

FEATURES

- **HIGH INSERTION GAIN:** 18.5 dB at 500 MHz
- **LOW NOISE FIGURE:** 1.5 dB at 500 MHz
- **HIGH POWER GAIN:** 12 dB at 2 GHz
- **LARGE DYNAMIC RANGE:** 19 dBm at 1 dB, 2 GHz Gain Compression

DESCRIPTION

NEC's NE021 series of NPN silicon transistors provides economical solutions to wide ranges of amplifier and oscillator problems. Low noise and high current capability provide low intermodulation distortion. The NE021 series is available as a chip or in several package styles. The series uses the NEC gold, platinum, titanium, and platinum-silicide metallization system to provide the utmost in reliability. NE02107 is available in both common-base and common-emitter configurations and has been qualified for high-reliability space applications.

NE02135

TYPICAL NOISE PARAMETERS (T_A = 25°C)

| FREQ. (MHz) | NF _{OPT} (dB) | GA (dB) | Γ _{OPT} | | Rn/50 |
|---|---------------------------|------------|------------------|------|-------|
| | | | MAG | ANG | |
| V_{CE} = 10 V, I_c = 5 mA | | | | | |
| 500 | 1.2 | 18.60 | .36 | 69 | .14 |
| 1000 | 1.5 | 13.82 | .31 | 124 | .12 |
| 1500 | 2.0 | 11.83 | .50 | 165 | .05 |
| 2000 | 2.4 | 9.36 | .44 | -175 | .06 |
| 2500 | 2.6 | 7.82 | .52 | -161 | .10 |
| 3000 | 3.6 | 7.51 | .68 | -141 | .14 |
| 3500 | 3.7 | 6.31 | .71 | -139 | .21 |
| V_{CE} = 10 V, I_c = 20 mA | | | | | |
| 500 | 1.8 | 21.32 | .16 | 149 | .15 |
| 1000 | 1.9 | 16.15 | .33 | 169 | .13 |
| 1500 | 2.4 | 13.50 | .46 | -179 | .09 |
| 2000 | 2.9 | 11.02 | .53 | -167 | .08 |
| 2500 | 3.2 | 9.12 | .57 | -154 | .14 |
| 3000 | 3.9 | 8.10 | .62 | -139 | .27 |
| 3500 | 4.3 | 6.48 | .67 | -134 | .42 |

PLEASE NOTE:

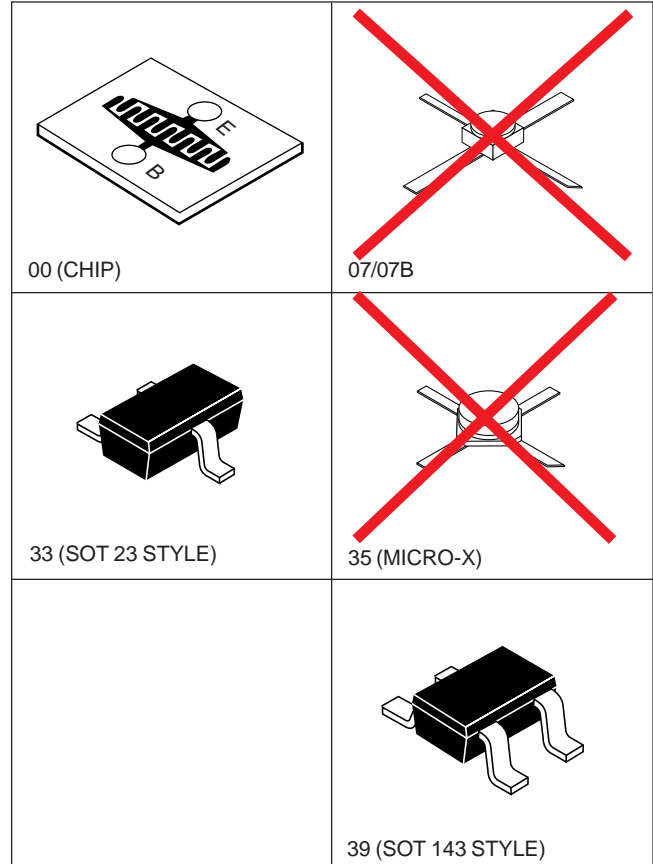
The following part numbers from this datasheet are nonpromotive:

NE02100
NE02133
NE02139

The following part numbers from this datasheet are discontinued:

NE02107
NE02135

Please call sales office for details.



NE02139

TYPICAL NOISE PARAMETERS (T_A = 25°C)

| FREQ. (MHz) | NF _{OPT} (dB) | GA (dB) | Γ _{OPT} | | Rn/50 |
|---|---------------------------|------------|------------------|------|-------|
| | | | MAG | ANG | |
| V_{CE} = 10 V, I_c = 20 mA | | | | | |
| 500 | 1.8 | 17.5 | 0.11 | 156 | .20 |
| 1000 | 2.1 | 12.5 | 0.27 | 168 | .16 |
| 1500 | 2.3 | 9.5 | 0.36 | -156 | .18 |
| 2000 | 2.6 | 7.5 | 0.43 | -147 | .21 |

NE021 SERIES

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

| PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE | | | NE02100 00 (CHIP) | | | NE02107 07/07B ³ | | |
|---|--|-------|----------------------|------|-----|--------------------------------|------|-----|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX |
| f _T | Gain Bandwidth Product at V _{CE} = 10 V, I _C = 20 mA | GHz | | 4.5 | | | 4.5 | |
| S ₂₁ ² | Insertion Power Gain at V _{CE} = 10 V, I _C = 20 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz | dB | | 18.5 | | | 18.5 | |
| | | dB | | 13 | | | 13 | |
| | | dB | 5.5 | 6.5 | | 5.5 | 6.5 | |
| NF _{MIN} | Minimum Noise Figure ² at V _{CE} = 10 V, I _C = 3 mA, f = 0.5 GHz V _{CE} = 10 V, I _C = 5 mA, f = 2 GHz | dB | | 1.5 | | | 1.5 | |
| | | dB | | 2.7 | 4.5 | | 2.7 | 4.5 |
| I _{CBO} | Collector Cutoff Current at V _{CB} = 15 V, I _E = 0 | μA | | | 1.0 | | | 1.0 |
| I _{EBO} | Emitter Cutoff Current at V _{EB} = 2 V, I _C = 0 | μA | | | 1.0 | | | 1.0 |
| h _{FE} | Forward Current Gain at V _{CE} = 10 V, I _C = 20 mA | | 20 | 70 | 250 | 20 | 70 | 250 |
| C _{CB} | Collector to Base Capacitance ⁴ at V _{CB} = 10 V, I _E = 0, f = 1 MHz | pF | | 0.6 | 1.0 | | 0.6 | 1.0 |
| R _{TH (J-C)} | Thermal Resistance (Junction to Case) | °C/W | | | 70 | | | 90 |
| R _{TH (J-A)} | Thermal Resistance (Junction to Ambient) | °C/W | | | | | | 500 |
| P _T ⁵ | Total Power Dissipation | mW | 580 | | 700 | 350 | | 700 |

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

| PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE | | | NE02133 2SC2351 33 | | | NE02135 2SC2149 35 | | | NE02139 2SC4092 39 | | |
|---|---|-------|--------------------------|------|-----|--------------------------|------|-----|--------------------------|-----|-----|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| f _T | Gain Bandwidth Product at V _{CE} = 10 V, I _C = 20 mA | GHz | | 4.5 | | | 4.5 | | | 4.5 | |
| S _{21E} ² | Insertion Power Gain at V _{CE} = 10 V, I _C = 20 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz | dB | | 15 | | | 18.5 | | | | |
| | | dB | 9 | 10 | | | 13 | | 9 | 10 | |
| | | dB | 4 | 5 | | 5 | 5.7 | | | | |
| NF _{MIN} | Minimum Noise Figure ⁶ at V _{CE} = 10 V, I _C = 3 mA, f = 0.5 GHz V _{CE} = 10 V, I _C = 5 mA, f = 1 GHz f = 2 GHz | dB | | | | | 1.5 | | | | |
| | | dB | | 1.5 | 3 | | | | | 1.5 | |
| | | dB | | | | | 2.7 | 4.0 | | | |
| I _{CBO} | Collector Cutoff Current at V _{CB} = 15 V, I _E = 0 | μA | | | 1.0 | | | 1.0 | | | 1.0 |
| I _{EBO} | Emitter Cutoff Current at V _{EB} = 2 V, I _C = 0 | μA | | | 1.0 | | | 1.0 | | | 1.0 |
| h _{FE} | Forward Current Gain at V _{CE} = 10 V, I _C = 20 mA | | 40 | 70 | 200 | 20 | 70 | 250 | 40 | 70 | 200 |
| C _{CB} | Collector to Base Capacitance ⁴ at V _{CB} = 10 V, I _E = 0, f = 1 MHz | pF | | 0.75 | 1.0 | | 0.6 | 1.0 | | .75 | |
| R _{TH (J-C)} | Thermal Resistance (Junction to Case) | °C/W | | | | | | 120 | | | |
| R _{TH (J-A)} | Thermal Resistance (Junction to Ambient) | °C/W | | | 666 | | | 600 | | | 500 |
| P _T ⁵ | Total Power Dissipation | mW | | | 150 | 290 | | 500 | | | 200 |

Notes:

- Electronic Industrial Association of Japan.
- Input and output are tuned for optimum noise figures.
- Common base electrical characteristics see S-Parameters.
- C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
- Minimum dissipations based on R_{TH (J-A)} for applications without effective heat sink, maximum dissipations based on R_{TH (J-C)} for applications with effective heat sink.
- Output and Input are tuned for minimum noise figure.

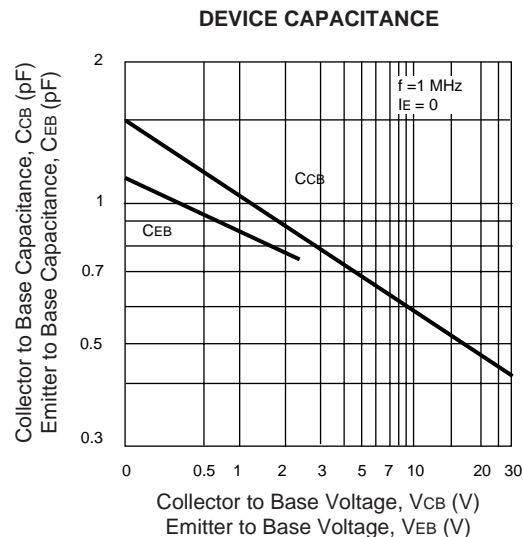
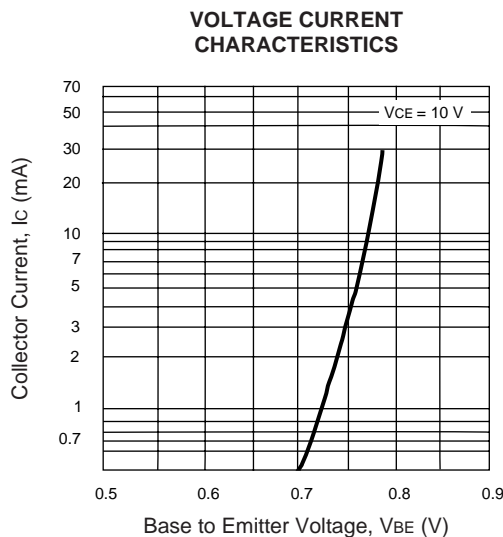
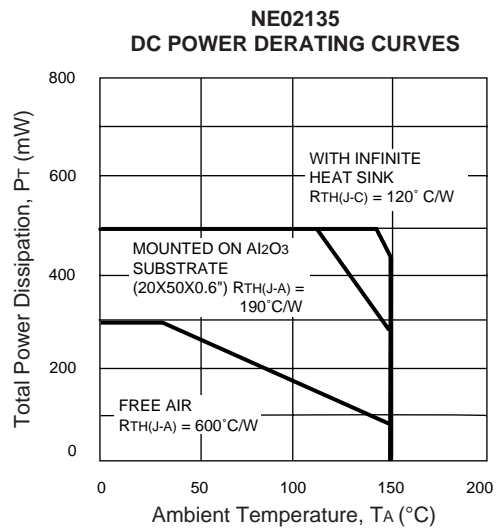
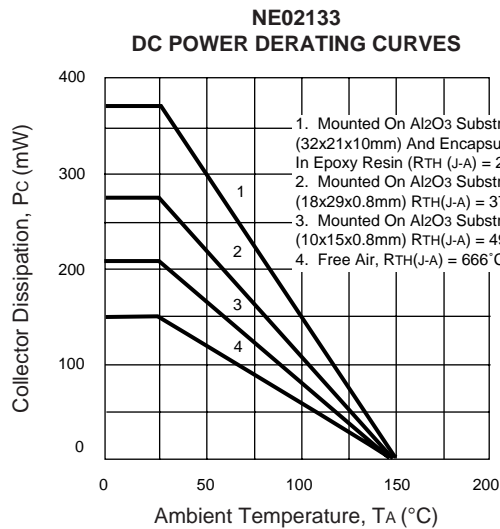
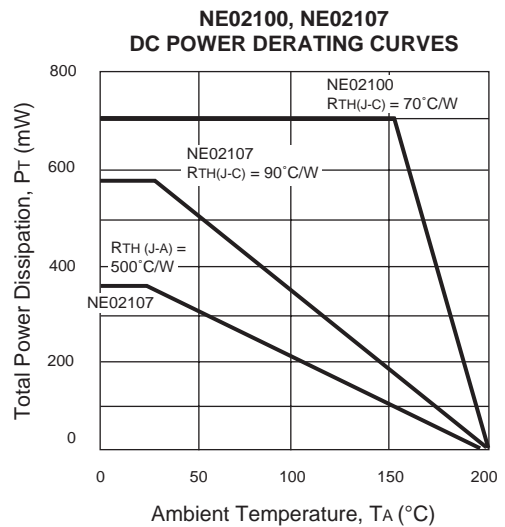
ABSOLUTE MAXIMUM RATINGS¹ (T_A = 25°C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|------------------------------|-------|--------------------------|
| V _{CB0} | Collector to Base Voltage | V | 25 |
| V _{CEO} | Collector to Emitter Voltage | V | 12 ² |
| V _{EB0} | Emitter to Base Voltage | V | 3 |
| I _C | Collector Current | mA | 70 |
| T _J | Junction Temperature | °C | 200 ³ |
| T _{STG} | Storage Temperature | °C | -65 to +200 ⁴ |

Notes:

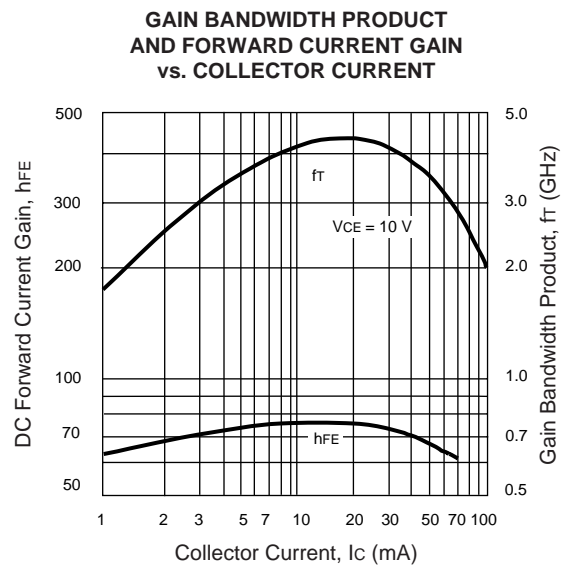
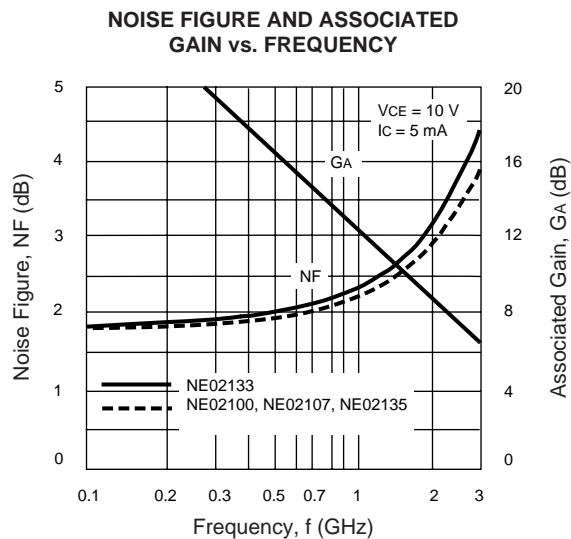
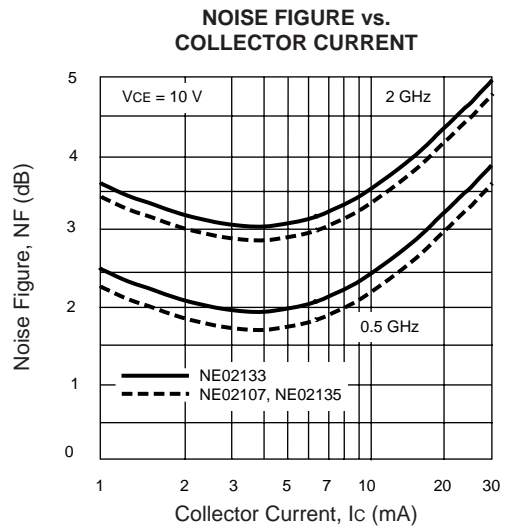
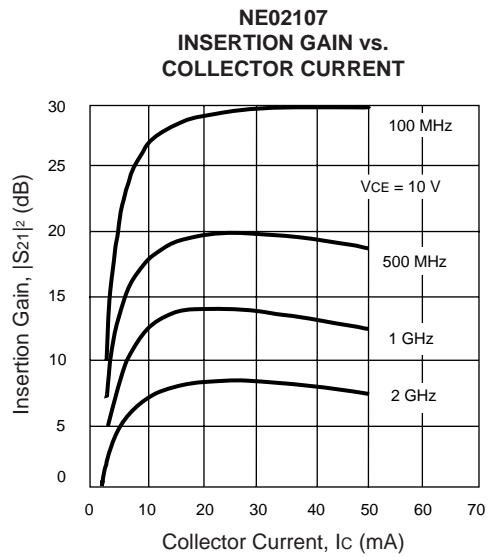
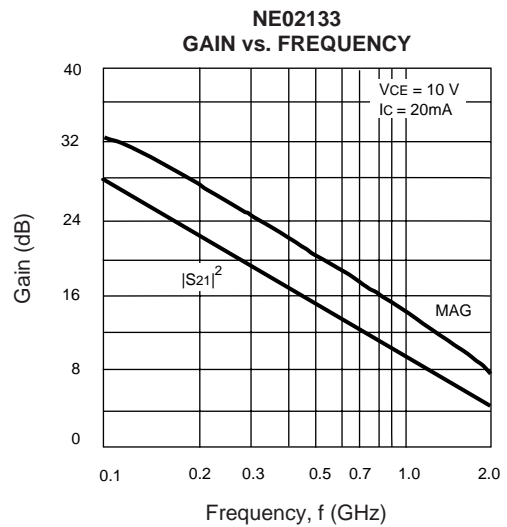
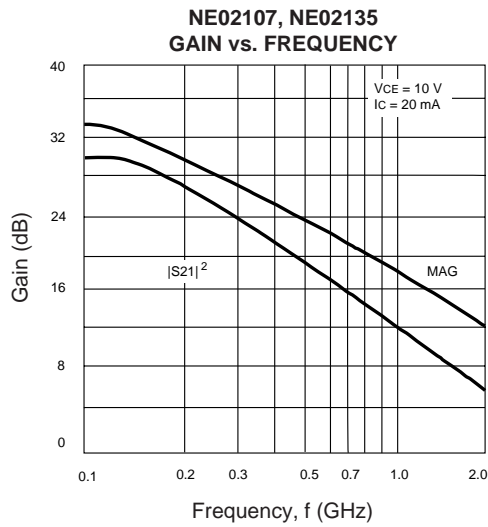
1. Operation in excess of any one of these parameters may result in permanent damage.
2. Typical BV_{CEr} = 25 V for R ≤ 300 Ω.
3. Maximum T_J for the NE02133 and NE02139 is +150°C.
4. Maximum storage temperature for the NE02135 is -65 to +150°C. Maximum storage temperature for the NE02133 and NE02139 is -55 to 150°C.

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

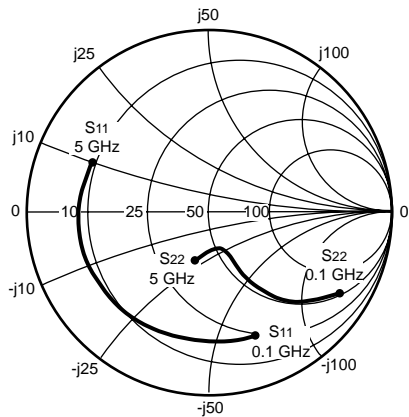


NE021 SERIES

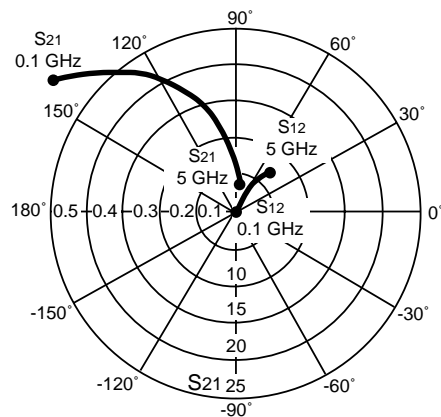
TYPICAL PERFORMANCE CURVES (T_A = 25°C)



TYPICAL COMMON EMITTER SCATTERING PARAMETERS¹ (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_c = 20 mA)



NE02100

V_{CE} = 10 V, I_c = 5 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ² (dB) |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|------|------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 100 | .84 | -32 | 11.83 | 160 | .03 | 70 | .94 | -16 | .11 | 26.4 |
| 500 | .75 | -114 | 7.22 | 113 | .07 | 36 | .56 | -45 | .29 | 19.9 |
| 1000 | .73 | -150 | 4.13 | 89 | .09 | 27 | .39 | -51 | .54 | 16.9 |
| 1500 | .71 | -164 | 2.85 | 76 | .09 | 27 | .36 | -56 | .77 | 15.0 |
| 2000 | .71 | -173 | 2.16 | 66 | .10 | 28 | .33 | -61 | .97 | 13.5 |
| 2500 | .71 | -179 | 1.75 | 57 | .10 | 30 | .33 | -67 | 1.14 | 10.1 |
| 3000 | .70 | 176 | 1.49 | 49 | .11 | 32 | .34 | -73 | 1.25 | 8.3 |
| 3500 | .70 | 172 | 1.28 | 42 | .12 | 33 | .35 | -80 | 1.35 | 6.9 |
| 4000 | .70 | 168 | 1.13 | 34 | .12 | 34 | .37 | -88 | 1.41 | 5.9 |
| 4500 | .70 | 165 | 1.02 | 27 | .13 | 34 | .39 | -94 | 1.47 | 4.9 |
| 5000 | .70 | 161 | .92 | 20 | .14 | 35 | .41 | -100 | 1.49 | 4.2 |

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

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|------|------|
| 100 | .75 | -47 | 20.04 | 153 | .02 | 65 | .89 | -24 | .11 | 29.2 |
| 500 | .72 | -137 | 9.40 | 105 | .05 | 34 | .41 | -57 | .39 | 22.5 |
| 1000 | .72 | -162 | 4.97 | 86 | .06 | 34 | .27 | -62 | .69 | 19.0 |
| 1500 | .71 | -173 | 3.37 | 75 | .07 | 38 | .23 | -66 | .92 | 16.8 |
| 2000 | .71 | -179 | 2.56 | 66 | .08 | 41 | .22 | -71 | 1.09 | 13.2 |
| 2500 | .71 | 176 | 2.05 | 58 | .09 | 43 | .23 | -76 | 1.19 | 10.9 |
| 3000 | .71 | 172 | 1.74 | 51 | .10 | 44 | .24 | -82 | 1.27 | 9.2 |
| 3500 | .71 | 168 | 1.50 | 44 | .11 | 44 | .25 | -88 | 1.31 | 7.9 |
| 4000 | .70 | 165 | 1.33 | 37 | .12 | 44 | .27 | -95 | 1.36 | 6.8 |
| 4500 | .70 | 162 | 1.19 | 30 | .13 | 44 | .29 | -100 | 1.39 | 5.9 |
| 5000 | .70 | 159 | 1.08 | 24 | .14 | 43 | .31 | -106 | 1.39 | 5.1 |

V_{CE} = 10 V, I_c = 20 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|------|------|
| 100 | .68 | -70 | 29.75 | 145 | .02 | 59 | .81 | -33 | .14 | 31.6 |
| 500 | .72 | -152 | 10.58 | 99 | .04 | 37 | .30 | -65 | .53 | 24.3 |
| 1000 | .72 | -170 | 5.42 | 84 | .05 | 43 | .19 | -69 | .87 | 20.4 |
| 1500 | .72 | -178 | 3.65 | 74 | .06 | 48 | .17 | -73 | 1.05 | 16.4 |
| 2000 | .72 | 177 | 2.74 | 66 | .07 | 50 | .17 | -78 | 1.17 | 13.2 |
| 2500 | .72 | 172 | 2.21 | 58 | .09 | 51 | .17 | -83 | 1.23 | 11.3 |
| 3000 | .71 | 169 | 1.86 | 51 | .10 | 52 | .19 | -87 | 1.27 | 9.7 |
| 3500 | .71 | 166 | 1.61 | 44 | .11 | 51 | .20 | -93 | 1.30 | 8.4 |
| 4000 | .71 | 162 | 1.42 | 38 | .12 | 51 | .22 | -99 | 1.34 | 7.3 |
| 4500 | .71 | 160 | 1.28 | 31 | .13 | 49 | .24 | -105 | 1.33 | 6.4 |
| 5000 | .71 | 157 | 1.15 | 25 | .14 | 48 | .27 | -109 | 1.34 | 5.6 |

Notes:

1. S-Parameters include bond wires.

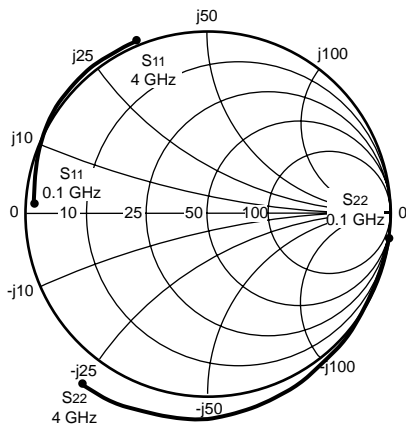
BASE: Total 1 wire (s), 1 per bond pad, 0.0115 (291 μm) long each wire. EMITTER: Total 2 wire (s), 1 per side, 0.015" (393 μm) long each wire.
COLLECTOR: Total 1 wire (s), 1 per bond pad, 0.0072" (182 μm) WIRE: 0.0007" (17.7 μm) dia., gold.
long each wire.

2. Gain Calculations:

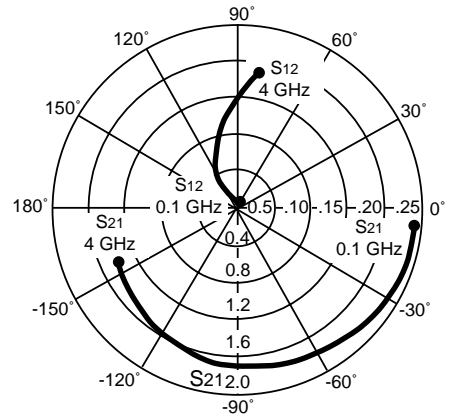
$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } MSG = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12}| |S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

NE021 SERIES

TYPICAL COMMON BASE SCATTERING PARAMETERS (TA = 25°C)



Coordinates in Ohms
Frequency in GHz
(Vcb = 10 V, Ic = 20 mA)



NE02107B

Vcb = 10 V, Ic = 5 mA

| FREQUENCY (MHz) | S11 | | S21 | | S12 | | S22 | | K | MAG ¹ (dB) |
|--------------------|-----|-----|------|------|-----|-----|------|------|--------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 100 | .79 | 175 | 1.77 | -10 | .01 | 106 | 1.01 | -9 | -0.477 | 22.480 |
| 500 | .79 | 170 | 1.78 | -24 | .01 | 111 | 1.02 | -22 | -0.808 | 22.504 |
| 1000 | .79 | 163 | 1.72 | -44 | .01 | 117 | 1.05 | -40 | -1.645 | 22.355 |
| 1500 | .83 | 157 | 1.71 | -64 | .03 | 109 | 1.09 | -58 | -1.076 | 17.559 |
| 2000 | .83 | 149 | 1.57 | -87 | .06 | 106 | 1.09 | -75 | -0.782 | 14.177 |
| 2500 | .87 | 145 | 1.53 | -99 | .08 | 103 | 1.08 | -81 | -0.574 | 12.816 |
| 3000 | .87 | 136 | 1.40 | -122 | .11 | 95 | 1.11 | -96 | -0.484 | 11.047 |
| 3500 | .87 | 126 | 1.21 | -140 | .13 | 86 | 1.10 | -111 | -0.427 | 9.688 |
| 4000 | .86 | 117 | 1.12 | -164 | .17 | 76 | 1.08 | -125 | -0.180 | 8.188 |

Vcb = 10 V, Ic = 10 mA

| | | | | | | | | | | |
|------|-----|-----|------|------|-----|-----|------|------|--------|--------|
| 100 | .88 | 177 | 1.84 | -6 | .01 | -31 | 1.01 | -6 | 0.671 | 22.648 |
| 500 | .88 | 171 | 1.84 | -19 | .01 | 112 | 1.00 | -18 | -0.431 | 22.648 |
| 1000 | .87 | 164 | 1.83 | -38 | .01 | 132 | 1.05 | -36 | -1.429 | 22.625 |
| 1500 | .90 | 159 | 1.82 | -57 | .03 | 118 | 1.08 | -53 | -0.950 | 17.830 |
| 2000 | .92 | 152 | 1.72 | -76 | .06 | 117 | 1.10 | -69 | -0.857 | 14.574 |
| 2500 | .95 | 144 | 1.68 | -92 | .08 | 108 | 1.09 | -81 | -0.707 | 13.222 |
| 3000 | .96 | 135 | 1.57 | -113 | .12 | 98 | 1.13 | -96 | -0.601 | 11.167 |
| 3500 | .96 | 125 | 1.45 | -135 | .15 | 88 | 1.12 | -111 | -0.458 | 9.853 |
| 4000 | .95 | 116 | 1.33 | -156 | .18 | 77 | 1.10 | -126 | -0.317 | 8.686 |

Vcb = 10 V, Ic = 20 mA

| | | | | | | | | | | |
|------|------|-----|------|------|-----|-----|------|------|--------|--------|
| 100 | .92 | 176 | 1.90 | -6 | .01 | 56 | 1.02 | -6 | 0.315 | 22.788 |
| 500 | .93 | 171 | 1.89 | -19 | .01 | 139 | 1.01 | -18 | -0.850 | 22.765 |
| 1000 | .92 | 164 | 1.89 | -37 | .01 | 129 | 1.05 | -36 | -1.189 | 22.765 |
| 1500 | .96 | 159 | 1.88 | -55 | .03 | 126 | 1.09 | -53 | -0.960 | 17.970 |
| 2000 | .97 | 152 | 1.81 | -75 | .06 | 119 | 1.10 | -69 | -0.832 | 14.795 |
| 2500 | 1.01 | 142 | 1.75 | -90 | .09 | 110 | 1.09 | -80 | -0.727 | 12.888 |
| 3000 | 1.02 | 132 | 1.67 | -110 | .12 | 100 | 1.13 | -95 | -0.658 | 11.435 |
| 3500 | 1.03 | 121 | 1.55 | -132 | .15 | 89 | 1.13 | -110 | -0.532 | 10.142 |
| 4000 | 1.02 | 112 | 1.42 | -154 | .18 | 79 | 1.12 | -125 | -0.388 | 8.970 |

Vcb = 10 V, Ic = 40 mA

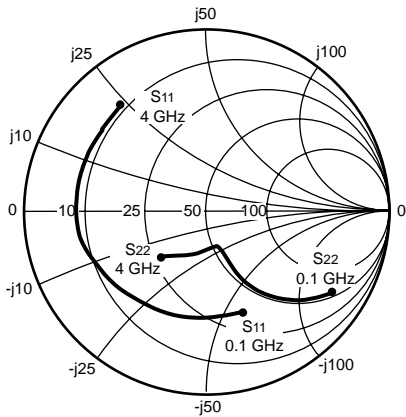
| | | | | | | | | | | |
|------|------|-----|------|------|-----|-----|------|------|--------|--------|
| 100 | .95 | 176 | 1.93 | -7 | .01 | -74 | 1.02 | -7 | 0.239 | 22.856 |
| 600 | .94 | 171 | 1.91 | -20 | .01 | 116 | 1.01 | -19 | -0.583 | 22.810 |
| 1000 | .94 | 163 | 1.91 | -38 | .01 | 133 | 1.05 | -36 | -1.140 | 22.810 |
| 1500 | .98 | 158 | 1.90 | -57 | .03 | 126 | 1.09 | -53 | -0.901 | 18.016 |
| 2000 | .99 | 151 | 1.83 | -77 | .06 | 119 | 1.10 | -69 | -0.798 | 14.843 |
| 2500 | 1.04 | 141 | 1.81 | -92 | .09 | 111 | 1.09 | -81 | -0.727 | 13.034 |
| 3000 | 1.05 | 132 | 1.72 | -115 | .12 | 100 | 1.13 | -97 | -0.591 | 11.563 |
| 3500 | 1.05 | 120 | 1.58 | -136 | .15 | 88 | 1.13 | -113 | -0.502 | 10.226 |
| 4000 | 1.03 | 111 | 1.46 | -157 | .18 | 77 | 1.10 | -127 | -0.341 | 9.091 |

Note:

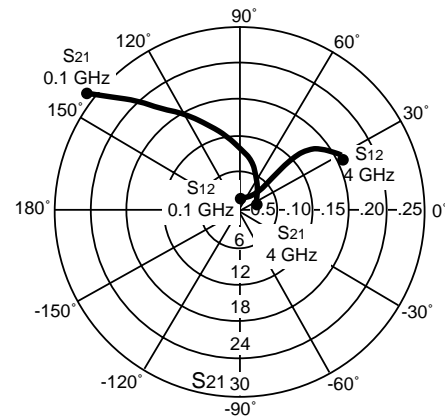
1. Gain Calculations:

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

TYPICAL COMMON EMITTER SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_c = 20 mA)



NE02107

V_{CE} = 10 V, I_c = 5 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 100 | .82 | -36 | 13.90 | 157 | .01 | 73 | .95 | -16 | 0.022 | 31.430 |
| 500 | .70 | -125 | 7.38 | 107 | .07 | 35 | .54 | -47 | 0.345 | 20.230 |
| 1000 | .68 | -161 | 4.17 | 82 | .08 | 25 | .39 | -59 | 0.628 | 17.170 |
| 1500 | .68 | -178 | 2.87 | 66 | .09 | 24 | .38 | -68 | 0.783 | 15.036 |
| 2000 | .68 | 170 | 2.18 | 53 | .10 | 26 | .37 | -78 | 0.928 | 13.385 |
| 2500 | .67 | 159 | 1.73 | 40 | .11 | 22 | .38 | -90 | 1.081 | 10.227 |
| 3000 | .67 | 151 | 1.49 | 28 | .12 | 23 | .40 | -102 | 1.116 | 8.867 |
| 3500 | .68 | 142 | 1.27 | 17 | .13 | 19 | .43 | -112 | 1.119 | 7.802 |
| 4000 | .68 | 134 | 1.16 | 6 | .14 | 17 | .45 | -122 | 1.101 | 7.249 |

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

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|-------|--------|
| 100 | .69 | -54 | 22.57 | 150 | .01 | 69 | .89 | -23 | 0.085 | 33.535 |
| 500 | .67 | -145 | 9.37 | 100 | .05 | 36 | .39 | -58 | 0.489 | 22.728 |
| 1000 | .67 | -172 | 5.00 | 79 | .06 | 36 | .27 | -70 | 0.821 | 19.208 |
| 1500 | .67 | 175 | 3.40 | 65 | .08 | 37 | .26 | -77 | 0.907 | 16.284 |
| 2000 | .67 | 165 | 2.57 | 53 | .09 | 40 | .25 | -87 | 1.071 | 12.933 |
| 2500 | .67 | 15 | 2.07 | 41 | .11 | 35 | .28 | -97 | 1.052 | 11.355 |
| 3000 | .67 | 146 | 1.80 | 30 | .12 | 34 | .31 | -108 | 1.074 | 10.096 |
| 3500 | .67 | 137 | 1.53 | 20 | .14 | 30 | .34 | -116 | 1.046 | 9.080 |
| 4000 | .67 | 130 | 1.41 | 8 | .15 | 23 | .36 | -125 | 1.023 | 8.803 |

V_{CE} = 10 V, I_c = 20 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|-------|--------|
| 100 | .58 | -79 | 31.63 | 142 | .01 | 65 | .81 | -32 | 0.170 | 35.001 |
| 500 | .67 | -161 | 10.57 | 95 | .03 | 45 | .28 | -68 | 0.774 | 25.470 |
| 1000 | .67 | 179 | 5.47 | 77 | .04 | 46 | .19 | -78 | 1.205 | 18.622 |
| 1500 | .67 | 168 | 3.70 | 64 | .07 | 46 | .19 | -84 | 1.041 | 15.998 |
| 2000 | .67 | 159 | 2.78 | 53 | .09 | 48 | .20 | -96 | 1.077 | 13.207 |
| 2500 | .67 | 150 | 2.26 | 42 | .11 | 44 | .23 | -105 | 1.058 | 11.658 |
| 3000 | .68 | 142 | 1.96 | 31 | .12 | 39 | .25 | -114 | 1.063 | 10.601 |
| 3500 | .67 | 134 | 1.68 | 21 | .14 | 36 | .28 | -122 | 1.065 | 9.238 |
| 4000 | .68 | 127 | 1.53 | 9 | .16 | 27 | .31 | -128 | 0.947 | 9.806 |

V_{CE} = 10 V, I_c = 30 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|-------|--------|
| 100 | .55 | -96 | 35.99 | 137 | .01 | 63 | .75 | -37 | 0.236 | 35.562 |
| 500 | .67 | -167 | 10.79 | 93 | .02 | 48 | .24 | -69 | 1.157 | 24.914 |
| 1000 | .68 | 176 | 5.52 | 75 | .04 | 53 | .17 | -77 | 1.192 | 18.752 |
| 1500 | .68 | 166 | 3.75 | 63 | .07 | 52 | .17 | -83 | 1.028 | 16.271 |
| 2000 | .68 | 158 | 2.81 | 52 | .09 | 53 | .18 | -96 | 1.065 | 13.383 |
| 2500 | .68 | 148 | 2.26 | 41 | .11 | 46 | .21 | -106 | 1.057 | 11.669 |
| 3000 | .68 | 141 | 1.96 | 30 | .13 | 42 | .24 | -115 | 1.008 | 11.227 |
| 3500 | .68 | 133 | 1.66 | 20 | .14 | 38 | .27 | -123 | 1.066 | 9.175 |
| 4000 | .68 | 126 | 1.51 | 9 | .16 | 29 | .30 | -131 | 0.984 | 9.749 |

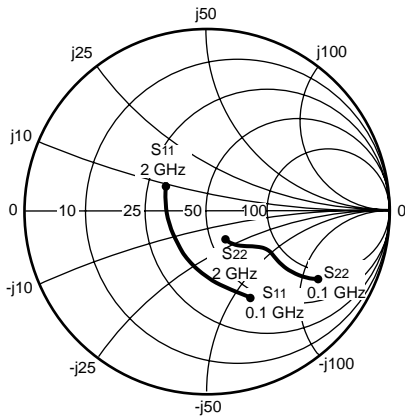
Note:

1. Gain Calculations:

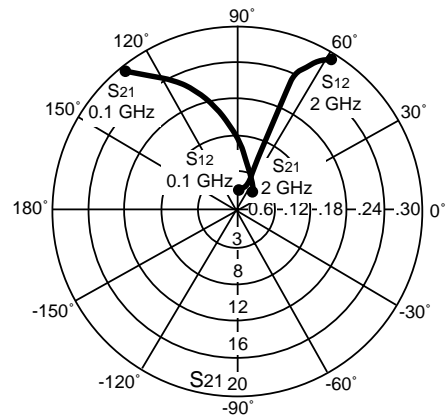
$$MAG = \frac{|S_{21}|}{|S_{12}|} \left(K \pm \sqrt{K^2 - 1} \right). \text{ When } K \leq 1, \text{ MAG is undefined and MSG values are used. } MSG = \frac{|S_{21}|}{|S_{12}|}, K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12} S_{21}|}, \Delta = S_{11} S_{22} - S_{21} S_{12}$$

NE021 SERIES

TYPICAL COMMON EMITTER SCATTERING PARAMETERS (TA = 25°C)



Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 20 mA)



NE02133

VCE = 10 V, IC = 5 mA

| FREQUENCY (MHz) | S11 | | S21 | | S12 | | S22 | | K | MAG ¹ (dB) |
|--------------------|-----|------|-------|-----|-----|-----|-----|-----|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 100 | .80 | -37 | 13.53 | 150 | .03 | 73 | .91 | -18 | 0.178 | 26.542 |
| 200 | .63 | -63 | 10.48 | 129 | .04 | 59 | .72 | -29 | 0.477 | 24.183 |
| 500 | .37 | -114 | 5.56 | 99 | .09 | 61 | .48 | -38 | 0.795 | 17.908 |
| 1000 | .27 | -158 | 3.02 | 76 | .15 | 60 | .40 | -41 | 0.988 | 13.039 |
| 1500 | .27 | 172 | 2.16 | 63 | .21 | 63 | .34 | -49 | 1.039 | 8.914 |
| 2000 | .29 | 151 | 1.74 | 49 | .27 | 58 | .31 | -62 | 1.031 | 7.022 |

VCE = 10 V, IC = 10 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|-----|-------|--------|
| 100 | .66 | -48 | 19.53 | 139 | .02 | 79 | .81 | -27 | 0.235 | 29.897 |
| 200 | .46 | -78 | 13.52 | 118 | .03 | 58 | .58 | -35 | 0.761 | 26.539 |
| 500 | .27 | -129 | 6.29 | 93 | .09 | 67 | .38 | -36 | 0.900 | 18.444 |
| 1000 | .21 | -169 | 3.31 | 74 | .16 | 66 | .34 | -40 | 0.993 | 13.157 |
| 1500 | .23 | 165 | 2.35 | 62 | .23 | 64 | .29 | -47 | 1.007 | 9.593 |
| 2000 | .26 | 146 | 1.87 | 50 | .29 | 59 | .26 | -62 | 1.011 | 7.438 |

VCE = 10 V, IC = 20 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|-----|-------|--------|
| 100 | .51 | -61 | 19.37 | 129 | .02 | 79 | .70 | -32 | 0.497 | 29.861 |
| 200 | .33 | -91 | 15.04 | 109 | .03 | 64 | .48 | -35 | 0.909 | 27.001 |
| 500 | .21 | -143 | 6.57 | 89 | .08 | 71 | .33 | -32 | 1.010 | 18.522 |
| 1000 | .19 | -177 | 3.41 | 72 | .16 | 69 | .32 | -37 | 1.005 | 12.847 |
| 1500 | .21 | 160 | 2.41 | 61 | .24 | 67 | .26 | -45 | 1.006 | 9.524 |
| 2000 | .24 | 142 | 1.92 | 49 | .30 | 59 | .23 | -59 | 1.013 | 7.369 |

Note:

1. Gain Calculations:

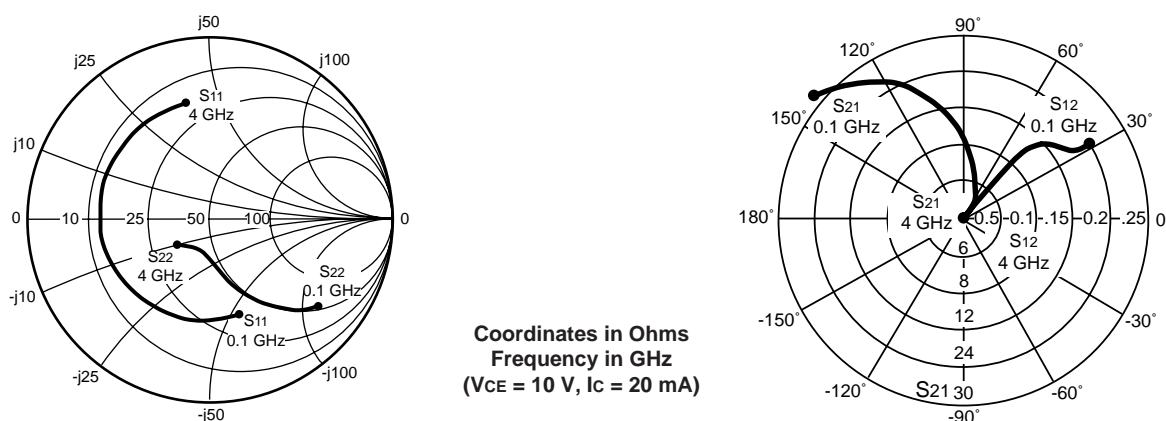
$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$$

When $K \leq 1$, 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 COMMON EMITTER SCATTERING PARAMETERS (T_A = 25°C)



NE02135

V_{CE} = 10 V, I_C = 5 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|------|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 100 | .84 | -36 | 13.82 | 156 | .02 | 73 | .94 | -18 | 0.023 | 28.395 |
| 500 | .68 | -126 | 7.18 | 106 | .08 | 35 | .51 | -53 | 0.368 | 19.530 |
| 1000 | .66 | -163 | 4.02 | 81 | .09 | 27 | .34 | -66 | 0.664 | 16.500 |
| 1500 | .65 | 178 | 2.75 | 64 | .10 | 27 | .31 | -74 | 0.890 | 14.393 |
| 2000 | .65 | 163 | 2.10 | 52 | .12 | 30 | .31 | -83 | 0.960 | 12.430 |
| 2500 | .66 | 151 | 1.68 | 39 | .13 | 26 | .31 | -95 | 1.075 | 9.441 |
| 3000 | .66 | 141 | 1.46 | 27 | .14 | 26 | .33 | -106 | 1.125 | 8.030 |
| 3500 | .67 | 129 | 1.24 | 17 | .16 | 26 | .36 | -116 | 1.099 | 6.974 |
| 4000 | .68 | 121 | 1.14 | 5 | .17 | 23 | .38 | -127 | 1.069 | 6.656 |

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

| | | | | | | | | | | |
|------|-------|------|--------|-----|-------|----|-------|------|-------|--------|
| 100 | 0.666 | -50 | 23.536 | 149 | 0.004 | 65 | 0.854 | -28 | 0.634 | 37.697 |
| 500 | 0.592 | -147 | 9.285 | 99 | 0.033 | 39 | 0.363 | -72 | 0.859 | 24.493 |
| 1000 | 0.604 | -179 | 4.955 | 77 | 0.051 | 39 | 0.276 | -82 | 1.128 | 17.700 |
| 1500 | 0.595 | 163 | 3.288 | 63 | 0.073 | 39 | 0.240 | -87 | 1.172 | 14.054 |
| 2000 | 0.609 | 152 | 2.527 | 46 | 0.109 | 36 | 0.195 | -104 | 1.138 | 11.397 |
| 2500 | 0.615 | 139 | 2.022 | 39 | 0.132 | 41 | 0.204 | -115 | 1.180 | 9.287 |
| 3000 | 0.632 | 126 | 1.726 | 28 | 0.152 | 38 | 0.212 | -125 | 1.168 | 8.071 |
| 3500 | 0.642 | 114 | 1.439 | 12 | 0.175 | 27 | 0.233 | -135 | 1.155 | 6.763 |
| 4000 | 0.649 | 104 | 1.315 | 5 | 0.199 | 27 | 0.256 | -144 | 1.113 | 6.156 |

V_{CE} = 10 V, I_C = 20 mA

| | | | | | | | | | | |
|------|-------|------|--------|-----|-------|----|-------|------|-------|--------|
| 100 | 0.545 | -74 | 32.448 | 140 | 0.002 | 67 | 0.763 | -38 | 1.982 | 36.428 |
| 500 | 0.593 | -163 | 10.200 | 94 | 0.020 | 46 | 0.270 | -80 | 1.428 | 23.189 |
| 1000 | 0.602 | 173 | 5.276 | 75 | 0.040 | 49 | 0.217 | -89 | 1.445 | 17.244 |
| 1500 | 0.605 | 158 | 3.505 | 61 | 0.072 | 50 | 0.188 | -93 | 1.210 | 14.212 |
| 2000 | 0.616 | 148 | 2.718 | 46 | 0.108 | 44 | 0.161 | -110 | 1.115 | 11.942 |
| 2500 | 0.623 | 135 | 2.159 | 39 | 0.133 | 48 | 0.176 | -120 | 1.142 | 9.815 |
| 3000 | 0.639 | 123 | 1.841 | 29 | 0.156 | 43 | 0.188 | -128 | 1.110 | 8.698 |
| 3500 | 0.644 | 111 | 1.549 | 13 | 0.180 | 32 | 0.210 | -135 | 1.094 | 7.477 |
| 4000 | 0.649 | 102 | 1.411 | 6 | 0.205 | 32 | 0.232 | -142 | 1.060 | 6.881 |

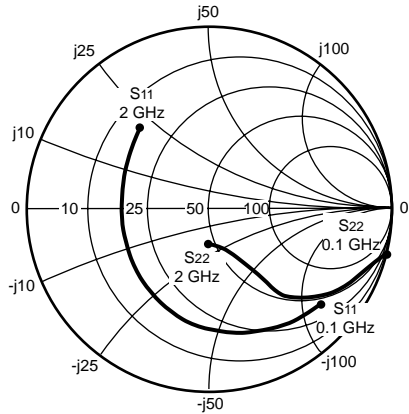
V_{CE} = 10 V, I_C = 30 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|-------|--------|
| 100 | .58 | -95 | 35.35 | 134 | .01 | 59 | .72 | -40 | 0.275 | 35.484 |
| 500 | .64 | -169 | 10.11 | 91 | .03 | 50 | .22 | -82 | 0.958 | 25.276 |
| 1000 | .65 | 173 | 5.15 | 74 | .06 | 55 | .14 | -97 | 1.016 | 18.563 |
| 1500 | .65 | 162 | 3.49 | 62 | .08 | 63 | .14 | -103 | 1.103 | 14.446 |
| 2000 | .66 | 152 | 2.63 | 52 | .11 | 54 | .15 | -112 | 1.058 | 12.315 |
| 2500 | .66 | 141 | 2.10 | 39 | .13 | 46 | .17 | -122 | 1.095 | 10.207 |
| 3000 | .66 | 132 | 1.82 | 29 | .15 | 42 | .19 | -129 | 1.086 | 9.052 |
| 3500 | .67 | 122 | 1.54 | 20 | .17 | 38 | .22 | -137 | 1.089 | 7.748 |
| 4000 | .68 | 115 | 1.44 | 9 | .20 | 31 | .24 | -146 | 0.970 | 8.573 |

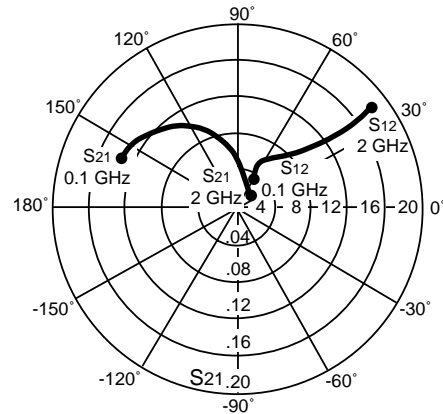
See note on next page.

NE021 SERIES

TYPICAL COMMON EMITTER SCATTERING PARAMETERS (T_A = 25°C)



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 5 mA)



NE02139

V_{CE} = 10 V, I_C = 5 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ (dB) |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|-----|-------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 100 | .78 | -39 | 13.96 | 156 | .027 | 63 | .91 | -21 | 0.167 | 27.135 |
| 200 | .71 | -74 | 11.81 | 131 | .058 | 62 | .77 | -36 | 0.329 | 21.430 |
| 400 | .57 | -114 | 7.51 | 107 | .081 | 42 | .54 | -50 | 0.563 | 18.797 |
| 600 | .50 | -143 | 5.68 | 93 | .093 | 39 | .42 | -56 | 0.738 | 16.985 |
| 800 | .49 | -164 | 4.16 | 72 | .104 | 37 | .35 | -59 | 0.860 | 15.398 |
| 1000 | .49 | -180 | 3.50 | 81 | .117 | 37 | .30 | -63 | 0.938 | 14.105 |
| 1200 | .51 | 168 | 2.83 | 55 | .129 | 37 | .27 | -66 | 0.977 | 12.978 |
| 1400 | .52 | 160 | 2.59 | 63 | .144 | 36 | .25 | -73 | 1.017 | 11.247 |
| 1600 | .53 | 150 | 2.19 | 49 | .155 | 38 | .22 | -79 | 1.046 | 9.850 |
| 1800 | .53 | 142 | 2.09 | 42 | .173 | 36 | .21 | -88 | 1.059 | 8.908 |
| 2000 | .56 | 135 | 1.79 | 36 | .181 | 36 | .19 | -98 | 1.096 | 8.065 |

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

| | | | | | | | | | | |
|------|-----|------|-------|-----|------|----|-----|------|-------|--------|
| 100 | .63 | -58 | 20.38 | 145 | .025 | 58 | .81 | -31 | 0.267 | 29.113 |
| 200 | .56 | -98 | 15.27 | 119 | .039 | 60 | .61 | -45 | 0.534 | 23.790 |
| 400 | .47 | -139 | 8.90 | 98 | .062 | 44 | .39 | -57 | 0.773 | 20.566 |
| 600 | .45 | -164 | 6.48 | 87 | .073 | 50 | .30 | -60 | 0.912 | 18.320 |
| 800 | .45 | 180 | 4.66 | 76 | .091 | 49 | .25 | -63 | 0.984 | 16.309 |
| 1000 | .47 | 168 | 3.89 | 69 | .109 | 50 | .21 | -68 | 1.023 | 13.826 |
| 1200 | .48 | 157 | 3.13 | 61 | .126 | 48 | .18 | -71 | 1.038 | 12.288 |
| 1400 | .50 | 152 | 2.86 | 54 | .143 | 44 | .17 | -80 | 1.044 | 11.116 |
| 1600 | .51 | 143 | 2.41 | 48 | .160 | 46 | .14 | -88 | 1.045 | 10.104 |
| 1800 | .52 | 136 | 2.30 | 42 | .181 | 42 | .14 | -99 | 1.048 | 9.263 |
| 2000 | .54 | 130 | 1.97 | 36 | .191 | 41 | .12 | -113 | 1.084 | 8.371 |

V_{CE} = 10 V, I_C = 20 mA

| | | | | | | | | | | |
|------|-----|------|-------|-----|------|----|-----|------|-------|--------|
| 100 | .53 | -82 | 25.86 | 136 | .021 | 35 | .72 | -41 | 0.435 | 30.904 |
| 200 | .47 | -121 | 17.23 | 110 | .033 | 61 | .48 | -51 | 0.711 | 25.017 |
| 400 | .43 | -157 | 9.44 | 92 | .051 | 50 | .30 | -58 | 0.905 | 21.298 |
| 600 | .44 | -177 | 6.74 | 83 | .069 | 57 | .23 | -60 | 0.971 | 18.616 |
| 800 | .45 | 170 | 4.82 | 74 | .090 | 55 | .20 | -61 | 1.024 | 15.561 |
| 1000 | .46 | 161 | 4.01 | 67 | .107 | 54 | .16 | -66 | 1.044 | 13.619 |
| 1200 | .48 | 152 | 3.23 | 39 | .127 | 54 | .14 | -71 | 1.028 | 12.483 |
| 1400 | .50 | 147 | 2.95 | 53 | .149 | 50 | .13 | -80 | 1.035 | 11.252 |
| 1600 | .51 | 139 | 2.48 | 47 | .164 | 50 | .10 | -91 | 1.038 | 10.206 |
| 1800 | .52 | 133 | 2.36 | 41 | .187 | 45 | .10 | -104 | 1.030 | 9.506 |
| 2000 | .55 | 127 | 2.02 | 36 | .197 | 44 | .09 | -121 | 1.055 | 8.680 |

Note:

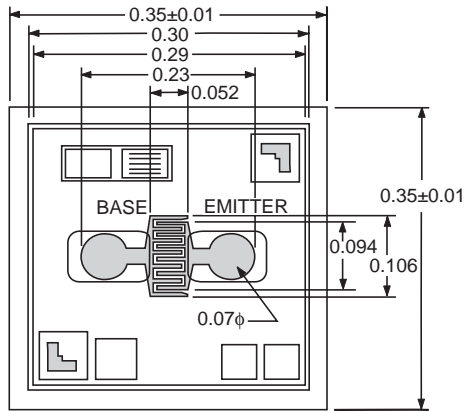
1. Gain Calculations:

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

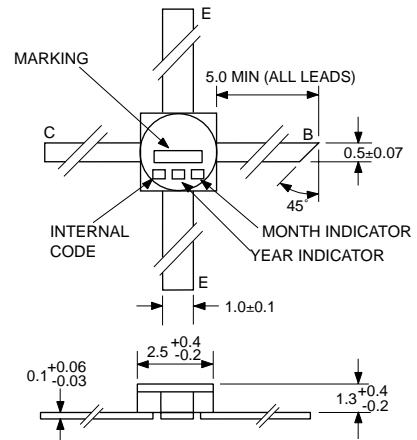
MAG = Maximum Available Gain, MSG = Maximum Stable Gain

OUTLINE DIMENSIONS (Units in mm)

NE02100 (CHIP)

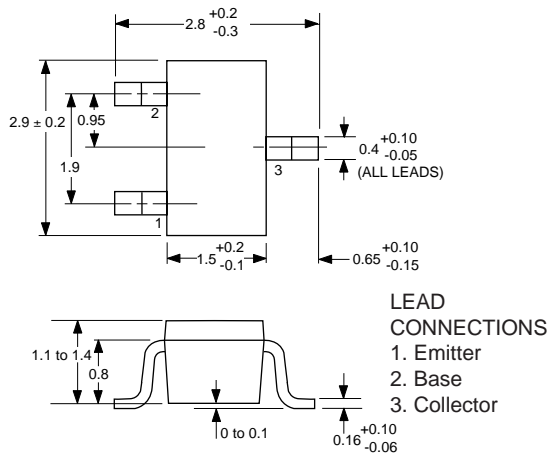


PACKAGE OUTLINE 07

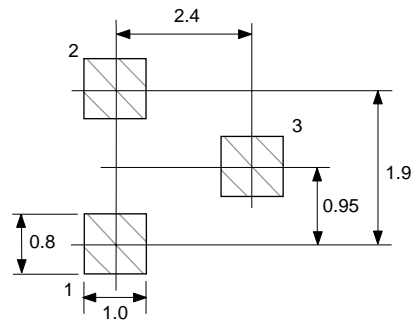


*07B has emitter and base reversed..

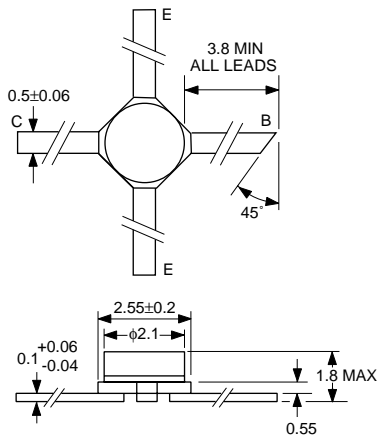
PACKAGE OUTLINE 33



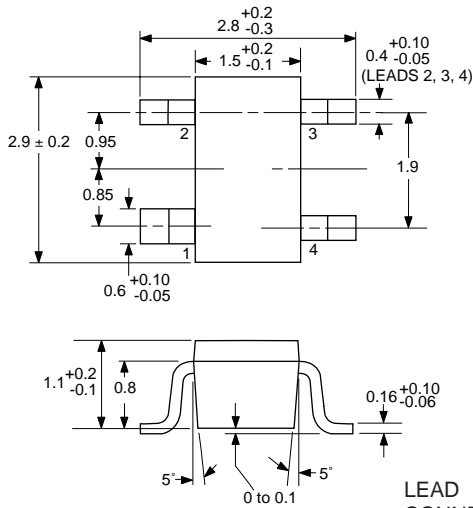
**PACKAGE OUTLINE 33
RECOMMENDED P.C.B. LAYOUT**



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

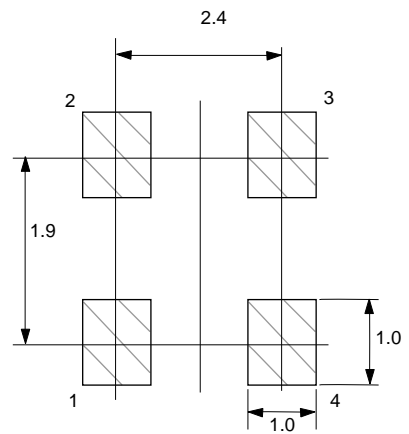


**PACKAGE OUTLINE 39
(SOT-23)**



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

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



ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKAGING |
|------------------|----------|-------------|
| NE02100 | 100 | Waffle Pack |
| NE02107/NE02107B | 1 | Hard Pack |
| NE02133-T1B | 3000 | Tape & Reel |
| NE02135 | 1 | ESD Bag |
| NE02139-T1 | 3000 | Tape & Reel |

Life Support Applications

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

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01/31/2005