



NPN SILICON HIGH FREQUENCY TRANSISTOR

NE219 SERIES

FEATURES

- HIGH fr: 8 GHz
- LOW NOISE:
1 dB at 0.5 GHz
2.2 dB at 2 GHz
- HIGH COLLECTOR CURRENT: 80 mA
- HIGH OSCILLATOR POWER OUTPUT:
100 mW at 6 GHz
- EXCELLENT GENERAL PURPOSE TRANSISTOR

DESCRIPTION AND APPLICATIONS

The NE219 series of NPN silicon bipolar transistors is designed for small signal amplifier and oscillator applications up to 6 GHz. The series employs arsenic doped emitters and NEC's hi-rel platinum-gold metallization system which permits reliable operation at high temperature operation (100°C) at rated dissipation. The series is available in either chip form (NE21900) or in a variety of packages. Low noise and high current capability provides wide dynamic range and economical solutions to a wide variety of microstrip thick and thin film applications. Quality, performance, uniformity and reliability are assured by NEC's quality assurance program which is patterned after MIL-S-19500. The NE219 is available in Grade C (JANTXV equivalent), Grade CX (JANTX equivalent), and Grade D.

ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|------------------------------|-------|--------------------------|
| V _{CB0} | Collector to Base Voltage | V | 20 |
| V _{CE0} | Collector to Emitter Voltage | V | 10 ¹ |
| V _{EB0} | Emitter to Base Voltage | V | 1.5 |
| I _C | Collector Current | mA | 80 |
| T _J | Junction Temperature | °C | 200 ² |
| T _{STG} | Storage Temperature | °C | -65 to +200 ³ |

Notes:

1. Typical V_{CER} = 20 V for R = 10 Ω.
2. T_J = 150°C for NE21936 and NE21937.
3. T_{STG} = -65 to +150°C for NE21936, NE21937 and NE21935 Grade D.

NE21935 TYPICAL NOISE PARAMETERS

V_{CE} = 8 V, I_C = 5 mA

| FREQUENCY (MHz) | NF _{min} (dB) | G _a */dB | OPT SOURCE | R _n /50 Ω |
|-----------------|------------------------|---------------------|-------------|----------------------|
| 500 | 1.3 | 20.7 | .15 ∠ 100° | .15 |
| 1000 | 1.4 | 16.2 | .31 ∠ 146° | .12 |
| 1500 | 2.1 | 13.5 | .49 ∠ 178° | .04 |
| 2000 | 2.3 | 11.8 | .48 ∠ -172° | .07 |
| 2500 | 2.7 | 9.6 | .53 ∠ -155° | .13 |
| 3000 | 3.4 | 9.6 | .58 ∠ -133° | .26 |
| 3500 | 3.6 | 8.0 | .66 ∠ -128° | .36 |

V_{CE} = 8 V, I_C = 20 mA

| | | | | |
|------|-----|------|-------------|-----|
| 500 | 1.6 | 22.0 | .14 ∠ 132° | .17 |
| 1000 | 2.0 | 17.3 | .30 ∠ 176° | .13 |
| 1500 | 2.6 | 14.9 | .47 ∠ -167° | .08 |
| 2000 | 2.9 | 13.0 | .53 ∠ -159° | .12 |
| 2500 | 3.2 | 11.4 | .56 ∠ -150° | .19 |
| 3000 | 3.9 | 11.4 | .58 ∠ -127° | .36 |
| 3500 | 4.3 | 9.2 | .68 ∠ -123° | .28 |

*Input tuned for minimum Noise Figure, output tuned for Maximum Gain.

PERFORMANCE SPECIFICATIONS (TA = 25°C)

| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | NE21903 2SC22174 | | | NE21908 2SC2218 | | | NE21912 | | | NE21935 2SC2367 | | | NE21937 2SC2869 | | | NE21987 | | |
|--------------------|------------------------------------------------------------------------------------------------------------|----------------|----------------------|----------------------|------|----------------------|----------------------|------|--------------|--------------|------|----------------------|----------------------|-------------|--------------------|------|------|---------|------|-----|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| fr | Gain Bandwidth Product at VCE = 8 V, IC = 20 mA | GHz | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | |
| S21E ² | Insertion Power Gain at VCE = 8 V, IC = 20 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz | dB dB dB | 8.0 | 21.0 15.5 9.6 | 8.0 | 8.0 | 21.0 15.5 9.6 | 8.0 | 15.5 | 15.5 | 15.5 | 15.5 | 15.5 | 13.0 7.0 | 13.0 | 13.0 | 13.0 | 13.0 | 13.0 | |
| NFM _{MIN} | Minimum Noise Figure ² at VCE = 8 V, IC = 5 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz | dB dB dB | 1.3 2.2 | 1.3 2.2 | 3.5 | 1.3 2.2 | 1.3 2.2 | 3.5 | 1.0 1.3 | 1.0 1.3 | 1.0 | 1.3 | 2.2 | 3.5 | 1.2 | 2.2 | 2.5 | 2.5 | 2.5 | |
| MAG | Maximum Available Gain ³ at VCE = 8 V, IC = 20 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz | dB dB dB | 25.0 18.4 12.6 | 25.0 18.4 12.6 | 25.0 | 25.0 18.4 12.6 | 25.0 18.4 12.6 | 25.0 | 23.0 16.4 | 23.0 16.4 | 23.0 | 25.0 18.4 12.6 | 25.0 18.4 12.6 | 25.0 | 16.0 | 10.0 | 16.0 | 16.0 | 16.0 | |
| GNF | Associated Gain at Optimum Noise Figure, VCE = 8 V, IC = 5 mA, f = 0.5 GHz f = 1 GHz f = 2 GHz | dB dB dB | 15.0 13.0 8.0 | 15.0 13.0 8.0 | 8.0 | 15.0 13.0 8.0 | 15.0 13.0 8.0 | 8.0 | 12.0 10.0 | 12.0 10.0 | 12.0 | 15.0 13.0 8.0 | 15.0 13.0 8.0 | 15.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | |
| Posc | Oscillator Power Output at VCE = 8 V, IC = 40 mA, f = 6 GHz | mW | | | | | | | | | | | | | | | | | 100 | |

Notes:
 1. Electronics Industrial Association of Japan.
 2. Input and output are tuned for optimum noise figure.
 3. Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation, $MAG = \frac{|S21|}{|S12|} (K \pm \sqrt{K^2 - 1})$ K = $\frac{1 + |\Delta|^2 - |S11|^2 - |S22|^2}{2|S21| |S12|}$ Δ = S11 S22 - S21 S12
 4. EIAJ registered number refers to grade C versions of these devices.

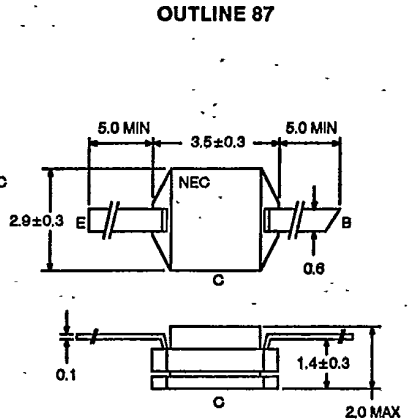
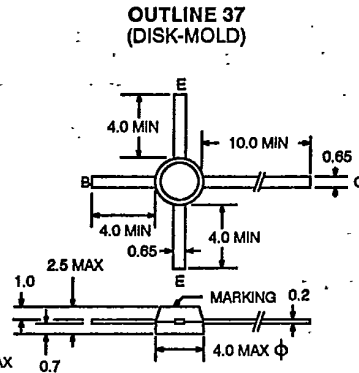
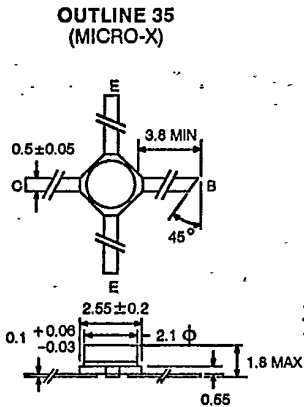
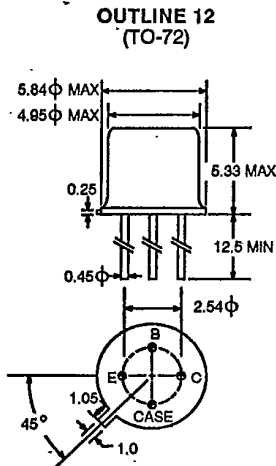
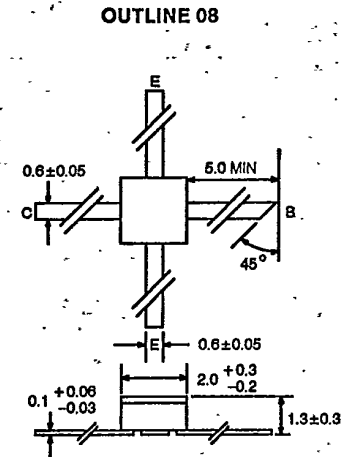
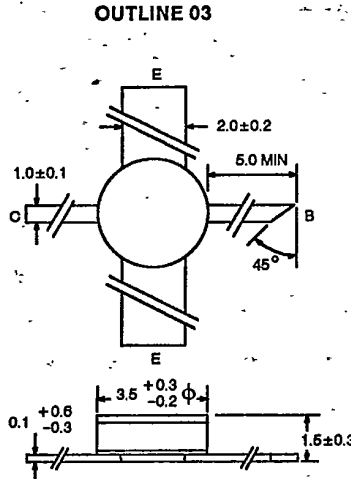
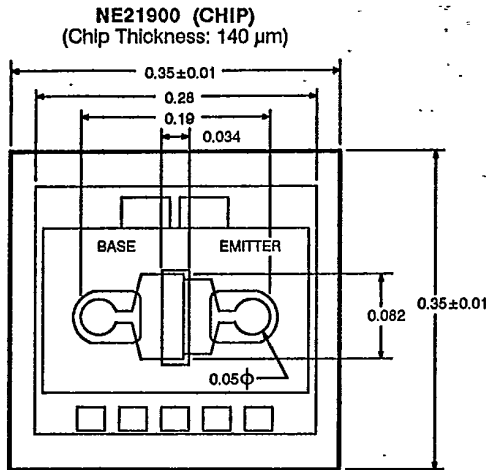
ELECTRICAL CHARACTERISTICS (TA = 25°C)

| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | NE21903 2SC22174 | | | NE21908 2SC22184 | | | NE21912 | | | NE21935 2SC2367 | | | NE21937 2SC2869 | | | NE21987 | | |
|---------|-----------------------------------------------------------------|-------|---------------------|-----|-----|---------------------|-----|-----|---------|-----|-----|--------------------|-----|-----|--------------------|------------------|-----|---------|-----|-----|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| ICBO | Collector Cutoff Current at VCB = 8 V, IE = 0 | μA | | 1.0 | 1.0 | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| IEBO | Emitter Cutoff Current at VEB = 1 V, IC = 0 | μA | | 1.0 | 1.0 | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | |
| hFE | Forward Current Gain at VCE = 8 V, IC = 20 mA | | 30 | 100 | 300 | 30 | 100 | 300 | 30 | 100 | 300 | 30 | 100 | 300 | 30 | 100 | 300 | 30 | 100 | |
| Ccb | Collector to Base Capacitance ² at VCB = 8 V, IE = 0 | pF | | 0.4 | 1.0 | | 0.4 | 1.0 | | 0.4 | 1.0 | | 0.4 | 1.0 | | 0.7 | 1.0 | | 0.4 | |
| Rth | Thermal Resistance (J-C) | °C/W | | 70 | 580 | | 90 | 350 | | 90 | 600 | | 80 | 580 | | 500 ³ | 250 | | 70 | |
| PT | Total Power Dissipation (TA = 25°C) | mW | | 580 | 580 | | 350 | 350 | | 600 | 600 | | 580 | 580 | | 250 | 250 | | 700 | |

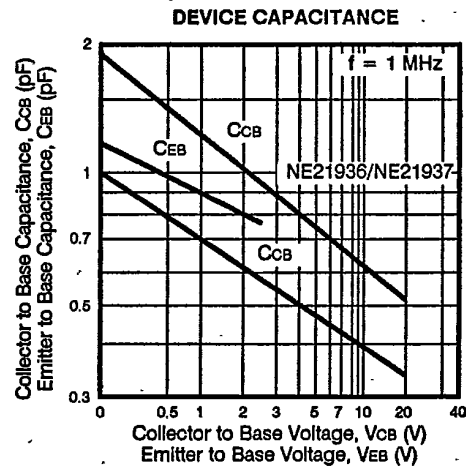
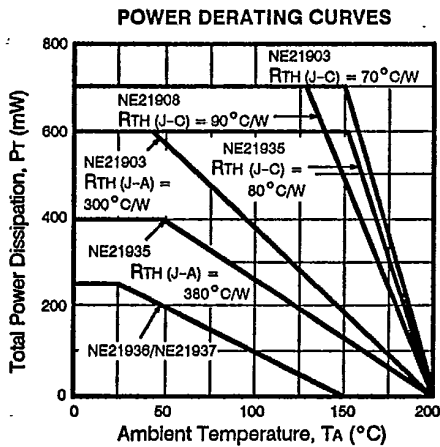
Notes:
 1. Electronic Industrial Association of Japan.
 2. Ccb measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.
 3. Rth(J-A)
 4. EIAJ registered number refers to grade C versions of these devices.



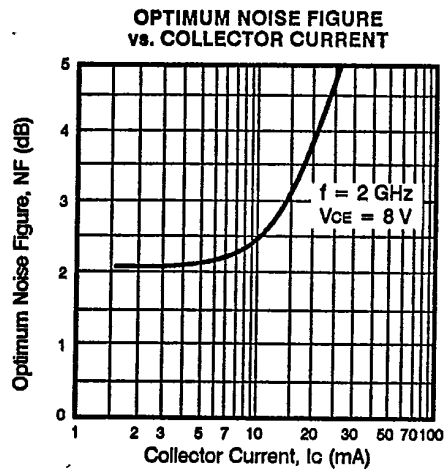
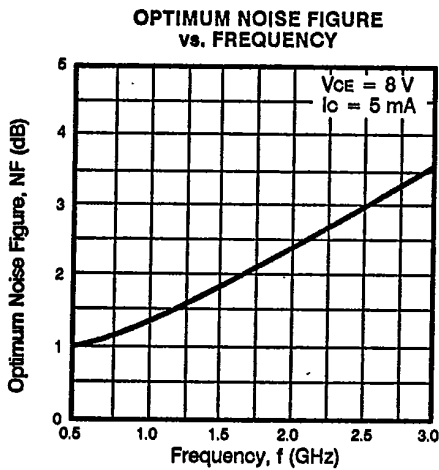
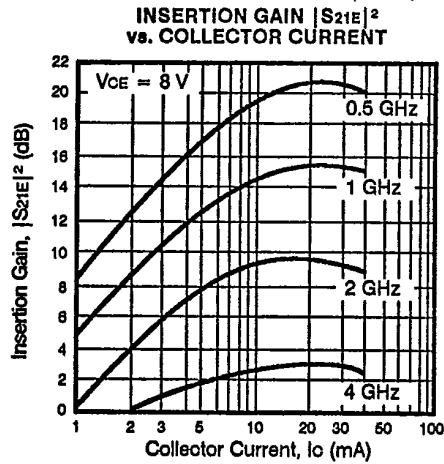
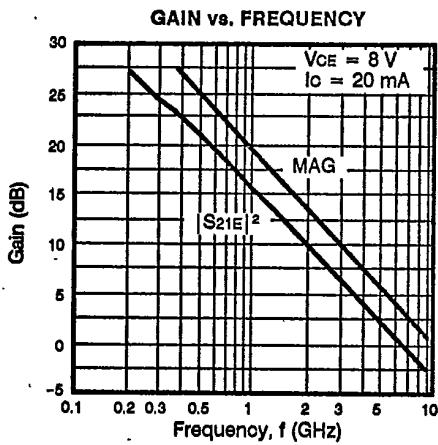
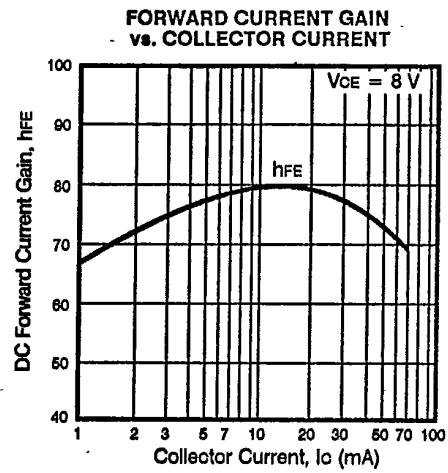
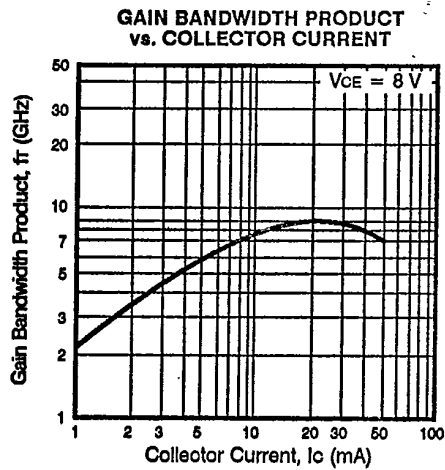
OUTLINE DIMENSIONS (Units in mm)



TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)



TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)

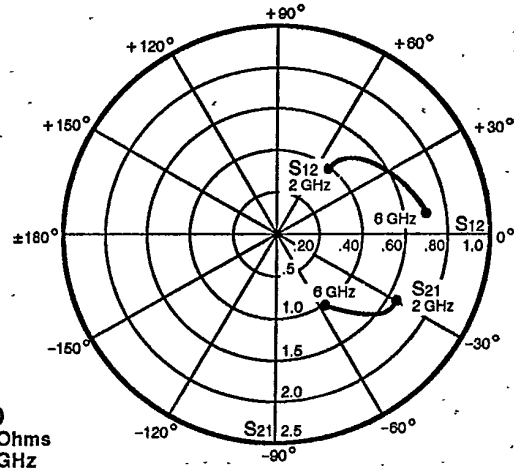
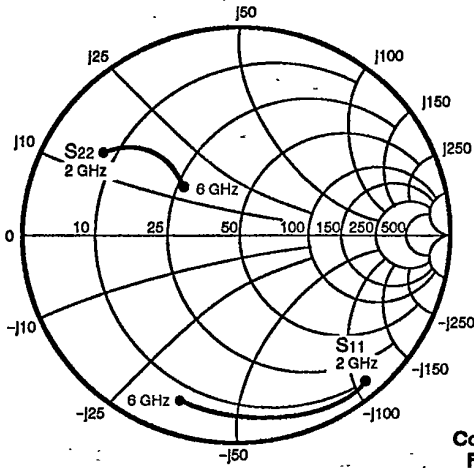


NE219 SERIES

T-31-21

T-31-23

TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS



NE21900
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 8 V, IC = 10 mA

FREQUENCY (MHz)

| | S11 | | S21 | | S12 | | S22 | |
|------|-----|------|------|-----|-----|----|-----|-----|
| 2000 | .88 | -56 | 1.57 | -29 | .44 | 47 | .64 | 143 |
| 2500 | .87 | -67 | 1.50 | -34 | .52 | 41 | .60 | 139 |
| 3000 | .83 | -77 | 1.39 | -42 | .58 | 31 | .54 | 128 |
| 3500 | .82 | -85 | 1.26 | -44 | .60 | 27 | .46 | 131 |
| 4000 | .80 | -93 | 1.18 | -49 | .64 | 21 | .43 | 124 |
| 4500 | .79 | -98 | 1.12 | -52 | .67 | 14 | .38 | 125 |
| 5000 | .79 | -103 | 1.02 | -53 | .68 | 11 | .32 | 130 |
| 5500 | .77 | -109 | 1.00 | -55 | .72 | 7 | .31 | 126 |
| 6000 | .78 | -113 | .93 | -57 | .72 | 4 | .25 | 142 |

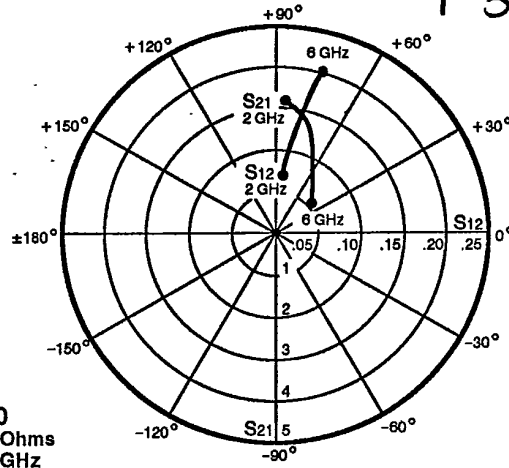
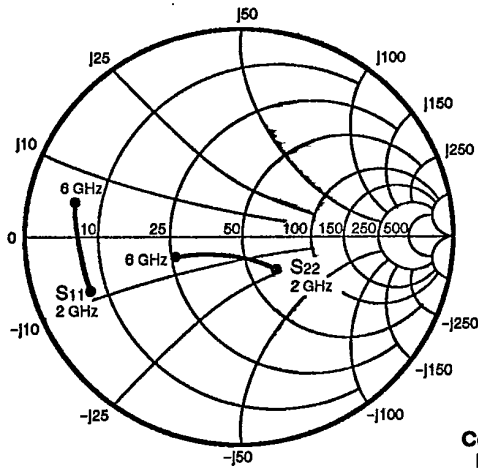
VCE = 8 V, IC = 20 mA

| | | | | | | | | |
|------|-----|------|------|-----|-----|----|-----|-----|
| 2000 | .91 | -53 | 1.66 | -29 | .40 | 51 | .71 | 147 |
| 2500 | .90 | -64 | 1.59 | -34 | .47 | 45 | .68 | 143 |
| 3000 | .87 | -74 | 1.47 | -42 | .53 | 35 | .62 | 132 |
| 3500 | .86 | -82 | 1.35 | -43 | .55 | 32 | .54 | 135 |
| 4000 | .84 | -90 | 1.26 | -49 | .60 | 26 | .52 | 128 |
| 4500 | .84 | -95 | 1.20 | -52 | .63 | 19 | .47 | 129 |
| 5000 | .83 | -101 | 1.09 | -54 | .64 | 16 | .41 | 131 |
| 5500 | .82 | -107 | 1.07 | -56 | .64 | 12 | .40 | 127 |
| 6000 | .82 | -111 | .99 | -59 | .69 | 9 | .34 | 138 |

VCE = 8 V, IC = 30 mA

| | | | | | | | | |
|------|-----|------|------|-----|-----|----|-----|-----|
| 2000 | .91 | -52 | 1.67 | -29 | .39 | 52 | .74 | 148 |
| 2500 | .91 | -64 | 1.61 | -34 | .47 | 46 | .70 | 144 |
| 3000 | .87 | -74 | 1.49 | -42 | .52 | 36 | .64 | 133 |
| 3500 | .87 | -82 | 1.36 | -44 | .55 | 33 | .57 | 136 |
| 4000 | .84 | -90 | 1.28 | -50 | .59 | 27 | .54 | 129 |
| 4500 | .85 | -95 | 1.22 | -53 | .62 | 20 | .50 | 129 |
| 5000 | .84 | -100 | 1.10 | -55 | .64 | 17 | .43 | 131 |
| 5500 | .83 | -107 | 1.08 | -57 | .69 | 13 | .42 | 127 |
| 6000 | .84 | -111 | 1.00 | -59 | .69 | 11 | .36 | 137 |

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE21900
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 8 V, I_C = 20 mA)

S-MAGN AND ANGLES:

V_{CE} = 8 V, I_C = 10 mA

FREQUENCY (MHz)

S₁₁

S₂₁

S₁₂

S₂₂

| | | | | | | | | |
|------|-----|------|------|----|-----|----|-----|------|
| 2000 | .70 | -155 | 2.78 | 89 | .08 | 72 | .32 | -44 |
| 2500 | .68 | -167 | 2.31 | 78 | .09 | 72 | .27 | -45 |
| 3000 | .72 | -173 | 1.99 | 70 | .11 | 74 | .24 | -42 |
| 3500 | .74 | -174 | 1.77 | 67 | .12 | 77 | .20 | -58 |
| 4000 | .70 | 176 | 1.57 | 55 | .14 | 71 | .13 | -80 |
| 4500 | .72 | 176 | 1.38 | 52 | .15 | 74 | .15 | -101 |
| 5000 | .76 | 172 | 1.26 | 46 | .17 | 73 | .19 | -128 |
| 5500 | .72 | 168 | 1.13 | 41 | .19 | 71 | .26 | -143 |
| 6000 | .73 | 168 | .99 | 38 | .19 | 72 | .33 | -148 |

V_{CE} = 8 V, I_C = 20 mA

| | | | | | | | | |
|------|-----|------|------|----|-----|----|-----|------|
| 2000 | .69 | -159 | 3.03 | 88 | .07 | 81 | .26 | -46 |
| 2500 | .67 | -170 | 2.51 | 78 | .09 | 79 | .21 | -44 |
| 3000 | .72 | -175 | 2.15 | 70 | .11 | 79 | .19 | -39 |
| 3500 | .74 | -176 | 1.90 | 67 | .13 | 81 | .14 | -58 |
| 4000 | .69 | 175 | 1.68 | 56 | .16 | 74 | .08 | -90 |
| 4500 | .73 | 174 | 1.46 | 53 | .16 | 77 | .11 | -115 |
| 5000 | .76 | 172 | 1.34 | 47 | .18 | 74 | .16 | -143 |
| 5500 | .72 | 167 | 1.21 | 42 | .19 | 73 | .23 | -154 |
| 6000 | .73 | 167 | 1.07 | 40 | .20 | 74 | .30 | -155 |

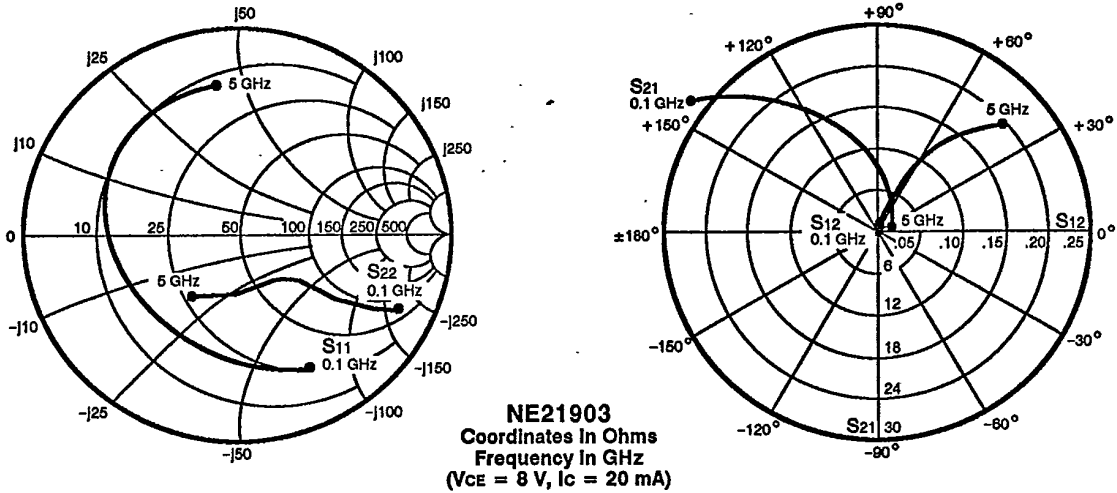
V_{CE} = 8 V, I_C = 30 mA

| | | | | | | | | |
|------|-----|------|------|----|-----|----|-----|------|
| 2000 | .69 | -161 | 3.07 | 87 | .07 | 84 | .25 | -45 |
| 2500 | .67 | -171 | 2.53 | 77 | .09 | 82 | .20 | -42 |
| 3000 | .72 | -176 | 2.16 | 70 | .11 | 82 | .18 | -36 |
| 3500 | .74 | -177 | 1.92 | 67 | .13 | 83 | .13 | -55 |
| 4000 | .70 | 174 | 1.68 | 56 | .15 | 75 | .07 | -86 |
| 4500 | .73 | 174 | 1.49 | 52 | .16 | 78 | .09 | -115 |
| 5000 | .77 | 171 | 1.36 | 47 | .18 | 75 | .15 | -144 |
| 5500 | .73 | 167 | 1.22 | 41 | .19 | 74 | .22 | -154 |
| 6000 | .73 | 166 | 1.08 | 40 | .20 | 74 | .29 | -155 |

2

NE219 SERIES

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 8 V, IC = 10 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|-----------------|-----------------|------|-----------------|-----|-----------------|----|-----------------|------|
| 100 | .79 | -45 | 22.62 | 152 | .01 | 77 | .91 | -18 |
| 500 | .63 | -140 | 9.88 | 102 | .04 | 39 | .47 | -41 |
| 1000 | .62 | -173 | 5.30 | 81 | .05 | 40 | .36 | -44 |
| 1500 | .62 | 169 | 3.59 | 67 | .07 | 43 | .35 | -49 |
| 2000 | .62 | 156 | 2.68 | 57 | .09 | 51 | .35 | -57 |
| 2500 | .64 | 143 | 2.17 | 45 | .10 | 51 | .31 | -69 |
| 3000 | .67 | 134 | 1.88 | 35 | .13 | 51 | .32 | -82 |
| 3500 | .68 | 122 | 1.58 | 25 | .14 | 44 | .32 | -94 |
| 4000 | .70 | 114 | 1.40 | 13 | .15 | 43 | .34 | -106 |
| 4500 | .70 | 106 | 1.18 | 6 | .17 | 39 | .36 | -116 |
| 5000 | .71 | 98 | 1.10 | -2 | .19 | 38 | .38 | -124 |

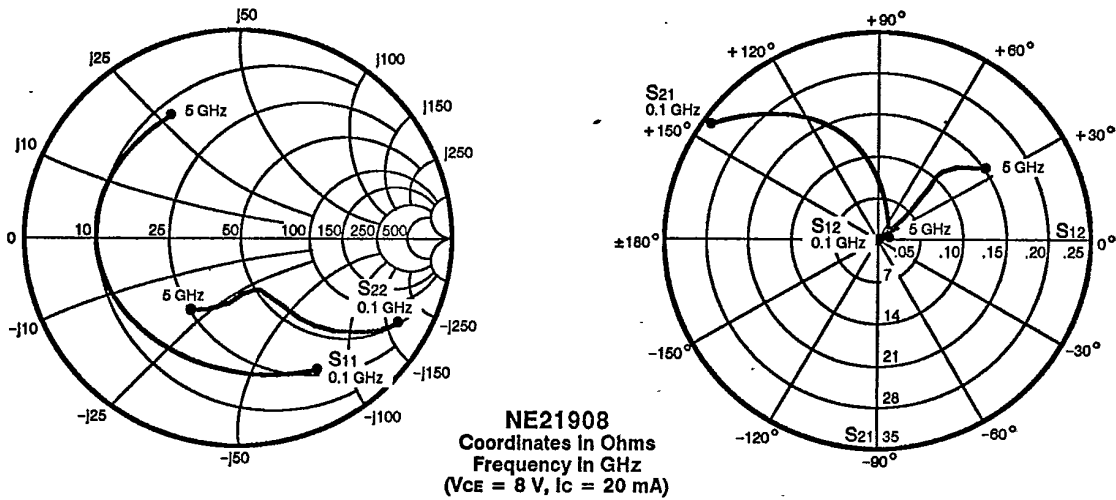
VCE = 8 V, IC = 20 mA

| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .69 | -64 | 32.32 | 144 | .01 | 71 | .84 | -24 |
| 500 | .60 | -166 | 11.17 | 96 | .03 | 46 | .37 | -42 |
| 1000 | .61 | 178 | 5.81 | 78 | .04 | 53 | .28 | -44 |
| 1500 | .61 | 164 | 3.92 | 66 | .06 | 55 | .28 | -50 |
| 2000 | .62 | 151 | 2.93 | 56 | .09 | 59 | .29 | -59 |
| 2500 | .64 | 140 | 2.38 | 46 | .11 | 55 | .25 | -72 |
| 3000 | .67 | 130 | 2.06 | 35 | .13 | 51 | .25 | -85 |
| 3500 | .68 | 120 | 1.73 | 26 | .15 | 48 | .26 | -96 |
| 4000 | .69 | 112 | 1.54 | 14 | .16 | 44 | .28 | -108 |
| 4500 | .69 | 105 | 1.32 | 7 | .18 | 42 | .31 | -115 |
| 5000 | .70 | 96 | 1.19 | 0 | .20 | 40 | .33 | -125 |

VCE = 8 V, IC = 40 mA

| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .62 | -84 | 39.23 | 136 | .01 | 57 | .76 | -29 |
| 500 | .60 | -166 | 11.61 | 92 | .02 | 54 | .32 | -39 |
| 1000 | .61 | 173 | 5.94 | 76 | .04 | 62 | .25 | -40 |
| 1500 | .62 | 160 | 3.99 | 64 | .06 | 59 | .26 | -47 |
| 2000 | .62 | 149 | 2.98 | 55 | .09 | 62 | .27 | -56 |
| 2500 | .65 | 138 | 2.43 | 45 | .11 | 56 | .24 | -70 |
| 3000 | .66 | 129 | 2.11 | 34 | .13 | 55 | .24 | -83 |
| 3500 | .68 | 120 | 1.78 | 25 | .15 | 51 | .25 | -94 |
| 4000 | .70 | 112 | 1.59 | 13 | .16 | 46 | .27 | -106 |
| 4500 | .70 | 104 | 1.35 | 6 | .18 | 43 | .30 | -113 |
| 5000 | .71 | 97 | 1.26 | -1 | .20 | 39 | .31 | -124 |

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 8 V, IC = 5 mA

| FREQUENCY (MHz) | S11 | | S21 | | S12 | | S22 | |
|-----------------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .91 | -29 | 14.21 | 160 | .01 | 79 | .96 | -13 |
| 500 | .73 | -112 | 8.27 | 113 | .07 | 38 | .61 | -40 |
| 1000 | .68 | -149 | 4.84 | 89 | .08 | 26 | .46 | -53 |
| 1500 | .67 | -169 | 3.34 | 73 | .08 | 22 | .44 | -58 |
| 2000 | .67 | 180 | 2.53 | 62 | .08 | 24 | .43 | -66 |
| 2500 | .67 | 168 | 2.01 | 50 | .09 | 24 | .42 | -76 |
| 3000 | .67 | 158 | 1.73 | 40 | .09 | 27 | .44 | -86 |
| 3500 | .67 | 149 | 1.48 | 30 | .10 | 29 | .46 | -94 |
| 4000 | .67 | 141 | 1.34 | 20 | .11 | 30 | .49 | -103 |
| 4500 | .66 | 134 | 1.16 | 10 | .12 | 30 | .52 | -110 |
| 5000 | .66 | 125 | 1.06 | 3 | .13 | 30 | .55 | -118 |

VCE = 8 V, IC = 10 mA

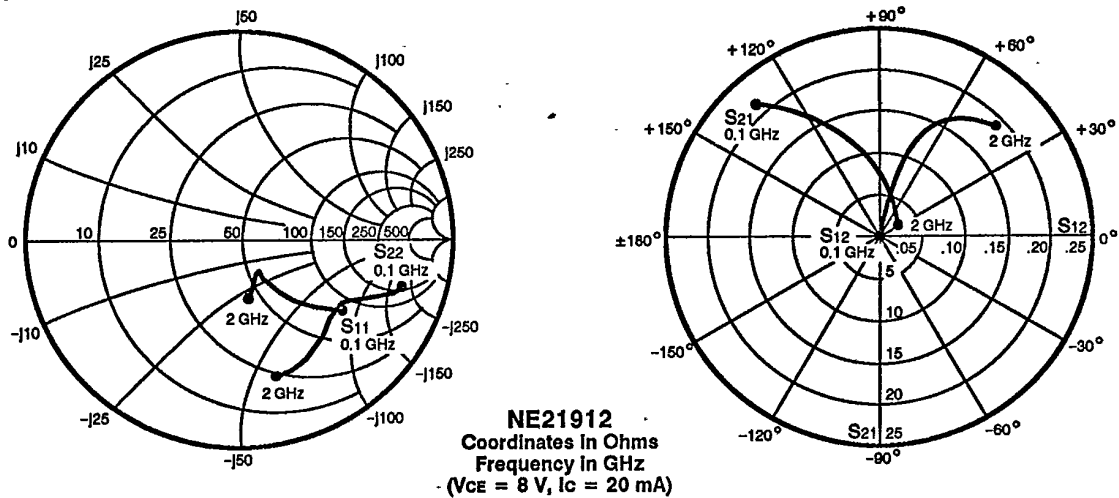
| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .84 | -42 | 23.68 | 153 | .01 | 78 | .91 | -19 |
| 500 | .67 | -132 | 10.89 | 105 | .05 | 37 | .45 | -50 |
| 1000 | .65 | -163 | 5.90 | 84 | .05 | 33 | .32 | -58 |
| 1500 | .63 | -178 | 4.00 | 71 | .07 | 37 | .31 | -64 |
| 2000 | .64 | 173 | 3.02 | 62 | .08 | 42 | .32 | -71 |
| 2500 | .65 | 160 | 2.47 | 50 | .08 | 37 | .31 | -82 |
| 3000 | .65 | 152 | 2.13 | 41 | .09 | 40 | .33 | -91 |
| 3500 | .65 | 143 | 1.82 | 32 | .11 | 40 | .35 | -98 |
| 4000 | .66 | 137 | 1.64 | 22 | .12 | 38 | .38 | -107 |
| 4500 | .65 | 130 | 1.44 | 13 | .13 | 36 | .41 | -113 |
| 5000 | .65 | 121 | 1.31 | 5 | .14 | 32 | .44 | -121 |

VCE = 8 V, IC = 20 mA

| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .75 | -59 | 34.58 | 145 | .01 | 71 | .84 | -27 |
| 500 | .65 | -148 | 12.63 | 99 | .03 | 43 | .34 | -58 |
| 1000 | .65 | -171 | 6.56 | 81 | .04 | 43 | .24 | -65 |
| 1500 | .64 | 176 | 4.44 | 69 | .06 | 44 | .24 | -69 |
| 2000 | .64 | 168 | 3.36 | 61 | .07 | 49 | .25 | -77 |
| 2500 | .65 | 156 | 2.73 | 51 | .08 | 47 | .24 | -87 |
| 3000 | .65 | 149 | 2.37 | 42 | .10 | 47 | .27 | -95 |
| 3500 | .65 | 141 | 2.02 | 32 | .11 | 46 | .30 | -101 |
| 4000 | .66 | 134 | 1.82 | 23 | .13 | 42 | .33 | -109 |
| 4500 | .65 | 127 | 1.58 | 13 | .14 | 38 | .36 | -115 |
| 5000 | .64 | 119 | 1.43 | 6 | .15 | 35 | .39 | -123 |



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 8 V, IC = 5 mA
FREQUENCY (MHz)

| | S11 | | S21 | | S12 | | S22 | |
|------|-----|-----|-------|-----|-----|----|-----|-----|
| 100 | .80 | -27 | 12.30 | 149 | .01 | 74 | .92 | -13 |
| 200 | .67 | -46 | 9.87 | 130 | .03 | 66 | .83 | -20 |
| 500 | .37 | -78 | 5.45 | 97 | .07 | 62 | .68 | -31 |
| 1000 | .19 | -97 | 3.03 | 71 | .11 | 62 | .63 | -43 |
| 1500 | .16 | -97 | 2.14 | 51 | .15 | 57 | .66 | -59 |
| 2000 | .20 | -98 | 1.62 | 31 | .16 | 46 | .71 | -78 |

VCE = 8 V, IC = 10 mA

| | | | | | | | | |
|------|-----|-----|-------|-----|-----|----|-----|-----|
| 100 | .69 | -31 | 17.67 | 140 | .01 | 74 | .86 | -15 |
| 200 | .53 | -47 | 12.60 | 120 | .02 | 67 | .76 | -22 |
| 500 | .29 | -66 | 6.18 | 92 | .07 | 70 | .64 | -29 |
| 1000 | .17 | -73 | 3.34 | 69 | .12 | 65 | .59 | -41 |
| 1500 | .19 | -76 | 2.33 | 51 | .17 | 56 | .62 | -58 |
| 2000 | .26 | -87 | 1.75 | 31 | .18 | 44 | .69 | -77 |

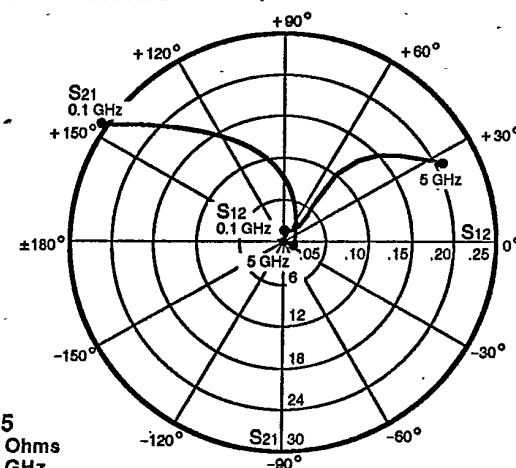
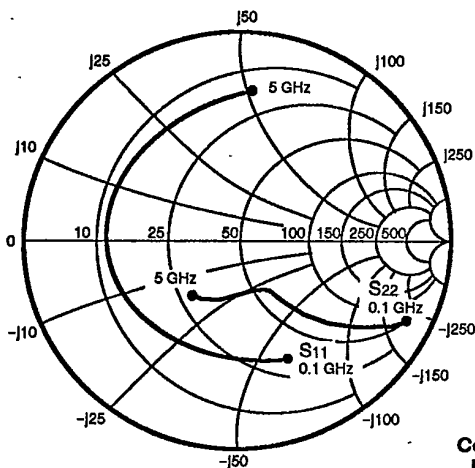
VCE = 8 V, IC = 20 mA

| | | | | | | | | |
|------|-----|-----|-------|-----|-----|----|-----|-----|
| 100 | .58 | -34 | 22.03 | 131 | .01 | 70 | .80 | -17 |
| 200 | .43 | -47 | 14.19 | 112 | .02 | 70 | .70 | -21 |
| 500 | .24 | -60 | 6.53 | 88 | .07 | 71 | .60 | -29 |
| 1000 | .17 | -61 | 3.49 | 67 | .13 | 66 | .58 | -40 |
| 1500 | .20 | -67 | 2.42 | 50 | .17 | 56 | .61 | -57 |
| 2000 | .29 | -84 | 1.81 | 30 | .18 | 43 | .68 | -77 |

VCE = 8 V, IC = 30 mA

| | | | | | | | | |
|------|-----|-----|-------|-----|-----|----|-----|-----|
| 100 | .52 | -36 | 23.55 | 126 | .01 | 70 | .77 | -17 |
| 200 | .38 | -46 | 14.52 | 109 | .02 | 71 | .67 | -20 |
| 500 | .22 | -58 | 6.54 | 86 | .07 | 70 | .59 | -28 |
| 1000 | .16 | -58 | 3.48 | 66 | .13 | 66 | .58 | -40 |
| 1500 | .20 | -65 | 2.41 | 49 | .17 | 56 | .61 | -58 |
| 2000 | .28 | -83 | 1.80 | 29 | .18 | 42 | .68 | -78 |

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE21935
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 8 V, IC = 5 mA
FREQUENCY (MHz)

| | S11 | | S21 | | S12 | | S22 | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .80 | -30 | 13.74 | 160 | .01 | 80 | .96 | -12 |
| 500 | .65 | -117 | 8.05 | 112 | .07 | 40 | .62 | -40 |
| 1000 | .62 | -159 | 4.72 | 86 | .07 | 30 | .45 | -50 |
| 1500 | .62 | 178 | 3.24 | 69 | .08 | 30 | .42 | -56 |
| 2000 | .62 | 162 | 2.44 | 56 | .09 | 34 | .42 | -64 |
| 2500 | .64 | 146 | 1.95 | 42 | .10 | 28 | .39 | -76 |
| 3000 | .65 | 133 | 1.67 | 30 | .11 | 33 | .40 | -87 |
| 3500 | .66 | 120 | 1.39 | 20 | .13 | 33 | .42 | -97 |
| 4000 | .67 | 109 | 1.27 | 9 | .14 | 32 | .43 | -108 |
| 4500 | .68 | 99 | 1.11 | -1 | .16 | 29 | .45 | -117 |
| 5000 | .69 | 89 | 1.02 | -10 | .18 | 25 | .48 | -127 |

VCE = 8 V, IC = 10 mA

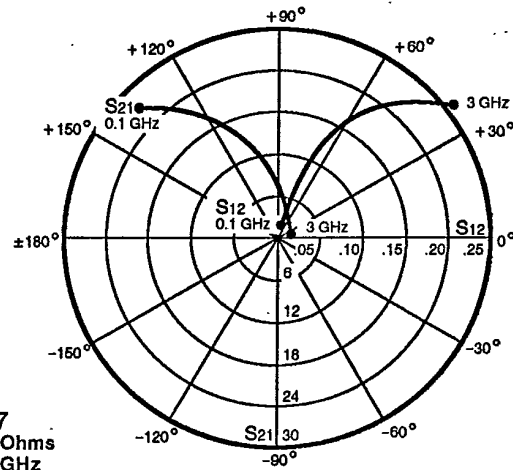
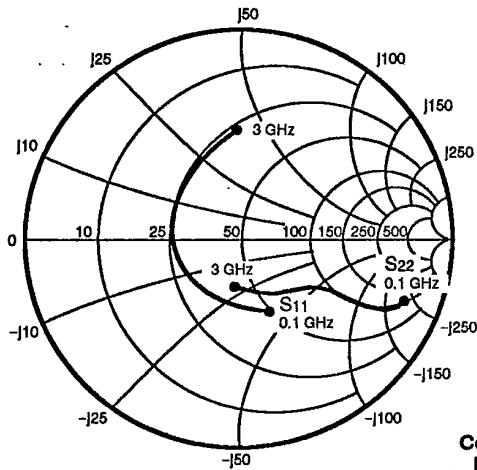
| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .67 | -44 | 22.00 | 153 | .01 | 76 | .92 | -18 |
| 500 | .59 | -139 | 10.21 | 104 | .04 | 42 | .48 | -48 |
| 1000 | .60 | -173 | 5.57 | 82 | .05 | 41 | .34 | -55 |
| 1500 | .59 | 169 | 3.78 | 67 | .07 | 42 | .32 | -61 |
| 2000 | .60 | 155 | 2.86 | 56 | .09 | 45 | .32 | -68 |
| 2500 | .62 | 140 | 2.29 | 43 | .11 | 43 | .30 | -80 |
| 3000 | .63 | 129 | 1.96 | 31 | .12 | 41 | .31 | -91 |
| 3500 | .64 | 117 | 1.68 | 22 | .14 | 39 | .32 | -101 |
| 4000 | .65 | 107 | 1.50 | 11 | .16 | 35 | .34 | -112 |
| 4500 | .66 | 98 | 1.30 | 1 | .18 | 29 | .36 | -121 |
| 5000 | .67 | 87 | 1.20 | -8 | .19 | 25 | .38 | -131 |

VCE = 8 V, IC = 20 mA

| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|------|
| 100 | .55 | -66 | 31.47 | 146 | .01 | 70 | .86 | -25 |
| 500 | .57 | -157 | 11.59 | 98 | .03 | 48 | .37 | -52 |
| 1000 | .59 | 177 | 6.10 | 79 | .05 | 51 | .26 | -58 |
| 1500 | .59 | 162 | 4.13 | 65 | .07 | 53 | .25 | -63 |
| 2000 | .59 | 150 | 3.09 | 55 | .09 | 55 | .26 | -71 |
| 2500 | .61 | 136 | 2.49 | 43 | .11 | 46 | .24 | -84 |
| 3000 | .62 | 125 | 2.13 | 32 | .13 | 45 | .26 | -94 |
| 3500 | .63 | 114 | 1.78 | 22 | .15 | 42 | .27 | -104 |
| 4000 | .65 | 105 | 1.62 | 12 | .17 | 37 | .29 | -115 |
| 4500 | .66 | 95 | 1.41 | 2 | .19 | 31 | .31 | -123 |
| 5000 | .67 | 85 | 1.31 | -7 | .20 | 26 | .33 | -132 |



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE21937
Coordinates in Ohms
Frequency in GHz
(VCE = 8 V, IC = 20 mA)

S-MAGN AND ANGLES:

VCE = 8 V, IC = 5 mA

FREQUENCY (MHz)

| | S11 | | S21 | | S12 | | S22 | |
|------|-----|------|-------|-----|-----|----|-----|-----|
| 100 | .67 | -36 | 12.58 | 154 | .01 | 76 | .95 | -13 |
| 200 | .56 | -69 | 10.71 | 135 | .03 | 58 | .84 | -21 |
| 500 | .43 | -132 | 6.19 | 102 | .06 | 50 | .60 | -31 |
| 1000 | .42 | 177 | 3.49 | 75 | .09 | 51 | .49 | -40 |
| 1500 | .44 | 148 | 2.41 | 56 | .12 | 51 | .46 | -48 |
| 2000 | .49 | 125 | 1.84 | 42 | .16 | 52 | .44 | -60 |
| 2500 | .54 | 105 | 1.50 | 26 | .19 | 45 | .37 | -71 |
| 3000 | .59 | 96 | 1.29 | 16 | .24 | 42 | .35 | -95 |

VCE = 8 V, IC = 10 mA

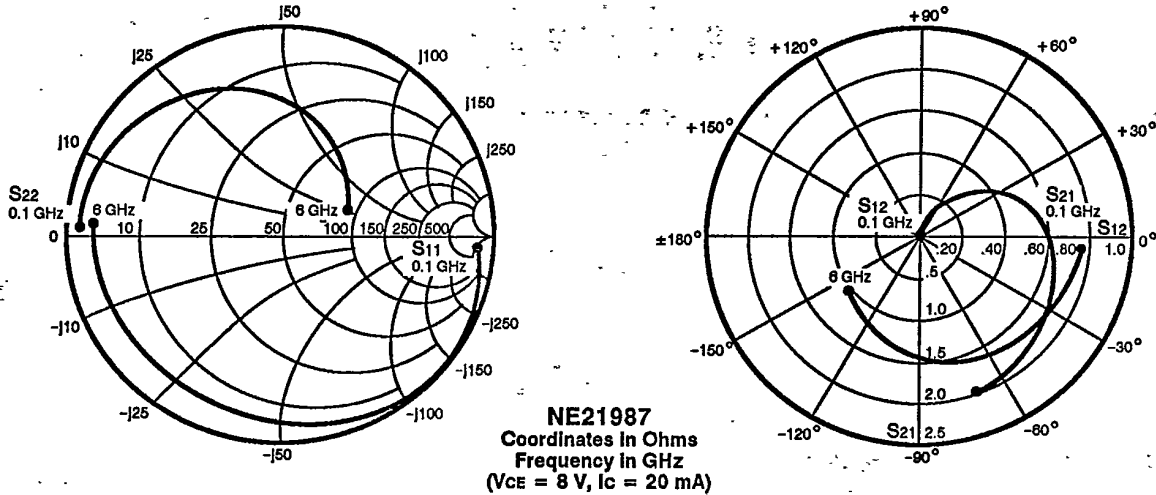
| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|-----|
| 100 | .53 | -52 | 19.37 | 146 | .01 | 72 | .89 | -17 |
| 200 | .42 | -91 | 14.71 | 125 | .02 | 56 | .73 | -27 |
| 500 | .36 | -153 | 7.39 | 95 | .05 | 58 | .49 | -32 |
| 1000 | .38 | 165 | 3.98 | 72 | .09 | 60 | .41 | -38 |
| 1500 | .41 | 140 | 2.71 | 56 | .13 | 57 | .39 | -47 |
| 2000 | .45 | 122 | 2.07 | 42 | .17 | 54 | .36 | -60 |
| 2500 | .50 | 105 | 1.70 | 27 | .21 | 47 | .31 | -73 |
| 3000 | .55 | 93 | 1.44 | 14 | .26 | 40 | .28 | -95 |

VCE = 8 V, IC = 20 mA

| | | | | | | | | |
|------|-----|------|-------|-----|-----|----|-----|-----|
| 100 | .39 | -71 | 26.29 | 137 | .01 | 74 | .81 | -23 |
| 200 | .32 | -118 | 17.89 | 116 | .01 | 60 | .62 | -30 |
| 500 | .32 | -170 | 8.16 | 90 | .05 | 66 | .42 | -30 |
| 1000 | .36 | 156 | 4.28 | 70 | .09 | 65 | .36 | -37 |
| 1500 | .39 | 135 | 2.91 | 54 | .14 | 59 | .34 | -46 |
| 2000 | .43 | 118 | 2.22 | 42 | .18 | 55 | .31 | -60 |
| 2500 | .49 | 102 | 1.80 | 27 | .22 | 46 | .26 | -77 |
| 3000 | .53 | 91 | 1.53 | 14 | .26 | 38 | .23 | -96 |

NE219 SERIES

TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCE = 8 V, IC = 10 mA
FREQUENCY (MHz)

| FREQUENCY (MHz) | S11 | S21 | S12 | S22 |
|-----------------|-----|------|------|------|
| 100 | .97 | -4 | 1.81 | -3 |
| 500 | .96 | -20 | 1.84 | -15 |
| 1000 | .98 | -42 | 1.82 | -30 |
| 1500 | .95 | -62 | 1.75 | -42 |
| 2000 | .91 | -80 | 1.60 | -56 |
| 2500 | .86 | -96 | 1.51 | -67 |
| 3000 | .85 | -113 | 1.42 | -78 |
| 3500 | .84 | -129 | 1.32 | -91 |
| 4000 | .82 | -144 | 1.21 | -100 |
| 4500 | .79 | -158 | 1.15 | -110 |
| 5000 | .77 | -173 | 1.06 | -120 |
| 5500 | .76 | -176 | 1.02 | -131 |
| 6000 | .73 | -163 | .94 | -140 |

VCE = 8 V, IC = 20 mA

| | | | | |
|------|------|------|------|------|
| 100 | .98 | -3 | 1.87 | -3 |
| 500 | .97 | -19 | 1.89 | -15 |
| 1000 | 1.00 | -39 | 1.88 | -28 |
| 1500 | .99 | -58 | 1.81 | -40 |
| 2000 | .94 | -75 | 1.64 | -55 |
| 2500 | .91 | -90 | 1.60 | -66 |
| 3000 | .91 | -107 | 1.51 | -77 |
| 3500 | .90 | -122 | 1.42 | -90 |
| 4000 | .89 | -137 | 1.31 | -100 |
| 4500 | .87 | -150 | 1.26 | -111 |
| 5000 | .85 | -165 | 1.16 | -121 |
| 5500 | .84 | -176 | 1.11 | -133 |
| 6000 | .82 | -171 | 1.02 | -143 |

VCE = 8 V, IC = 40 mA

| | | | | |
|------|------|------|------|------|
| 100 | .97 | -3 | 1.88 | -3 |
| 500 | .97 | -19 | 1.92 | -14 |
| 1000 | 1.00 | -38 | 1.91 | -28 |
| 1500 | .99 | -57 | 1.85 | -39 |
| 2000 | .95 | -75 | 1.63 | -54 |
| 2500 | .93 | -91 | 1.66 | -66 |
| 3000 | .93 | -110 | 1.59 | -78 |
| 3500 | .93 | -127 | 1.51 | -92 |
| 4000 | .91 | -143 | 1.39 | -102 |
| 4500 | .90 | -158 | 1.33 | -114 |
| 5000 | .88 | -175 | 1.21 | -125 |
| 5500 | .88 | -172 | 1.16 | -138 |
| 6000 | .85 | -158 | 1.04 | -148 |

