 25     |
| VAR        | Infinity | ITF        | 0.1    |
| IKR        | Infinity | PTF        | 0      |
| ISC        | 0        | TR         | 0.3e-9 |
| NC         | 2        | EG         | 1.11   |
| RE         | 0.6      | XTB        | 0      |
| RB         | 12       | XTI        | 3      |
| RBM        | 3.7      | KF         | 0      |
| IRB        | 1.2e-5   | AF         | 1      |
| RC         | 8        |            |        |
| CJE        | 1.2e-12  |            |        |
| VJE        | 0.77     |            |        |
| MJE        | 0.5      |            |        |
| CJC        | 0.8e-12  |            |        |
| VJC        | 0.27     |            |        |

(1) Gummel-Poon Model

## UNITS

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

## ADDITIONAL PARAMETERS

| Parameters | 68133    |
|------------|----------|
| CCB        | 0.07e-12 |
| CCE        | 0.01e-12 |
| LB         | 0.9e-9   |
| LE         | 1.2e-9   |
| CCBPKG     | 0.2e-12  |
| CCEPKG     | 0.2e-12  |
| CBEPKG     | 0.01e-12 |
| LBX        | 0.3e-9   |
| LCX        | 0.6e-9   |
| LEX        | 0.3e-9   |

## MODEL RANGE

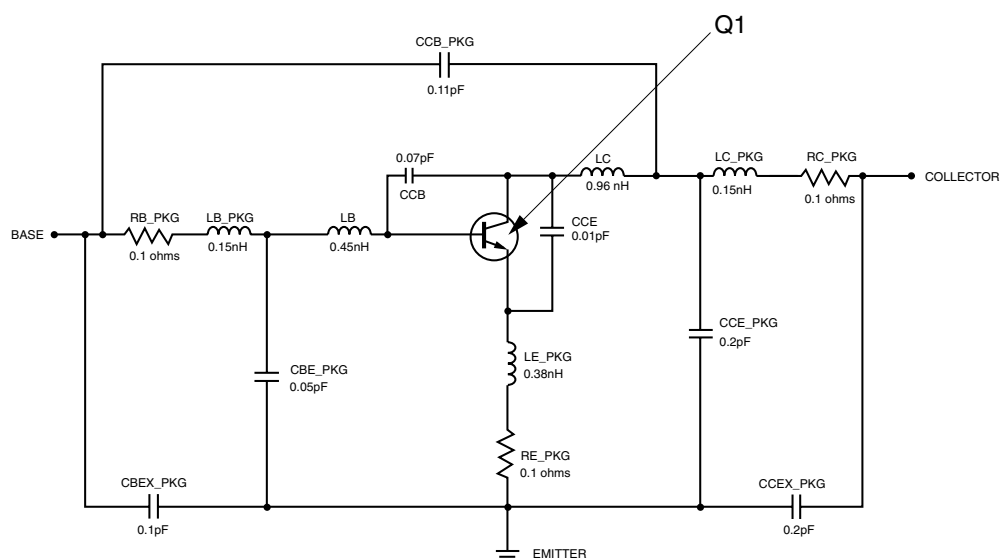
Frequency: 0.1 to 8.0 GHz  
 Bias:  $V_{CE} = 1\text{ V to }8\text{ V}$ ,  $I_C = 1\text{ mA to }30\text{ mA}$   
 Date: 7/97

Note:

This nonlinear model utilized the latest data available. See our Design Parameter Library at [www.cel.com](http://www.cel.com) for this data.

## NE68135 NONLINEAR MODEL

## SCHEMATIC

BJT NONLINEAR MODEL PARAMETERS <sup>(1)</sup>

| Parameters | Q1       | Parameters | Q1     |
|------------|----------|------------|--------|
| IS         | 2.7e-16  | MJC        | 0.56   |
| BF         | 185.0    | XCJC       | 0      |
| NF         | 1.02     | CJS        | 0      |
| VAF        | 15.0     | VJS        | 0.75   |
| IKF        | 0.055    | MJS        | 0      |
| ISE        | 1.77e-11 | FC         | 0.5    |
| NE         | 2.1      | TF         | 14e-12 |
| BR         | 1        | XTF        | 3      |
| NR         | 1        | VTF        | 25     |
| VAR        | Infinity | ITF        | 0.1    |
| IKR        | Infinity | PTF        | 0      |
| ISC        | 0        | TR         | 0.3e-9 |
| NC         | 2        | EG         | 1.11   |
| RE         | 0.6      | XTB        | 0      |
| RB         | 12       | XTI        | 3      |
| RBM        | 3.7      | KF         | 0      |
| IRB        | 1.2e-5   | AF         | 1      |
| RC         | 8        |            |        |
| CJE        | 1.2e-12  |            |        |
| VJE        | 0.77     |            |        |
| MJE        | 0.5      |            |        |
| CJC        | 0.8e-12  |            |        |
| VJC        | 0.27     |            |        |

(1) Gummel-Poon Model

## UNITS

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

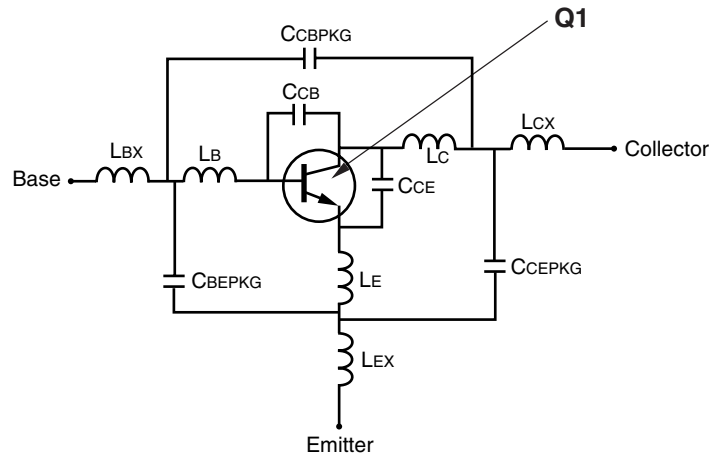
## MODEL RANGE

Frequency: 0.05 to 5.0 GHz  
 Bias:  $V_{CE} = 8.0\text{ V}$ ,  $I_C = 7\text{ mA}$  to  $30\text{ mA}$   
 Date: 11/1/96



## NE68139 NONLINEAR MODEL

## SCHEMATIC

BJT NONLINEAR MODEL PARAMETERS<sup>(1)</sup>

| Parameters | Q1       | Parameters | Q1       |
|------------|----------|------------|----------|
| IS         | 2.7e-16  | MJC        | 0.56     |
| BF         | 185.0    | XCJC       | 0        |
| NF         | 1.02     | CJS        | 0        |
| VAF        | 15.0     | VJS        | 0.750    |
| IKF        | 0.055    | MJS        | 0        |
| ISE        | 1.77e-11 | FC         | 0.50     |
| NE         | 2.1      | TF         | 14.0e-12 |
| BR         | 1.0      | XTF        | 3.0      |
| NR         | 1.0      | VTF        | 25.0     |
| VAR        | Infinity | ITF        | 0.1      |
| IKR        | Infinity | PTF        | 0        |
| ISC        | 0        | TR         | 0.3e-9   |
| NC         | 2.0      | EG         | 1.11     |
| RE         | 0.6      | XTB        | 0        |
| RB         | 12.0     | XTI        | 3.0      |
| RBM        | 3.7      | KF         | 0        |
| IRB        | 1.2e-5   | AF         | 1.0      |
| RC         | 8.0      |            |          |
| CJE        | 1.2e-12  |            |          |
| VJE        | 0.77     |            |          |
| MJE        | 0.50     |            |          |
| CJC        | 0.8e-12  |            |          |
| VJC        | 0.27     |            |          |

(1) Gummel-Poon Model

## UNITS

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

## ADDITIONAL PARAMETERS

| Parameters | 68139     |
|------------|-----------|
| CCB        | 0.07e-12  |
| CCE        | 0.01e-12  |
| LB         | 0.88e-9   |
| LC         | 0.79e-9   |
| LE         | 0.7e-9    |
| CCBPKG     | 0.165e-12 |
| CCEPKG     | 0.165e-12 |
| CBEPKG     | 0.01e-12  |
| LBX        | 0.39e-9   |
| LCX        | 0.39e-9   |
| LEX        | 0.2e-9    |

## MODEL RANGE

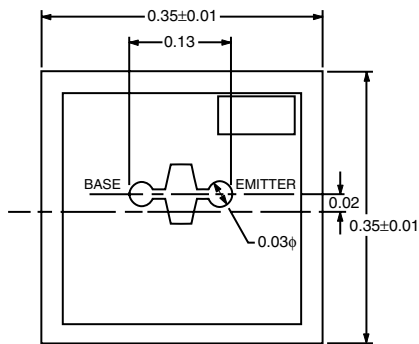
Frequency: 0.1 to 3.0 GHz

Bias:  $V_{CE} = 2.5 \text{ V to } 8.0 \text{ V}$ ,  $I_C = 0.3 \text{ mA to } 7 \text{ mA}$ 

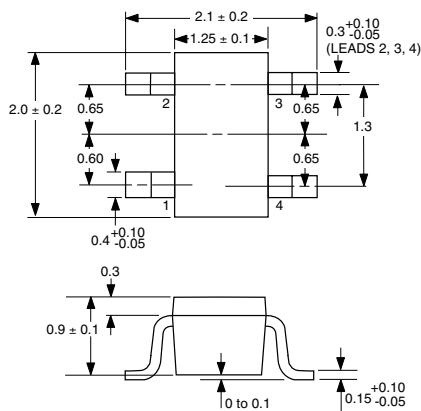
Date: 6/17/96

**OUTLINE DIMENSIONS** (Units in mm)

**NE68100 (CHIP)**  
(Chip Thickness: 160 mm)

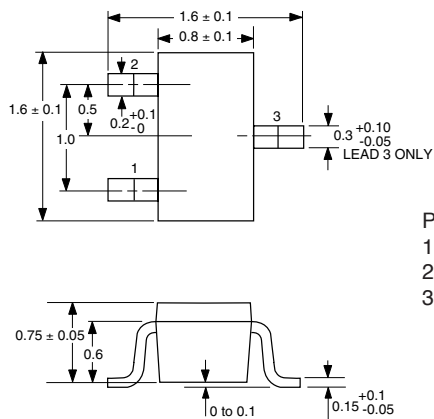


**PACKAGE OUTLINE 18**



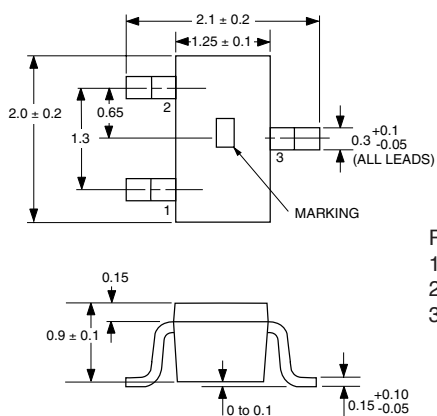
**PIN CONNECTIONS**  
1. Collector  
2. Emitter  
3. Base  
4. Emitter

**PACKAGE OUTLINE 19**



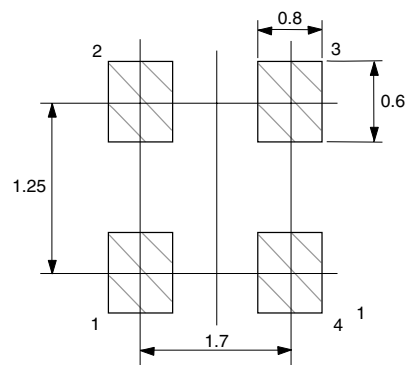
**PIN CONNECTIONS**  
1. Emitter  
2. Base  
3. Collector

**PACKAGE OUTLINE 30**

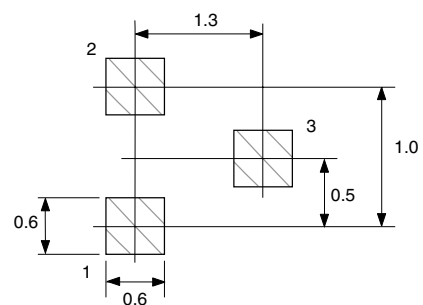


**PIN CONNECTIONS**  
1. Emitter  
2. Base  
3. Collector

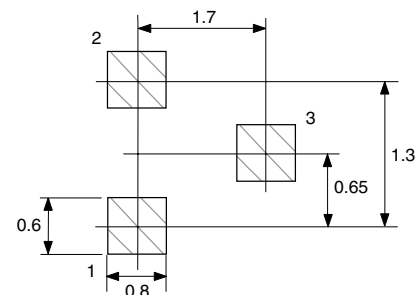
**PACKAGE OUTLINE 18**  
**RECOMMENDED P.C.B. LAYOUT**



**PACKAGE OUTLINE 19**  
**RECOMMENDED P.C.B. LAYOUT**

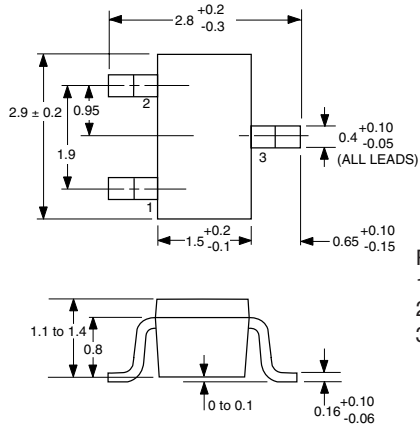


**PACKAGE OUTLINE 30**  
**RECOMMENDED P.C.B. LAYOUT**



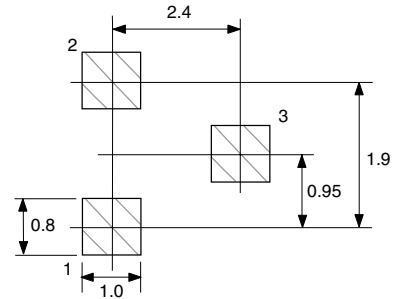
**OUTLINE DIMENSIONS** (Units in mm)

**PACKAGE OUTLINE 33**  
(SOT-23)

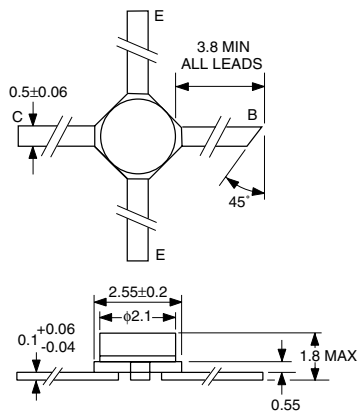


**PIN CONNECTIONS**  
1. Emitter  
2. Base  
3. Collector

**PACKAGE OUTLINE 33**  
**RECOMMENDED P.C.B. LAYOUT**

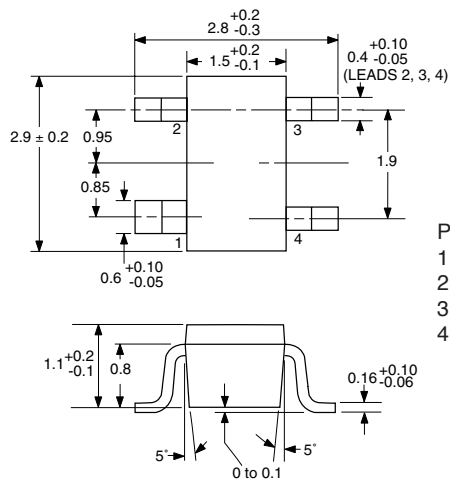


**PACKAGE OUTLINE 35**  
(MICRO-X)



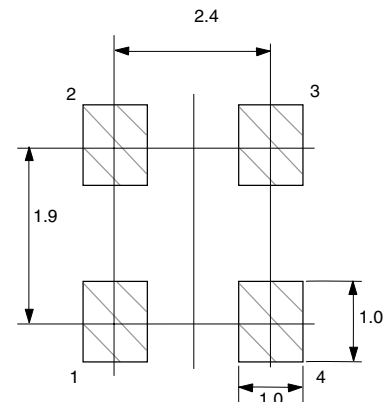
**PIN CONNECTIONS**  
1. Collector  
2. Emitter  
3. Base  
4. Emitter

**PACKAGE OUTLINE 39**



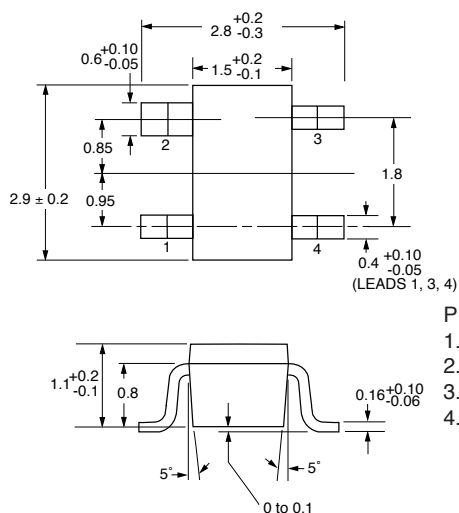
**PIN CONNECTIONS**  
1. Collector  
2. Emitter  
3. Base  
4. Emitter

**PACKAGE OUTLINE 39**  
**RECOMMENDED P.C.B. LAYOUT**



**OUTLINE DIMENSIONS** (Units in mm)

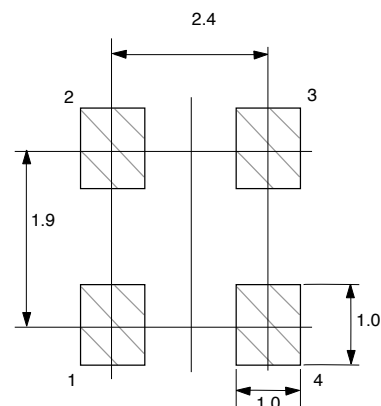
**PACKAGE OUTLINE 39R**



**PIN CONNECTIONS**

1. Emitter
2. Collector
3. Emitter
4. Base

**PACKAGE OUTLINE 39R  
RECOMMENDED P.C.B. LAYOUT**



**ORDERING INFORMATION (Solder Contains Lead)**

| PART NUMBER | QUANTITY | PACKAGING   |
|-------------|----------|-------------|
| NE68100     | 100      | Waffle Pack |
| NE68118-T1  | 3000     | Tape & Reel |
| NE68119-T1  | 3000     | Tape & Reel |
| NE68130-T1  | 3000     | Tape & Reel |
| NE68133-T1B | 3000     | Tape & Reel |
| NE68135     | 1        | ESD Bag     |
| NE68139-T1  | 3000     | Tape & Reel |
| NE68139R-T1 | 3000     | Tape & Reel |

**ORDERING INFORMATION (Pb-Free)**

| PART NUMBER   | QUANTITY | PACKAGING   |
|---------------|----------|-------------|
| NE68100       | 100      | Waffle Pack |
| NE68118-T1-A  | 3000     | Tape & Reel |
| NE68119-T1-A  | 3000     | Tape & Reel |
| NE68130-T1-A  | 3000     | Tape & Reel |
| NE68133-T1B-A | 3000     | Tape & Reel |
| NE68135       | 1        | ESD Bag     |
| NE68139-T1-A  | 3000     | Tape & Reel |
| NE68139R-T1   | 3000     | Tape & Reel |