

## SURFACE MOUNT NPN SILICON HIGH FREQUENCY TRANSISTOR

### FEATURES

- **HIGH GAIN BANDWIDTH PRODUCT:**  $f_T$  of 15 GHz
- **LOW VOLTAGE/LOW CURRENT OPERATION**
- **HIGH INSERTION POWER GAIN:**  
 $IS_{21eI}^2 = 12 \text{ dB @ } 2 \text{ V, } 7 \text{ mA, } 2 \text{ GHz}$   
 $IS_{21eI}^2 = 11 \text{ dB @ } 1 \text{ V, } 5 \text{ mA, } 2 \text{ GHz}$
- **LOW NOISE:** 1.5 dB AT 2.0 GHz
- **AVAILABLE IN SIX LOW COST PLASTIC SURFACE MOUNT PACKAGE STYLES**

### DESCRIPTION

The NE686 series of NPN epitaxial silicon transistors are designed for low voltage/low current, amplifier and oscillator applications. NE686's high  $f_T$  make it an excellent choice for portable wireless applications up to 5 GHz. The NE686 die is available in six different low cost plastic surface mount package styles.

### ELECTRICAL CHARACTERISTICS (TA = 25°C)

| PART NUMBER <sup>1</sup><br>EIAJ <sup>2</sup> REGISTERED NUMBER<br>PACKAGE OUTLINE |                                                                                                |       | NE68618<br>2SC5180<br>18 |      |     | NE68619<br>2SC5181<br>19 |      |      | NE68630<br>2SC5179<br>30 |     |     | NE68633<br>2SC5177<br>33 |     |     | NE68639/39R<br>2SC5178/78R<br>39/39R |      |     |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-------|--------------------------|------|-----|--------------------------|------|------|--------------------------|-----|-----|--------------------------|-----|-----|--------------------------------------|------|-----|
| SYMBOLS                                                                            | PARAMETERS AND CONDITIONS                                                                      | UNITS | MIN                      | TYP  | MAX | MIN                      | TYP  | MAX  | MIN                      | TYP | MAX | MIN                      | TYP | MAX | MIN                                  | TYP  | MAX |
| $f_T$                                                                              | Gain Bandwidth Product at<br>$V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA, } f = 2.0 \text{ GHz}$ | GHz   | 12                       | 15.5 |     | 10                       | 13   |      | 7.5                      | 9   |     | 10                       | 13  |     | 10.5                                 | 13.5 |     |
| $f_T$                                                                              | Gain Bandwidth Product at<br>$V_{CE} = 1 \text{ V, } I_C = 5 \text{ mA, } f = 2.0 \text{ GHz}$ | GHz   | 10                       | 13   |     | 8.5                      | 12   |      | 7                        | 8.5 |     | 8.5                      | 12  |     | 8.5                                  | 12   |     |
| NF <sub>MIN</sub>                                                                  | Minimum Noise Figure at<br>$V_{CE} = 2 \text{ V, } I_C = 3 \text{ mA, } f = 2.0 \text{ GHz}$   | dB    |                          | 1.5  | 2.0 |                          | 1.5  | 2.0  |                          | 1.5 | 2.0 |                          | 1.5 | 2.0 |                                      | 1.5  | 2.0 |
| NF <sub>MIN</sub>                                                                  | Minimum Noise Figure at<br>$V_{CE} = 1 \text{ V, } I_C = 3 \text{ mA, } f = 2.0 \text{ GHz}$   | dB    |                          | 1.5  | 2.0 |                          | 1.5  | 2.0  |                          | 1.5 | 2.0 |                          | 1.5 | 2.0 |                                      | 1.5  | 2.0 |
| $IS_{21eI}^2$                                                                      | Insertion Power Gain at<br>$V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA, } f = 2.0 \text{ GHz}$   | dB    | 10                       | 12   |     | 8                        | 10.5 |      | 7.5                      | 9   |     | 7.5                      | 9   |     | 9.5                                  | 11.5 |     |
| $IS_{21eI}^2$                                                                      | Insertion Power Gain at<br>$V_{CE} = 1 \text{ V, } I_C = 5 \text{ mA, } f = 2.0 \text{ GHz}$   | dB    | 8.5                      | 11   |     | 7                        | 9    |      | 7                        | 8.5 |     | 7                        | 8.5 |     | 7.5                                  | 10.5 |     |
| $h_{FE}$                                                                           | Forward Current Gain <sup>3</sup> at<br>$V_{CE} = 2 \text{ V, } I_C = 7 \text{ mA}$            |       | 70                       |      | 140 | 70                       |      | 140  | 70                       |     | 140 | 70                       |     | 140 | 70                                   |      | 140 |
| $I_{CBO}$                                                                          | Collector Cutoff Current<br>at $V_{CB} = 5 \text{ V, } I_E = 0 \text{ mA}$                     | nA    |                          |      | 100 |                          |      | 100  |                          |     | 100 |                          |     | 100 |                                      |      | 100 |
| $I_{EBO}$                                                                          | Emitter Cutoff Current<br>at $V_{EB} = 1 \text{ V, } I_C = 0 \text{ mA}$                       | nA    |                          |      | 100 |                          |      | 100  |                          |     | 100 |                          |     | 100 |                                      |      | 100 |
| CRE <sup>4</sup>                                                                   | Feedback Capacitance at<br>$V_{CB} = 2 \text{ V, } I_E = 0 \text{ mA, } f = 1 \text{ MHz}$     | pF    |                          | 0.3  | 0.5 |                          | 0.4  | 0.6  |                          | 0.4 | 0.6 |                          | 0.5 | 0.6 |                                      | 0.3  | 0.5 |
| P <sub>T</sub>                                                                     | Total Power Dissipation                                                                        | mW    |                          |      | 30  |                          |      | 30   |                          |     | 30  |                          |     | 30  |                                      |      | 30  |
| R <sub>TH(J-A)</sub>                                                               | Thermal Resistance<br>(Junction to Ambient)                                                    | °C/W  |                          |      | 833 |                          |      | 1250 |                          |     | 833 |                          |     | 625 |                                      |      | 625 |
| R <sub>TH(J-C)</sub>                                                               | 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.



## NE686 SERIES

### ABSOLUTE MAXIMUM RATINGS<sup>1</sup> (T<sub>A</sub> = 25°C)

| SYMBOLS          | PARAMETERS                     | UNITS | RATINGS     |
|------------------|--------------------------------|-------|-------------|
| V <sub>CB0</sub> | Collector to Base Voltage      | V     | 5           |
| V <sub>CE0</sub> | Collector to Emitter Voltage   | V     | 3           |
| V <sub>EB0</sub> | Emitter to Base Voltage        | V     | 2           |
| I <sub>C</sub>   | Collector Current              | mA    | 10          |
| T <sub>J</sub>   | Operating Junction Temperature | °C    | 150         |
| T <sub>STG</sub> | Storage Temperature            | °C    | -65 to +150 |

Notes:

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

### NE68618

#### TYPICAL NOISE PARAMETERS (T<sub>A</sub> = 25°C)

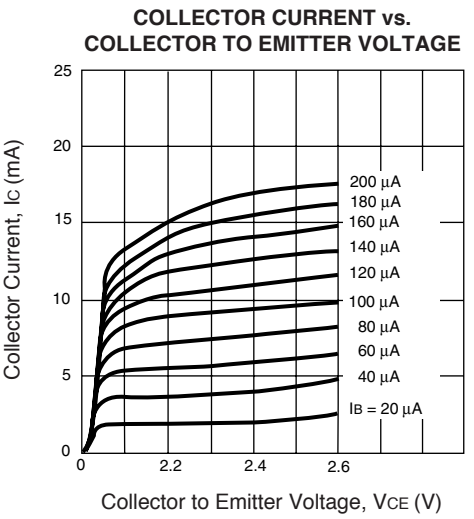
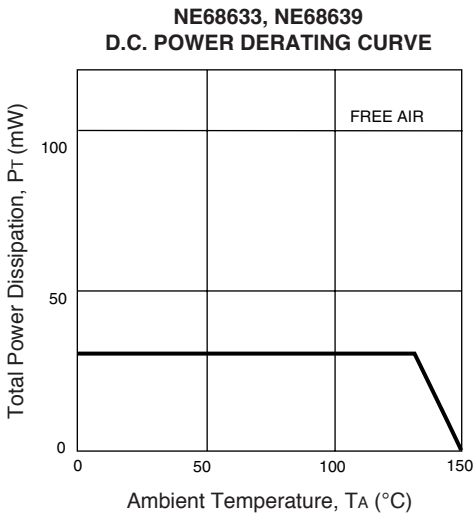
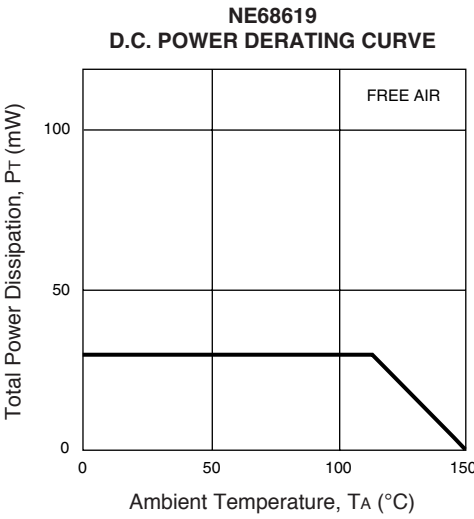
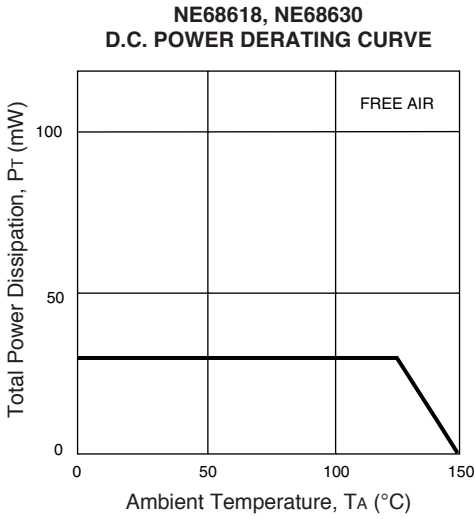
| FREQ.<br>(MHz)                                    | NF <sub>OPT</sub><br>(dB) | G <sub>A</sub><br>(dB) | Γ <sub>OPT</sub> |     | R <sub>n</sub> /50 |
|---------------------------------------------------|---------------------------|------------------------|------------------|-----|--------------------|
|                                                   |                           |                        | MAG              | ANG |                    |
| V <sub>CE</sub> = 1.0 V, I <sub>C</sub> = 1.0 mA  |                           |                        |                  |     |                    |
| 500                                               | 1.03                      | 18.47                  | 0.76             | 14  | 0.96               |
| 800                                               | 1.10                      | 17.10                  | 0.69             | 29  | 0.83               |
| 1000                                              | 1.15                      | 14.81                  | 0.66             | 34  | 0.78               |
| 1500                                              | 1.30                      | 10.20                  | 0.63             | 40  | 0.67               |
| 2000                                              | 1.52                      | 7.97                   | 0.58             | 50  | 0.58               |
| 2500                                              | 1.74                      | 6.65                   | 0.51             | 61  | 0.53               |
| V <sub>CE</sub> = 1.0 V, I <sub>C</sub> = 3.0 mA  |                           |                        |                  |     |                    |
| 500                                               | 1.30                      | 21.08                  | 0.61             | 13  | 0.56               |
| 800                                               | 1.33                      | 17.51                  | 0.58             | 23  | 0.53               |
| 1000                                              | 1.36                      | 15.75                  | 0.55             | 28  | 0.52               |
| 1500                                              | 1.50                      | 12.35                  | 0.50             | 37  | 0.50               |
| 2000                                              | 1.67                      | 10.03                  | 0.46             | 45  | 0.48               |
| 2500                                              | 1.83                      | 8.47                   | 0.41             | 54  | 0.44               |
| 3000                                              | 1.98                      | 7.30                   | 0.36             | 64  | 0.33               |
| V <sub>CE</sub> = 2.0 V, I <sub>C</sub> = 3.0 mA  |                           |                        |                  |     |                    |
| 500                                               | 1.30                      | 21.96                  | 0.61             | 13  | 0.66               |
| 800                                               | 1.33                      | 18.38                  | 0.58             | 23  | 0.58               |
| 1000                                              | 1.36                      | 16.61                  | 0.55             | 28  | 0.57               |
| 1500                                              | 1.50                      | 13.20                  | 0.50             | 37  | 0.55               |
| 2000                                              | 1.67                      | 10.81                  | 0.46             | 45  | 0.50               |
| 2500                                              | 1.83                      | 9.22                   | 0.41             | 54  | 0.47               |
| 3000                                              | 1.98                      | 8.00                   | 0.36             | 64  | 0.38               |
| V <sub>CE</sub> = 2.0 V, I <sub>C</sub> = 10.0 mA |                           |                        |                  |     |                    |
| 500                                               | 2.15                      | 23.2                   | 0.39             | 14  | 0.58               |
| 800                                               | 2.17                      | 19.21                  | 0.36             | 20  | 0.56               |
| 1000                                              | 2.20                      | 17.52                  | 0.32             | 27  | 0.55               |
| 1500                                              | 2.28                      | 14.18                  | 0.27             | 36  | 0.51               |
| 2000                                              | 2.42                      | 11.81                  | 0.24             | 45  | 0.48               |
| 2500                                              | 2.55                      | 10.09                  | 0.21             | 51  | 0.43               |
| 3000                                              | 2.70                      | 8.78                   | 0.17             | 61  | 0.29               |

### NE68619

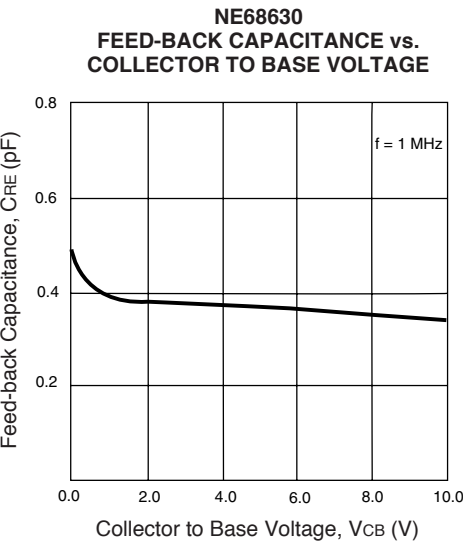
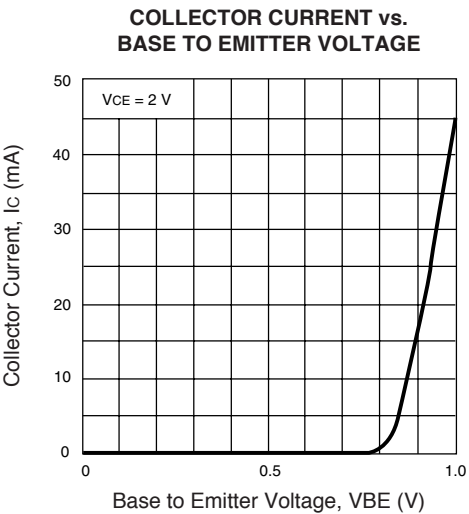
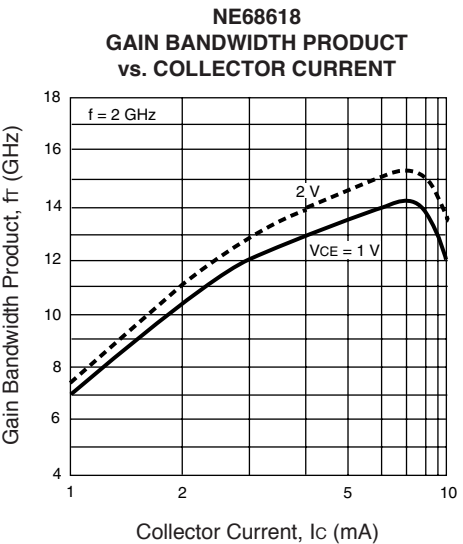
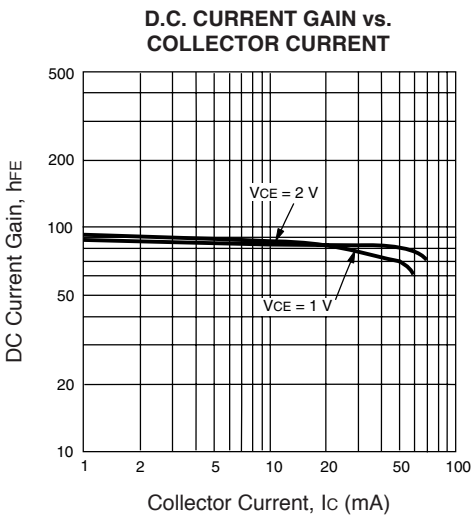
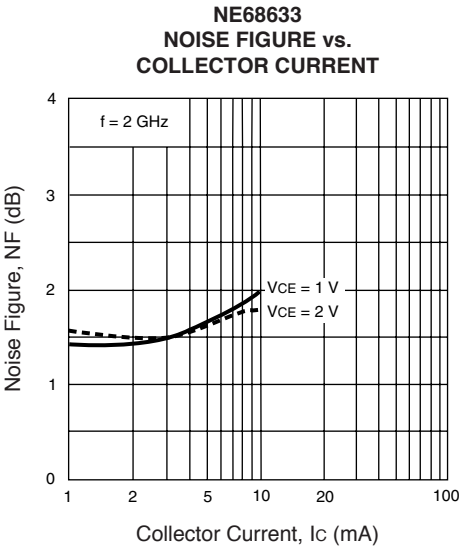
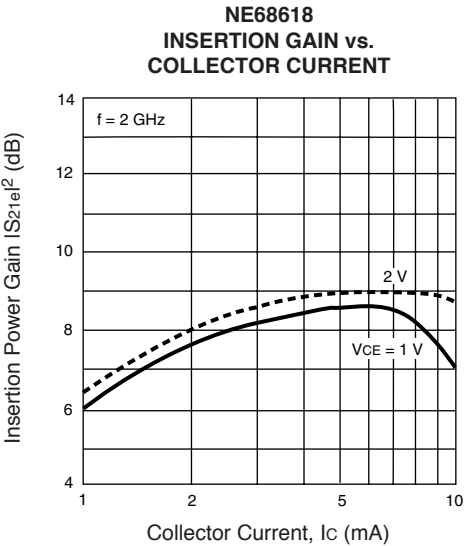
#### TYPICAL NOISE PARAMETERS (T<sub>A</sub> = 25°C)

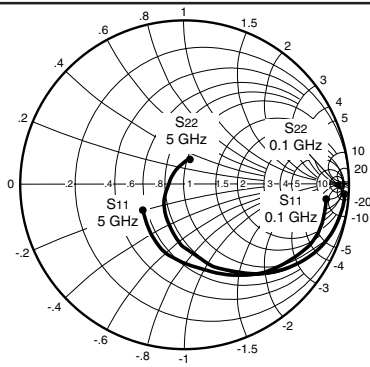
| FREQ.<br>(MHz)           | NF <sub>OPT</sub><br>(dB) | G <sub>A</sub><br>(dB) | Γ <sub>OPT</sub> |     | Rn/50 |
|--------------------------|---------------------------|------------------------|------------------|-----|-------|
|                          |                           |                        | MAG              | ANG |       |
| VCE = 0.5 V, IC = 0.5 mA |                           |                        |                  |     |       |
| 500                      | 0.96                      | 15.00                  | 0.76             | 16  | 1.20  |
| 800                      | 1.03                      | 12.50                  | 0.76             | 30  | 1.13  |
| 1000                     | 1.10                      | 11.94                  | 0.72             | 40  | 1.09  |
| 1500                     | 1.42                      | 6.69                   | 0.67             | 48  | 1.10  |
| VCE = 1.0 V, IC = 1.0 mA |                           |                        |                  |     |       |
| 500                      | 0.91                      | 17.59                  | 0.73             | 14  | 1.09  |
| 800                      | 1.00                      | 15.38                  | 0.69             | 28  | 0.82  |
| 1000                     | 1.08                      | 14.50                  | 0.66             | 38  | 0.80  |
| 1500                     | 1.35                      | 9.78                   | 0.63             | 46  | 0.78  |
| 2000                     | 1.60                      | 7.41                   | 0.59             | 56  | 0.75  |
| 2500                     | 1.80                      | 6.15                   | 0.53             | 70  | 0.68  |
| VCE = 1.0 V, IC = 3.0 mA |                           |                        |                  |     |       |
| 500                      | 1.35                      | 20.29                  | 0.63             | 15  | 0.59  |
| 800                      | 1.38                      | 16.88                  | 0.60             | 28  | 0.55  |
| 1000                     | 1.43                      | 15.44                  | 0.56             | 37  | 0.52  |
| 1500                     | 1.55                      | 11.50                  | 0.53             | 43  | 0.51  |
| 2000                     | 1.67                      | 9.28                   | 0.48             | 51  | 0.50  |
| 2500                     | 1.78                      | 7.70                   | 0.44             | 62  | 0.47  |
| 3000                     | 1.83                      | 6.52                   | 0.30             | 71  | 0.38  |
| VCE = 1.0 V, IC = 5.0 mA |                           |                        |                  |     |       |
| 500                      | 1.68                      | 21.17                  | 0.50             | 14  | 0.55  |
| 800                      | 1.70                      | 17.59                  | 0.48             | 28  | 0.53  |
| 1000                     | 1.74                      | 15.74                  | 0.46             | 33  | 0.52  |
| 1500                     | 1.83                      | 12.25                  | 0.42             | 41  | 0.51  |
| 2000                     | 1.91                      | 10.00                  | 0.38             | 53  | 0.49  |
| 2500                     | 2.00                      | 8.49                   | 0.33             | 65  | 0.39  |
| 3000                     | 2.09                      | 7.30                   | 0.28             | 77  | 0.35  |
| VCE = 2.0 V, IC = 3.0 mA |                           |                        |                  |     |       |
| 500                      | 1.35                      | 21.12                  | 0.63             | 15  | 0.68  |
| 800                      | 1.38                      | 17.80                  | 0.60             | 28  | 0.62  |
| 1000                     | 1.43                      | 16.34                  | 0.56             | 37  | 0.60  |
| 1500                     | 1.55                      | 12.36                  | 0.53             | 43  | 0.58  |
| 2000                     | 1.67                      | 10.00                  | 0.48             | 51  | 0.56  |
| 2500                     | 1.78                      | 8.48                   | 0.44             | 62  | 0.50  |
| 3000                     | 1.83                      | 7.24                   | 0.40             | 71  | 0.36  |

TYPICAL PERFORMANCE CURVES (TA = 25°)

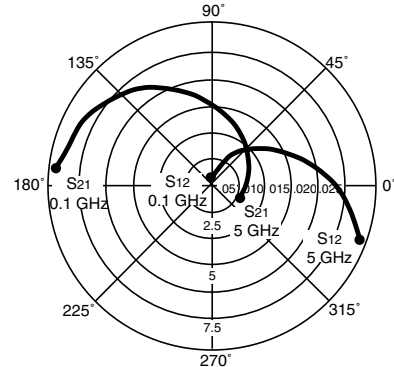


TYPICAL PERFORMANCE CURVES (TA = 25°C)



TYPICAL SCATTERING PARAMETERS (T<sub>A</sub> = 25°C)

Coordinates in Ohms  
Frequency in GHz  
(V<sub>CE</sub> = 1 V, I<sub>C</sub> = 3 mA)



## NE68618

V<sub>CE</sub> = 0.5 V, I<sub>C</sub> = 0.5 mA

| FREQUENCY | S <sub>11</sub> |          | S <sub>21</sub> |         | S <sub>12</sub> |         | S <sub>22</sub> |          | K     | MAG <sup>1</sup> |
|-----------|-----------------|----------|-----------------|---------|-----------------|---------|-----------------|----------|-------|------------------|
| GHz       | MAG             | ANG      | MAG             | ANG     | MAG             | ANG     | MAG             | ANG      |       | (dB)             |
| 0.1       | 0.981           | -5.400   | 1.742           | 170.900 | 0.018           | 85.100  | 0.998           | -4.500   | 0.088 | 19.858           |
| 0.4       | 0.965           | -19.400  | 1.717           | 156.600 | 0.069           | 72.900  | 0.988           | -17.400  | 0.128 | 13.959           |
| 0.8       | 0.910           | -38.900  | 1.667           | 134.100 | 0.130           | 56.400  | 0.953           | -33.800  | 0.247 | 11.080           |
| 1.0       | 0.873           | -47.700  | 1.620           | 123.700 | 0.156           | 48.600  | 0.930           | -41.500  | 0.310 | 10.164           |
| 1.5       | 0.775           | -70.200  | 1.506           | 98.600  | 0.208           | 30.500  | 0.863           | -59.000  | 0.455 | 8.598            |
| 2.0       | 0.675           | -90.800  | 1.385           | 76.400  | 0.241           | 15.000  | 0.795           | -74.000  | 0.595 | 7.594            |
| 2.5       | 0.584           | -111.200 | 1.289           | 56.200  | 0.261           | 1.800   | 0.741           | -86.800  | 0.714 | 6.936            |
| 3.0       | 0.505           | -130.500 | 1.215           | 38.700  | 0.273           | -9.500  | 0.694           | -98.500  | 0.820 | 6.484            |
| 4.0       | 0.363           | -175.500 | 1.118           | 6.100   | 0.289           | -29.700 | 0.599           | -120.800 | 1.013 | 5.181            |
| 5.0       | 0.298           | 122.200  | 1.049           | -26.800 | 0.289           | -47.800 | 0.492           | -151.700 | 1.187 | 2.982            |

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

|     |       |          |       |         |       |         |       |          |       |        |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.951 | -6.200   | 3.324 | 171.000 | 0.015 | 82.800  | 0.995 | -4.900   | 0.119 | 23.456 |
| 0.4 | 0.941 | -21.900  | 3.232 | 154.800 | 0.057 | 71.800  | 0.976 | -19.000  | 0.147 | 17.536 |
| 0.8 | 0.854 | -43.300  | 3.027 | 131.200 | 0.105 | 55.200  | 0.919 | -36.500  | 0.277 | 14.598 |
| 1.0 | 0.799 | -53.000  | 2.879 | 120.700 | 0.125 | 47.700  | 0.884 | -44.400  | 0.341 | 13.623 |
| 1.5 | 0.669 | -75.800  | 2.529 | 95.900  | 0.161 | 31.200  | 0.793 | -61.500  | 0.507 | 11.961 |
| 2.0 | 0.554 | -95.800  | 2.211 | 74.800  | 0.184 | 18.500  | 0.715 | -75.600  | 0.656 | 10.798 |
| 2.5 | 0.456 | -114.500 | 1.969 | 55.800  | 0.199 | 8.000   | 0.657 | -87.300  | 0.793 | 9.954  |
| 3.0 | 0.378 | -132.100 | 1.781 | 39.300  | 0.211 | -0.500  | 0.611 | -97.900  | 0.907 | 9.264  |
| 4.0 | 0.247 | -176.200 | 1.543 | 8.700   | 0.238 | -15.500 | 0.520 | -119.200 | 1.075 | 6.442  |
| 5.0 | 0.207 | 114.600  | 1.397 | -22.400 | 0.269 | -31.300 | 0.411 | -151.100 | 1.165 | 4.693  |

V<sub>CE</sub> = 1.0 V, I<sub>C</sub> = 3.0 mA

|     |       |          |       |         |       |         |       |          |       |        |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.888 | -9.000   | 8.309 | 169.500 | 0.015 | 86.700  | 0.981 | -7.200   | 0.058 | 27.435 |
| 0.4 | 0.806 | -34.400  | 7.521 | 143.100 | 0.053 | 66.400  | 0.905 | -27.100  | 0.266 | 21.520 |
| 0.8 | 0.619 | -61.800  | 6.033 | 114.400 | 0.088 | 50.300  | 0.758 | -46.800  | 0.486 | 18.361 |
| 1.0 | 0.537 | -72.800  | 5.360 | 103.200 | 0.101 | 44.600  | 0.695 | -54.100  | 0.580 | 17.248 |
| 1.5 | 0.377 | -95.200  | 4.085 | 79.700  | 0.126 | 34.100  | 0.582 | -67.900  | 0.782 | 15.108 |
| 2.0 | 0.272 | -113.800 | 3.257 | 61.200  | 0.148 | 26.500  | 0.516 | -78.500  | 0.921 | 13.426 |
| 2.5 | 0.201 | -131.800 | 2.729 | 44.700  | 0.168 | 19.300  | 0.478 | -87.400  | 1.015 | 11.363 |
| 3.0 | 0.149 | -147.600 | 2.359 | 30.200  | 0.190 | 12.500  | 0.453 | -96.200  | 1.072 | 9.303  |
| 4.0 | 0.092 | 146.900  | 1.921 | 3.400   | 0.240 | -2.500  | 0.387 | -116.200 | 1.114 | 6.980  |
| 5.0 | 0.175 | 74.000   | 1.669 | -24.300 | 0.292 | -20.500 | 0.284 | -150.600 | 1.116 | 5.501  |

V<sub>CE</sub> = 2.0 V, I<sub>C</sub> = 3.0 mA

|     |       |          |       |         |       |         |       |          |       |        |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.888 | -8.100   | 8.454 | 169.600 | 0.013 | 81.500  | 0.986 | -6.600   | 0.146 | 28.131 |
| 0.4 | 0.819 | -31.700  | 7.701 | 144.300 | 0.047 | 68.200  | 0.918 | -25.000  | 0.263 | 22.144 |
| 0.8 | 0.638 | -57.400  | 6.259 | 116.100 | 0.080 | 52.500  | 0.785 | -43.400  | 0.483 | 18.934 |
| 1.0 | 0.555 | -67.400  | 5.586 | 105.000 | 0.092 | 46.900  | 0.727 | -50.500  | 0.576 | 17.833 |
| 1.5 | 0.389 | -87.700  | 4.289 | 81.500  | 0.116 | 36.500  | 0.621 | -63.800  | 0.775 | 15.679 |
| 2.0 | 0.282 | -103.500 | 3.425 | 63.000  | 0.138 | 28.700  | 0.558 | -74.100  | 0.909 | 13.948 |
| 2.5 | 0.203 | -118.000 | 2.868 | 46.600  | 0.157 | 21.600  | 0.524 | -82.800  | 0.999 | 12.617 |
| 3.0 | 0.145 | -127.900 | 2.472 | 32.300  | 0.178 | 14.700  | 0.503 | -91.300  | 1.056 | 9.982  |
| 4.0 | 0.056 | -178.900 | 2.004 | 5.900   | 0.225 | -0.200  | 0.446 | -109.700 | 1.101 | 7.565  |
| 5.0 | 0.126 | 66.600   | 1.747 | -21.100 | 0.278 | -17.500 | 0.346 | -138.700 | 1.098 | 6.072  |

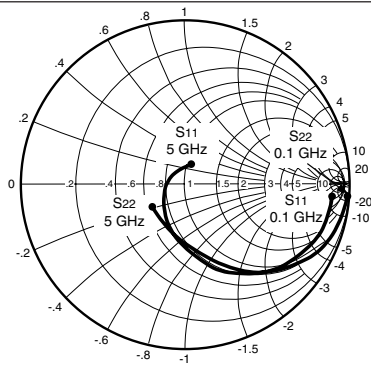
Note:

1. Gain Calculation:

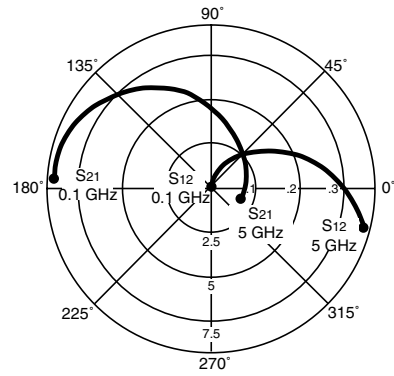
$$MAG = \frac{|S_{21}|}{|S_{12}|} \left( K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } MSG = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

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

Coordinates in Ohms  
Frequency in GHz  
( $V_{CE} = 1\text{ V}$ ,  $I_C = 3\text{ mA}$ )



## NE68619

 $V_{CE} = 0.5\text{ V}$ ,  $I_C = 0.5\text{ mA}$ 

| FREQUENCY<br>GHz | S11   |          | S21   |         | S12   |         | S22   |          | K     | MAG <sup>1</sup><br>(dB) |
|------------------|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------------------------|
|                  | MAG   | ANG      | MAG   | ANG     | MAG   | ANG     | MAG   | ANG      |       |                          |
| 0.1              | 0.978 | -5.400   | 1.736 | 170.700 | 0.020 | 84.800  | 0.997 | -4.700   | 0.096 | 19.385                   |
| 0.4              | 0.959 | -21.100  | 1.711 | 154.500 | 0.080 | 71.800  | 0.984 | -18.400  | 0.147 | 13.302                   |
| 0.8              | 0.897 | -41.100  | 1.617 | 131.200 | 0.148 | 54.700  | 0.936 | -34.900  | 0.289 | 10.384                   |
| 1.0              | 0.861 | -50.000  | 1.562 | 120.500 | 0.176 | 47.000  | 0.907 | -42.000  | 0.363 | 9.482                    |
| 1.5              | 0.758 | -72.300  | 1.414 | 96.300  | 0.227 | 30.200  | 0.827 | -56.800  | 0.526 | 7.944                    |
| 2.0              | 0.670 | -92.200  | 1.302 | 75.400  | 0.259 | 16.800  | 0.749 | -68.400  | 0.676 | 7.013                    |
| 2.5              | 0.591 | -110.700 | 1.211 | 56.800  | 0.281 | 5.400   | 0.685 | -78.100  | 0.809 | 6.344                    |
| 3.0              | 0.517 | -129.300 | 1.163 | 40.000  | 0.298 | -4.600  | 0.619 | -88.300  | 0.919 | 5.914                    |
| 4.0              | 0.372 | -167.900 | 1.088 | 7.900   | 0.321 | -23.200 | 0.488 | -113.800 | 1.126 | 3.145                    |
| 5.0              | 0.251 | 140.900  | 1.015 | -22.800 | 0.320 | -39.200 | 0.398 | -152.600 | 1.313 | 1.663                    |

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

|     |       |          |       |         |       |         |       |          |       |        |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.961 | -6.300   | 3.302 | 171.100 | 0.018 | 82.900  | 0.994 | -5.400   | 0.109 | 22.635 |
| 0.4 | 0.930 | -24.200  | 3.199 | 152.900 | 0.068 | 71.000  | 0.970 | -20.700  | 0.146 | 16.725 |
| 0.8 | 0.836 | -46.000  | 2.916 | 129.000 | 0.123 | 53.900  | 0.899 | -38.500  | 0.294 | 13.749 |
| 1.0 | 0.784 | -55.600  | 2.756 | 118.400 | 0.144 | 46.900  | 0.860 | -45.900  | 0.362 | 12.819 |
| 1.5 | 0.660 | -78.000  | 2.370 | 94.800  | 0.182 | 31.900  | 0.761 | -60.600  | 0.532 | 11.147 |
| 2.0 | 0.562 | -97.200  | 2.065 | 75.200  | 0.207 | 21.100  | 0.677 | -71.400  | 0.681 | 9.989  |
| 2.5 | 0.480 | -115.000 | 1.847 | 57.500  | 0.226 | 12.500  | 0.609 | -80.100  | 0.814 | 9.124  |
| 3.0 | 0.408 | -131.900 | 1.699 | 41.600  | 0.244 | 5.100   | 0.547 | -89.400  | 0.920 | 8.428  |
| 4.0 | 0.280 | -169.700 | 1.504 | 11.500  | 0.284 | -9.200  | 0.431 | -114.200 | 1.058 | 5.763  |
| 5.0 | 0.180 | 131.100  | 1.356 | -18.200 | 0.320 | -24.300 | 0.360 | -153.900 | 1.126 | 4.110  |

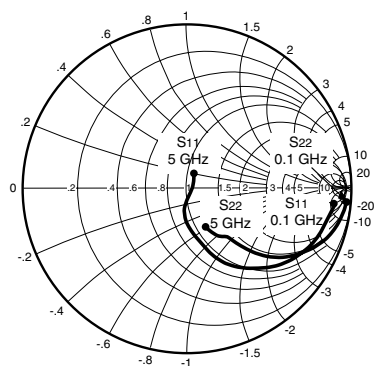
 $V_{CE} = 1.0\text{ V}$ ,  $I_C = 3.0\text{ mA}$ 

|     |       |          |       |         |       |         |       |          |       |        |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.892 | -9.200   | 8.262 | 169.100 | 0.016 | 82.600  | 0.977 | -8.000   | 0.118 | 27.130 |
| 0.4 | 0.787 | -37.400  | 7.340 | 140.500 | 0.061 | 65.500  | 0.886 | -29.400  | 0.281 | 20.804 |
| 0.8 | 0.588 | -64.400  | 5.668 | 111.800 | 0.100 | 50.400  | 0.721 | -48.500  | 0.523 | 17.534 |
| 1.0 | 0.508 | -74.400  | 4.989 | 100.900 | 0.114 | 45.500  | 0.658 | -54.700  | 0.622 | 16.411 |
| 1.5 | 0.364 | -94.500  | 3.743 | 78.900  | 0.142 | 37.000  | 0.548 | -64.600  | 0.819 | 14.209 |
| 2.0 | 0.282 | -110.800 | 2.989 | 61.800  | 0.168 | 30.900  | 0.483 | -70.900  | 0.943 | 12.502 |
| 2.5 | 0.223 | -124.100 | 2.515 | 46.400  | 0.197 | 24.800  | 0.439 | -75.600  | 1.020 | 10.186 |
| 3.0 | 0.179 | -140.000 | 2.202 | 32.500  | 0.226 | 18.500  | 0.400 | -82.000  | 1.062 | 8.366  |
| 4.0 | 0.104 | 168.400  | 1.825 | 6.200   | 0.293 | 3.400   | 0.309 | -103.900 | 1.086 | 6.160  |
| 5.0 | 0.127 | 70.800   | 1.587 | -20.100 | 0.355 | -14.700 | 0.242 | -147.500 | 1.081 | 4.769  |

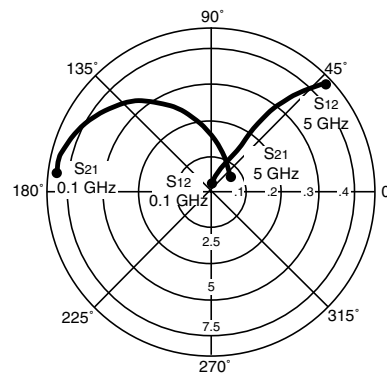
 $V_{CE} = 2.0\text{ V}$ ,  $I_C = 3.0\text{ mA}$ 

|     |       |          |       |         |       |         |       |          |       |        |
|-----|-------|----------|-------|---------|-------|---------|-------|----------|-------|--------|
| 0.1 | 0.904 | -9.100   | 8.282 | 169.400 | 0.015 | 80.300  | 0.982 | -7.500   | 0.146 | 27.420 |
| 0.4 | 0.802 | -34.800  | 7.456 | 142.400 | 0.056 | 66.800  | 0.902 | -27.800  | 0.266 | 21.243 |
| 0.8 | 0.619 | -60.300  | 5.880 | 114.400 | 0.094 | 51.800  | 0.748 | -46.500  | 0.498 | 17.962 |
| 1.0 | 0.542 | -70.200  | 5.215 | 103.600 | 0.107 | 46.700  | 0.686 | -52.800  | 0.593 | 16.879 |
| 1.5 | 0.403 | -89.400  | 3.951 | 81.500  | 0.134 | 37.900  | 0.576 | -63.000  | 0.786 | 14.696 |
| 2.0 | 0.315 | -105.000 | 3.172 | 64.500  | 0.159 | 31.700  | 0.509 | -69.600  | 0.912 | 12.999 |
| 2.5 | 0.260 | -117.100 | 2.670 | 49.100  | 0.185 | 25.800  | 0.464 | -74.500  | 0.995 | 11.593 |
| 3.0 | 0.216 | -130.900 | 2.337 | 35.400  | 0.213 | 19.500  | 0.424 | -80.800  | 1.040 | 9.182  |
| 4.0 | 0.134 | -168.900 | 1.938 | 9.200   | 0.276 | 4.900   | 0.334 | -102.000 | 1.071 | 6.832  |
| 5.0 | 0.094 | 96.000   | 1.691 | -17.000 | 0.337 | -12.900 | 0.265 | -143.300 | 1.070 | 5.392  |

See note on previous page.

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

Coordinates in Ohms  
Frequency in GHz  
( $V_{CE} = 1\text{ V}$ ,  $I_C = 3\text{ mA}$ )



## NE68630

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

| FREQUENCY<br>GHz | 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     |       |                          |
| 0.1              | 0.958           | -5.400   | 3.367           | 172.000 | 0.025           | 84.700 | 0.991           | -5.000  | 0.099 | 21.293                   |
| 0.4              | 0.910           | -22.800  | 3.220           | 153.400 | 0.092           | 73.800 | 0.949           | -18.900 | 0.194 | 15.441                   |
| 0.8              | 0.785           | -42.300  | 2.873           | 131.200 | 0.162           | 61.200 | 0.843           | -34.100 | 0.366 | 12.488                   |
| 1.0              | 0.712           | -50.100  | 2.675           | 121.800 | 0.189           | 56.600 | 0.788           | -40.100 | 0.451 | 11.509                   |
| 1.5              | 0.557           | -67.000  | 2.254           | 102.100 | 0.234           | 48.200 | 0.665           | -51.500 | 0.636 | 9.837                    |
| 2.0              | 0.438           | -80.000  | 1.929           | 87.000  | 0.264           | 43.800 | 0.577           | -58.900 | 0.785 | 8.637                    |
| 2.5              | 0.340           | -90.100  | 1.708           | 74.600  | 0.288           | 41.800 | 0.516           | -64.200 | 0.903 | 7.731                    |
| 3.0              | 0.262           | -98.500  | 1.552           | 64.300  | 0.310           | 40.900 | 0.475           | -68.800 | 0.985 | 6.995                    |
| 4.0              | 0.137           | -117.500 | 1.336           | 47.900  | 0.364           | 40.300 | 0.407           | -76.700 | 1.073 | 3.998                    |
| 5.0              | 0.081           | 159.300  | 1.247           | 33.800  | 0.432           | 37.900 | 0.318           | -89.800 | 1.072 | 2.961                    |

 $V_{CE} = 1.0\text{ V}$ ,  $I_C = 3.0\text{ mA}$ 

|     |       |         |       |         |       |        |       |         |       |        |
|-----|-------|---------|-------|---------|-------|--------|-------|---------|-------|--------|
| 0.1 | 0.887 | -10.600 | 8.217 | 167.700 | 0.024 | 81.700 | 0.969 | -8.500  | 0.154 | 25.345 |
| 0.4 | 0.718 | -40.600 | 6.754 | 137.100 | 0.078 | 66.700 | 0.815 | -28.700 | 0.386 | 19.375 |
| 0.8 | 0.480 | -64.500 | 4.780 | 111.800 | 0.121 | 58.200 | 0.612 | -41.300 | 0.676 | 15.966 |
| 1.0 | 0.391 | -72.000 | 4.086 | 103.500 | 0.138 | 56.800 | 0.546 | -44.200 | 0.785 | 14.714 |
| 1.5 | 0.251 | -85.900 | 2.992 | 87.800  | 0.176 | 55.700 | 0.447 | -47.600 | 0.962 | 12.304 |
| 2.0 | 0.165 | -94.200 | 2.373 | 76.600  | 0.214 | 55.000 | 0.399 | -49.000 | 1.054 | 9.032  |
| 2.5 | 0.098 | -96.600 | 1.993 | 67.300  | 0.252 | 54.100 | 0.375 | -50.200 | 1.100 | 7.058  |
| 3.0 | 0.051 | -88.500 | 1.745 | 59.200  | 0.288 | 52.600 | 0.363 | -52.200 | 1.118 | 5.731  |
| 4.0 | 0.042 | 17.300  | 1.428 | 46.400  | 0.362 | 48.400 | 0.337 | -56.900 | 1.124 | 3.817  |
| 5.0 | 0.099 | 60.800  | 1.280 | 35.400  | 0.433 | 43.400 | 0.264 | -63.300 | 1.104 | 2.741  |

 $V_{CE} = 1.0\text{ V}$ ,  $I_C = 5.0\text{ mA}$ 

|     |       |         |        |         |       |        |       |         |       |        |
|-----|-------|---------|--------|---------|-------|--------|-------|---------|-------|--------|
| 0.1 | 0.826 | -13.600 | 11.659 | 165.100 | 0.023 | 80.000 | 0.949 | -11.200 | 0.194 | 27.049 |
| 0.4 | 0.613 | -46.800 | 8.787  | 130.400 | 0.073 | 66.900 | 0.736 | -35.200 | 0.471 | 20.805 |
| 0.8 | 0.379 | -69.300 | 5.730  | 105.800 | 0.116 | 62.200 | 0.520 | -47.300 | 0.753 | 16.937 |
| 1.0 | 0.303 | -75.700 | 4.805  | 98.200  | 0.134 | 61.600 | 0.459 | -49.900 | 0.842 | 15.546 |
| 1.5 | 0.190 | -86.800 | 3.434  | 83.800  | 0.181 | 60.900 | 0.375 | -52.900 | 0.959 | 12.781 |
| 2.0 | 0.123 | -93.300 | 2.693  | 73.300  | 0.227 | 59.400 | 0.338 | -54.600 | 1.012 | 10.084 |
| 2.5 | 0.074 | -93.100 | 2.251  | 64.500  | 0.273 | 57.300 | 0.321 | -56.500 | 1.032 | 8.058  |
| 3.0 | 0.043 | -80.100 | 1.958  | 56.800  | 0.316 | 54.700 | 0.315 | -59.400 | 1.040 | 6.692  |
| 4.0 | 0.029 | 17.700  | 1.595  | 44.000  | 0.401 | 48.600 | 0.294 | -67.500 | 1.040 | 4.770  |
| 5.0 | 0.088 | 80.400  | 1.427  | 32.300  | 0.480 | 41.700 | 0.218 | -82.000 | 1.028 | 3.714  |

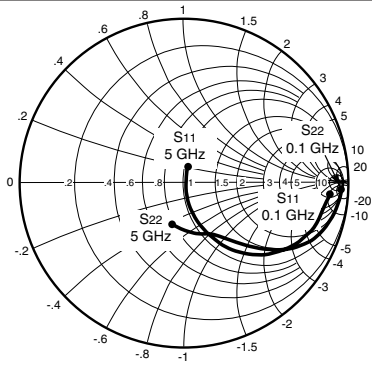
 $V_{CE} = 2.0\text{ V}$ ,  $I_C = 3.0\text{ mA}$ 

|     |       |         |       |         |       |        |       |         |       |        |
|-----|-------|---------|-------|---------|-------|--------|-------|---------|-------|--------|
| 0.1 | 0.898 | -9.500  | 8.250 | 168.600 | 0.022 | 83.000 | 0.975 | -7.900  | 0.132 | 25.740 |
| 0.4 | 0.749 | -35.900 | 6.999 | 139.900 | 0.075 | 69.200 | 0.841 | -27.500 | 0.357 | 19.700 |
| 0.8 | 0.525 | -57.500 | 5.127 | 114.800 | 0.121 | 60.800 | 0.645 | -41.300 | 0.625 | 16.271 |
| 1.0 | 0.438 | -64.300 | 4.423 | 106.300 | 0.138 | 59.000 | 0.577 | -44.900 | 0.727 | 15.058 |
| 1.5 | 0.297 | -75.100 | 3.271 | 90.100  | 0.178 | 57.400 | 0.470 | -49.400 | 0.896 | 12.643 |
| 2.0 | 0.209 | -80.300 | 2.599 | 78.700  | 0.217 | 56.200 | 0.416 | -51.600 | 0.988 | 10.783 |
| 2.5 | 0.148 | -81.000 | 2.187 | 69.000  | 0.256 | 55.000 | 0.389 | -53.100 | 1.033 | 8.201  |
| 3.0 | 0.107 | -73.500 | 1.909 | 60.900  | 0.294 | 53.300 | 0.375 | -55.300 | 1.056 | 6.682  |
| 4.0 | 0.064 | -42.400 | 1.558 | 47.800  | 0.370 | 49.000 | 0.349 | -60.600 | 1.068 | 4.653  |
| 5.0 | 0.049 | 43.000  | 1.397 | 36.400  | 0.444 | 43.600 | 0.276 | -69.000 | 1.057 | 3.522  |

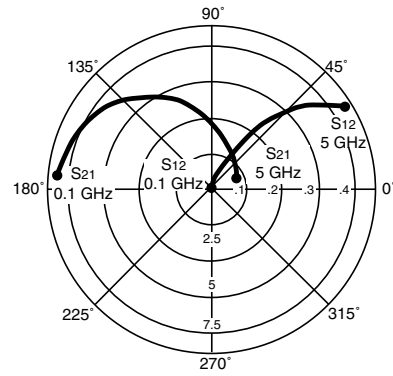
See note on next page

# NE686 SERIES

## TYPICAL SCATTERING PARAMETERS (T<sub>A</sub> = 25°C)



Coordinates in Ohms  
Frequency in GHz  
(V<sub>CE</sub> = 1 V, I<sub>c</sub> = 3 mA)



### NE68633

V<sub>CE</sub> = 1.0 V, I<sub>c</sub> = 1.0 mA

|     |       |          |       |         |       |        |       |          |       |        |
|-----|-------|----------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.951 | -4.800   | 3.286 | 170.200 | 0.022 | 85.000 | 0.992 | -4.400   | 0.139 | 21.742 |
| 0.4 | 0.916 | -20.800  | 3.203 | 154.600 | 0.079 | 74.800 | 0.958 | -17.000  | 0.196 | 16.079 |
| 0.8 | 0.793 | -39.700  | 2.914 | 131.500 | 0.142 | 62.200 | 0.862 | -31.200  | 0.386 | 13.122 |
| 1.0 | 0.723 | -47.500  | 2.730 | 121.800 | 0.167 | 57.400 | 0.811 | -37.000  | 0.471 | 12.134 |
| 1.5 | 0.560 | -65.000  | 2.338 | 100.900 | 0.212 | 48.200 | 0.685 | -48.700  | 0.663 | 10.425 |
| 2.0 | 0.415 | -78.500  | 2.017 | 83.600  | 0.242 | 42.800 | 0.588 | -57.400  | 0.832 | 9.209  |
| 2.5 | 0.304 | -92.200  | 1.786 | 69.500  | 0.266 | 39.500 | 0.518 | -65.000  | 0.947 | 8.270  |
| 3.0 | 0.222 | -104.600 | 1.607 | 57.600  | 0.290 | 37.600 | 0.468 | -72.500  | 1.025 | 6.458  |
| 4.0 | 0.100 | -144.900 | 1.389 | 38.200  | 0.347 | 34.900 | 0.402 | -87.600  | 1.079 | 4.313  |
| 5.0 | 0.095 | 123.200  | 1.260 | 21.000  | 0.422 | 30.400 | 0.349 | -107.900 | 1.057 | 3.286  |

V<sub>CE</sub> = 1.0 V, I<sub>c</sub> = 3.0 mA

|     |       |         |       |         |       |        |       |          |       |        |
|-----|-------|---------|-------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.889 | -8.500  | 8.189 | 167.000 | 0.021 | 85.000 | 0.973 | -7.600   | 0.147 | 25.910 |
| 0.4 | 0.750 | -33.500 | 7.038 | 139.600 | 0.070 | 70.100 | 0.847 | -26.100  | 0.380 | 20.024 |
| 0.8 | 0.519 | -53.800 | 5.176 | 112.800 | 0.114 | 61.600 | 0.658 | -39.300  | 0.661 | 16.571 |
| 1.0 | 0.432 | -59.900 | 4.470 | 103.500 | 0.133 | 59.500 | 0.592 | -42.900  | 0.760 | 15.265 |
| 1.5 | 0.285 | -69.900 | 3.309 | 86.100  | 0.175 | 56.700 | 0.481 | -48.700  | 0.920 | 12.767 |
| 2.0 | 0.186 | -74.600 | 2.641 | 72.600  | 0.217 | 54.200 | 0.419 | -53.200  | 1.002 | 10.604 |
| 2.5 | 0.113 | -78.500 | 2.218 | 61.600  | 0.259 | 51.400 | 0.379 | -58.600  | 1.038 | 8.139  |
| 3.0 | 0.065 | -74.200 | 1.934 | 51.900  | 0.301 | 48.100 | 0.353 | -65.200  | 1.051 | 6.692  |
| 4.0 | 0.019 | 36.600  | 1.606 | 35.700  | 0.384 | 40.600 | 0.311 | -81.600  | 1.044 | 4.938  |
| 5.0 | 0.099 | 72.600  | 1.426 | 20.500  | 0.467 | 31.800 | 0.262 | -104.700 | 1.023 | 3.921  |

V<sub>CE</sub> = 1.0 V, I<sub>c</sub> = 5.0 mA

|     |       |         |        |         |       |        |       |          |       |        |
|-----|-------|---------|--------|---------|-------|--------|-------|----------|-------|--------|
| 0.1 | 0.826 | -11.900 | 11.534 | 163.800 | 0.021 | 84.800 | 0.955 | -9.700   | 0.176 | 27.398 |
| 0.4 | 0.623 | -40.600 | 8.878  | 130.600 | 0.064 | 69.300 | 0.761 | -30.000  | 0.507 | 21.421 |
| 0.8 | 0.385 | -57.600 | 5.834  | 104.700 | 0.105 | 64.100 | 0.563 | -39.700  | 0.796 | 17.448 |
| 1.0 | 0.311 | -61.900 | 4.901  | 96.300  | 0.123 | 63.100 | 0.507 | -41.700  | 0.877 | 16.004 |
| 1.5 | 0.193 | -66.600 | 3.501  | 81.000  | 0.169 | 60.900 | 0.424 | -45.400  | 0.986 | 13.163 |
| 2.0 | 0.121 | -64.700 | 2.751  | 69.000  | 0.216 | 58.000 | 0.379 | -49.200  | 1.029 | 9.999  |
| 2.5 | 0.069 | -57.300 | 2.294  | 58.900  | 0.263 | 54.300 | 0.349 | -54.800  | 1.043 | 8.138  |
| 3.0 | 0.043 | -32.000 | 1.986  | 49.900  | 0.307 | 50.300 | 0.329 | -61.900  | 1.049 | 6.761  |
| 4.0 | 0.047 | 46.100  | 1.640  | 34.400  | 0.394 | 41.600 | 0.292 | -79.400  | 1.034 | 5.066  |
| 5.0 | 0.120 | 65.700  | 1.452  | 19.800  | 0.477 | 32.000 | 0.243 | -103.700 | 1.016 | 4.066  |

V<sub>CE</sub> = 2.0 V, I<sub>c</sub> = 3.0 mA

|     |       |         |       |         |       |        |       |         |       |        |
|-----|-------|---------|-------|---------|-------|--------|-------|---------|-------|--------|
| 0.1 | 0.894 | -7.900  | 8.161 | 167.300 | 0.018 | 84.000 | 0.978 | -7.000  | 0.161 | 26.565 |
| 0.4 | 0.766 | -31.100 | 7.109 | 141.000 | 0.066 | 71.500 | 0.862 | -24.300 | 0.372 | 20.323 |
| 0.8 | 0.544 | -50.100 | 5.308 | 114.600 | 0.109 | 62.900 | 0.682 | -37.000 | 0.650 | 16.875 |
| 1.0 | 0.460 | -55.400 | 4.601 | 105.300 | 0.127 | 60.800 | 0.618 | -40.500 | 0.749 | 15.590 |
| 1.5 | 0.311 | -63.800 | 3.423 | 88.000  | 0.168 | 57.800 | 0.509 | -46.200 | 0.908 | 13.091 |
| 2.0 | 0.217 | -66.800 | 2.731 | 74.700  | 0.209 | 55.500 | 0.448 | -50.500 | 0.990 | 11.162 |
| 2.5 | 0.147 | -67.800 | 2.297 | 63.800  | 0.249 | 52.600 | 0.409 | -55.600 | 1.028 | 8.616  |
| 3.0 | 0.102 | -63.900 | 2.002 | 54.100  | 0.290 | 49.400 | 0.384 | -61.800 | 1.042 | 7.129  |
| 4.0 | 0.042 | -34.200 | 1.655 | 38.200  | 0.370 | 42.400 | 0.345 | -76.800 | 1.038 | 5.306  |
| 5.0 | 0.068 | 52.700  | 1.475 | 23.200  | 0.453 | 34.000 | 0.296 | -97.100 | 1.018 | 4.311  |

Note:

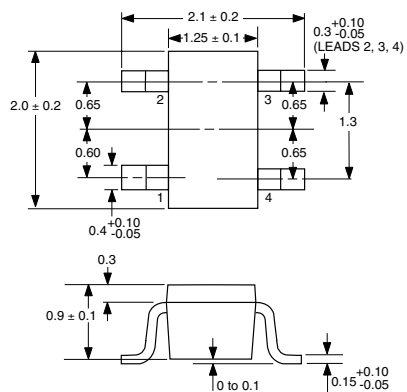
1. Gain Calculation:

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

MAG = Maximum Available Gain

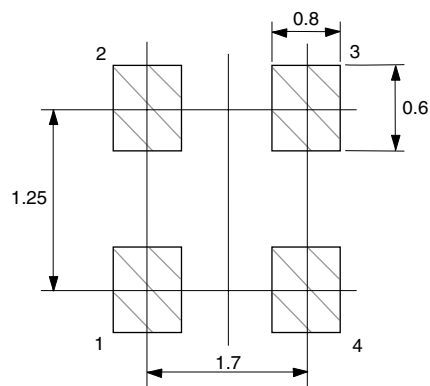
MSG = Maximum Stable Gain

## OUTLINE DIMENSIONS (Units in mm)

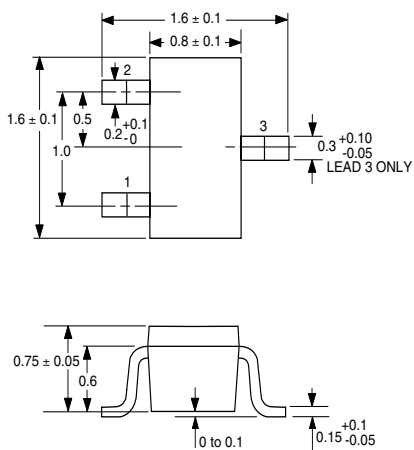
PACKAGE OUTLINE 18  
(SOT-343)

## LEAD CONNECTIONS

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

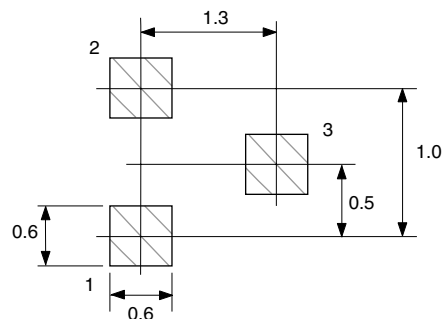
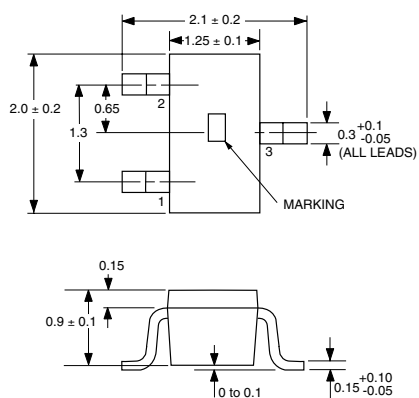
OUTLINE 18  
RECOMMENDED P.C.B. LAYOUT

PACKAGE OUTLINE 19



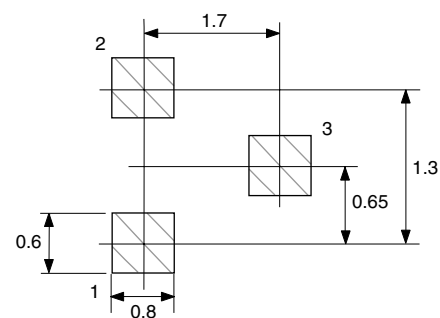
## LEAD CONNECTIONS

1. Emitter
2. Base
3. Collector

OUTLINE 19  
RECOMMENDED P.C.B. LAYOUTPACKAGE OUTLINE 30  
(SOT-323)

## LEAD CONNECTIONS

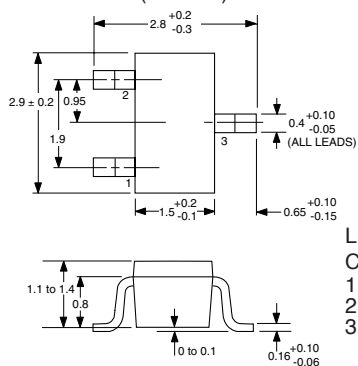
1. Emitter
2. Base
3. Collector

OUTLINE 30  
RECOMMENDED P.C.B. LAYOUT

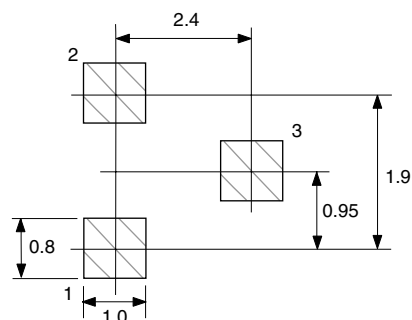
# OUTLINE DIMENSIONS (Units in mm)

## PACKAGE OUTLINE 33

(SOT-23)

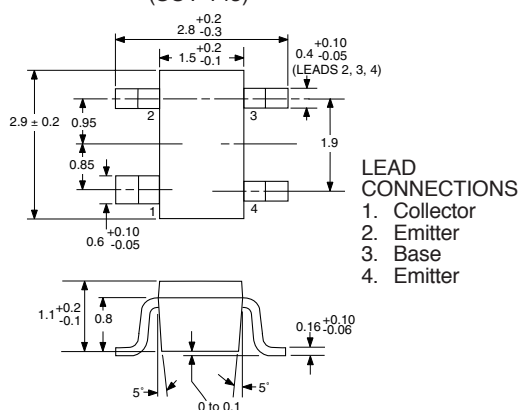


## OUTLINE 33 RECOMMENDED P.C.B. LAYOUT

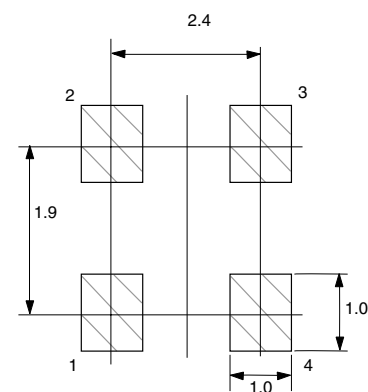


## PACKAGE OUTLINE 39

(SOT-143)

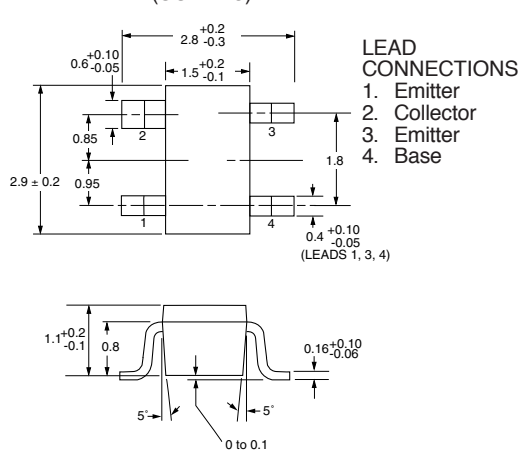


## OUTLINE 39 RECOMMENDED P.C.B. LAYOUT

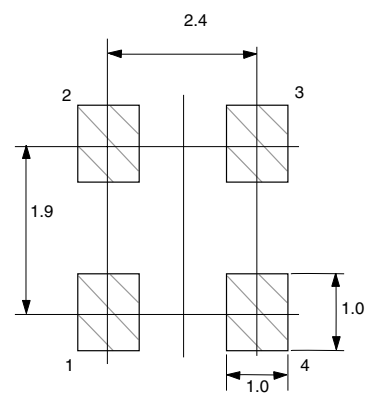


## PACKAGE OUTLINE 39R

(SOT-143)



## OUTLINE 39R RECOMMENDED P.C.B. LAYOUT



**ORDERING INFORMATION**

| PART NUMBER  | QUANTITY | PACKAGING   |
|--------------|----------|-------------|
| NE68618-T1-A | 3000     | Tape & Reel |
| NE68619-T1-A | 3000     | Tape & Reel |
| NE68630-T1   | 3000     | Tape & Reel |
| NE68633-T1   | 3000     | Tape & Reel |
| NE68639-T1   | 3000     | Tape & Reel |
| NE68639R-T1  | 3000     | Tape & Reel |

Note:

1. Lead material: Cu  
Lead plating: PbSn

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