NEC

# NPN SILICON OSCILLATOR AND MIXER TRANSISTOR

# NE944 SERIES

## FEATURES

- **LOW COST**
- **HIGH GAIN BANDWIDTH PRODUCT:** $f_T$ = 2000 MHz TYP
- **LOW COLLECTOR TO BASE TIME CONSTANT:** $C_{C} \cdot r_{b'b}$ = 5 ps TYP
- **LOW FEEDBACK CAPACITANCE:** $C_{RE}$= 0.55 pF TYP

## DESCRIPTION

The NE944 series of NPN silicon epitaxial bipolar transistors is intended for use in general purpose UHF oscillator and mixer applications. It is suitable for automotive keyless entry and TV tuner designs.

The device features stable oscillation and small frequency drift during changes in the supply voltage and over the ambient temperature range.

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## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

| PART NUMBER<br>EIAJ[1] REGISTERED NUMBER<br>PACKAGE CODE | | | NE94430<br>2SC4184<br>30 | | | NE94432<br>2SC3544<br>32 | | | NE94433<br>2SC3545<br>33 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| $I_{CBO}$ | Collector Cutoff Current, $V_{CB}$ = 12 V, $I_E$ = 0 | μA | | | 0.1 | | | 0.1 | | | 0.1 |
| $h_{FE}$ | DC Current Gain, $V_{CE}$ = 10 V, $I_C$ = 5.0 mA | | 40 | 100 | 200 | 50 | 100 | 250 | 50 | 100 | 250 |
| $V_{CE(sat)}$ | Collector Saturation Voltage, $I_C$ = 10 mA, $I_B$ = 1.0 mA | V | | | 0.5 | | | 0.5 | | | 0.5 |
| $f_T$ | Gain Bandwidth Product, $V_{CE}$ = 3 V, $I_E$ = 5 mA | GHz | 1.2 | 2.0 | | 1.3 | 2.0 | | 1.3 | 2.0 | |
| $C_{OB}$ | Output Capacitance, $V_{CB}$ = 3 V, $I_E$ = 0 mA, f = 1.0 MHz | pF | | 0.7 | 1.2 | | | | | | |
| $C_{C} \cdot r_{b'b}$ | Collector to Base Time Constant, $V_{CE}$ = 3 V, $I_E$ = -5.0 mA, f = 31.9 MHz | ps | | 3.5 | 8.0 | | 5.0 | | | 5.0 | |
| $C_{RE}$ | Feedback Capacitance, $V_{CB}$ = 10 V, $I_E$ = 0, f = 1.0 MHz | pF | | | | | 0.55 | 1.0 | | 0.55 | 1.0 |
| $R_{TH\ (J\text{-}C)}$ | Thermal Resistance, Junction to Case (infinite heat sink) | °C/W | | | 200 | | | 200 | | | 200 |
| $R_{TH\ (J\text{-}A)}$ | Thermal Resistance, Junction to Ambient (free air) | °C/W | | | 833 | | | 400 | | | 620 |
| $P_T$ | Power Dissipation | mW | | | 150 | | | 250 | | | 150 |

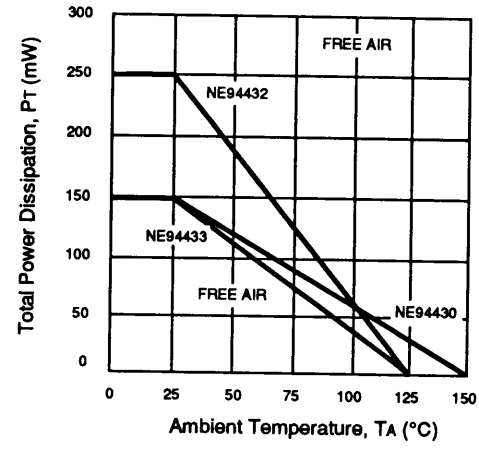
Note:
1. Electronic Industrial Association of Japan.

## ABSOLUTE MAXIMUM RATINGS[1] ($T_A$ = 25°C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | V | 30 |
| $V_{CEO}$ | Collector to Emitter Voltage | V | 15 |
| $V_{EBO}$ | Emitter to Base Voltage | V | 3.0 |
| $I_C$ | Collector Current | mA | 50 |
| $T_J$ | Junction Temperature<br>NE94432, NE94433<br>NE94430 | <br>°C<br>°C | <br>125<br>150 |
| $T_{STG}$ | Storage Temperature | °C | -55 to +125 |

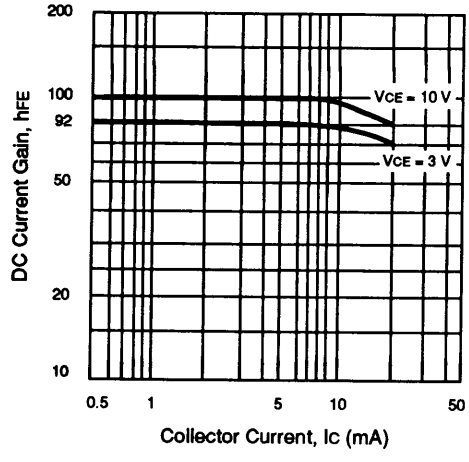
Notes:
1. Operation in excess of any one of these parameters may result in permanent damage.

**TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE**

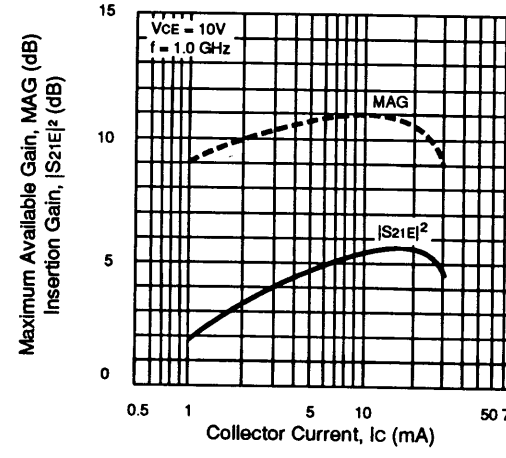



## TYPICAL PERFORMANCE CURVES ($T_A$ = 25°C)

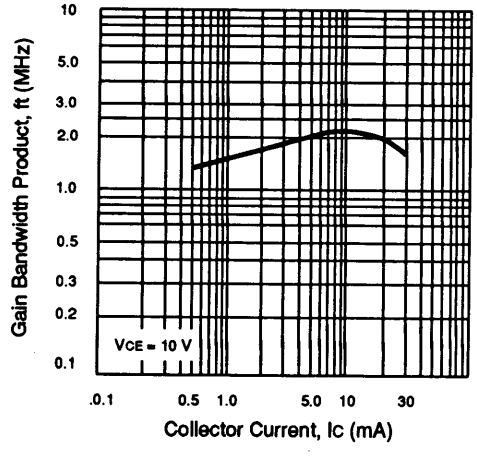
**DC CURRENT GAIN vs. COLLECTOR CURRENT**



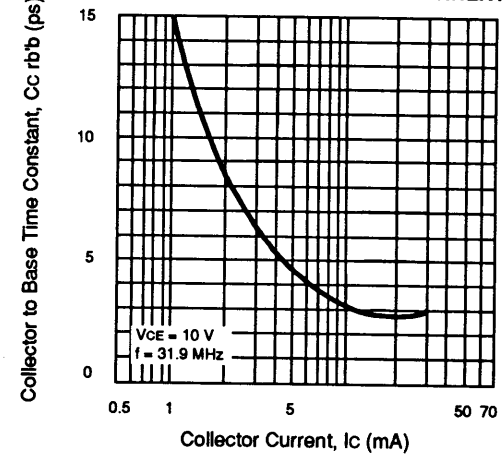

**NE94432**
**INSERTION GAIN, MAXIMUM AVAILABLE GAIN vs. COLLECTOR CURRENT**




**GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT**

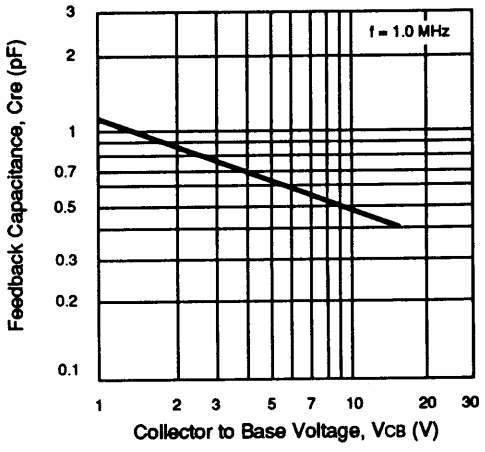



**NE94432**
**COLLECTOR TO BASE TIME CONSTANT vs. COLLECTOR CURRENT**



## TYPICAL PERFORMANCE CURVES (TA = 25°C)

TYPICAL DEVICE CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE




## NE94432
## TYPICAL NOISE PARAMETERS (TA = 25°C)

| FREQ. (MHz) | NFOPT (dB) | GA (dB) | ΓOPT MAG | ΓOPT ANG | Rn/50 |
|---|---|---|---|---|---|
| VCE = 10 V, IC = 5 mA | | | | | |
| 500 | 3.8 | 12.5 | O.34 | 112 | 0.49 |
| 1000 | 6.3 | 8.0 | 0.23 | 179 | 0.62 |

## NE94430
## TYPICAL NOISE PARAMETERS (TA = 25°C)

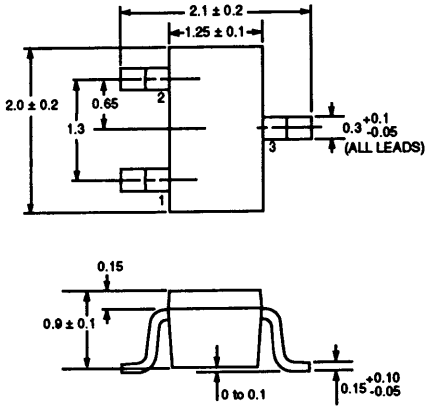
| FREQ. (MHz) | NFOPT (dB) | GA (dB) | ΓOPT MAG | ΓOPT ANG | Rn/50 |
|---|---|---|---|---|---|
| VCE = 2.5 V, IC = 2.5 mA | | | | | |
| 500 | 3.2 | 10.8 | 0.33 | 63 | 0.75 |
| 1000 | 5.4 | 6.3 | 0.29 | 142 | 0.45 |
| 1500 | 6.7 | 4.5 | 0.32 | 165 | 0.64 |
| VCE = 3 V, IC = 5 mA | | | | | |
| 500 | 3.8 | 12.2 | 0.27 | 79 | 0.70 |
| 1000 | 6.3 | 7.8 | 0.28 | 168 | 0.48 |
| 1500 | 8.3 | 5.6 | 0.38 | -175 | 0.55 |
| VCE = 10 V, IC = 5 mA | | | | | |
| 500 | 3.8 | 12.9 | 0.27 | 69 | 0.75 |
| 1000 | 6.3 | 8.4 | 0.27 | 160 | 0.58 |
| 1500 | 8.3 | 6.4 | 0.32 | 174 | 0.68 |

## NE94433
## TYPICAL NOISE PARAMETERS (TA = 25°C)

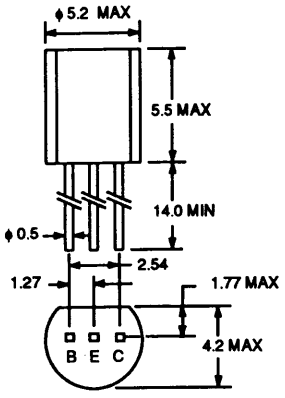
| FREQ. (MHz) | NFOPT (dB) | GA (dB) | ΓOPT MAG | ΓOPT ANG | Rn/50 | VCE (V) | IC (mA) |
|---|---|---|---|---|---|---|---|
| VCE = 8 V, IC = 5 mA | | | | | | | |
| 500 | 3.6 | 13 | .43 | 51 | 1.0 | 8 | 5 |
| 1000 | 5.8 | 8.9 | .29 | 113 | .7 | 8 | 5 |
| VCE = 10 V, IC = 5 mA | | | | | | | |
| 500 | 3.6 | 12.9 | .44 | .51 | 1.04 | 10 | 5 |
| 1000 | 6.0 | 8.9 | .32 | 117 | .70 | 10 | 5 |

## OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE 30

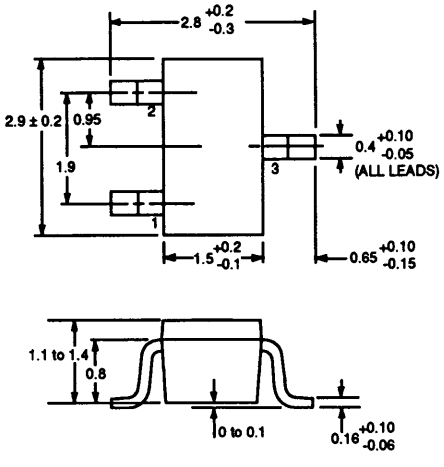



PACKAGE OUTLINE 32
(TO-92)

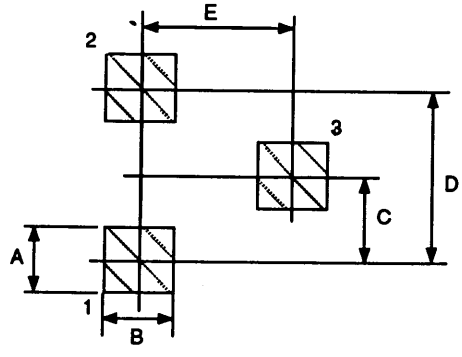



LEAD CONNECTIONS
1. Base
2. Emitter
3. Collector

PACKAGE OUTLINE 33

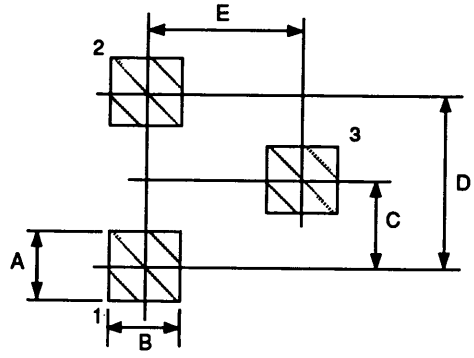


**PACKAGE OUTLINE 30**
**RECOMMENDED P.C.B. LAYOUT**



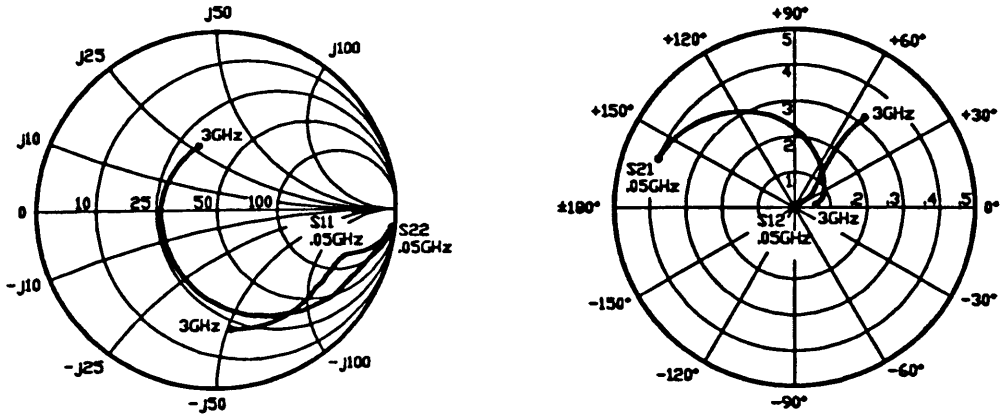

| SYMBOL | DIMENSION | |
|---|---|---|
| | MILLIMETERS | INCHES |
| A | 0.6 MIN | 0.024 |
| B | 0.8 MIN | 0.031 |
| C | 0.65 | 0.026 |
| D | 1.3 | 0.051 |
| E | 1.7 | 0.067 |

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




| SYMBOL | DIMENSION | |
|---|---|---|
| | MILLIMETERS | INCHES |
| A | 0.8 MIN | 0.031 |
| B | 1.0 MIN | 0.039 |
| C | 0.95 | 0.037 |
| D | 1.9 | 0.075 |
| E | 2.4 | 0.095 |

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




**NE94430**
**Coordinates in Ohms**
**Frequency in GHz**
**($V_{CE}$ = 2.5 V, $I_C$ = 2.5 mA)**

**$V_{CE}$ = 2.5 V, $I_C$ = 2.5 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .929 | -13.0 | 4.051 | 160.3 | .017 | 89.3 | .977 | -6.0 | 0.10 | 12.2 | 23.8 |
| 100 | .854 | -24.4 | 3.892 | 148.7 | .030 | 66.4 | .936 | -10.9 | 0.47 | 11.8 | 21.1 |
| 200 | .735 | -50.1 | 3.591 | 129.9 | .049 | 56.9 | .843 | -16.2 | 0.65 | 11.1 | 18.7 |
| 300 | .608 | -74.2 | 3.285 | 114.9 | .060 | 53.8 | .788 | -18.4 | 0.78 | 10.3 | 17.4 |
| 400 | .498 | -96.3 | 2.956 | 102.1 | .069 | 52.3 | .756 | -19.9 | 0.89 | 9.4 | 16.3 |
| 500 | .423 | -113.8 | 2.607 | 92.2 | .076 | 52.4 | .738 | -21.8 | 0.99 | 8.3 | 15.4 |
| 600 | .382 | -126.3 | 2.273 | 84.7 | .084 | 53.1 | .728 | -23.7 | 1.06 | 7.1 | 12.8 |
| 700 | .355 | -136.7 | 2.013 | 78.4 | .091 | 54.1 | .721 | -25.7 | 1.13 | 6.1 | 11.3 |
| 800 | .338 | -145.4 | 1.803 | 72.9 | .099 | 54.6 | .717 | -28.0 | 1.17 | 5.1 | 10.1 |
| 900 | .327 | -152.6 | 1.630 | 68.0 | .107 | 55.3 | .713 | -30.2 | 1.21 | 4.2 | 9.1 |
| 1000 | .318 | -159.5 | 1.490 | 63.5 | .115 | 56.0 | .710 | -32.6 | 1.22 | 3.5 | 8.2 |
| 1500 | .308 | 172.6 | 1.071 | 45.4 | .157 | 58.2 | .704 | -43.9 | 1.25 | 0.6 | 5.4 |
| 2000 | .315 | 148.6 | 0.851 | 31.3 | .201 | 58.7 | .702 | -56.4 | 1.20 | -1.4 | 3.7 |
| 2500 | .340 | 125.9 | 0.710 | 21.1 | .257 | 58.2 | .691 | -69.1 | 1.14 | -3.0 | 2.1 |
| 3000 | .379 | 105.4 | 0.614 | 14.8 | .326 | 55.2 | .670 | -82.8 | 1.11 | -4.2 | 0.8 |

**$V_{CE}$ = 3 V, $I_{CE}$ = 5 mA**

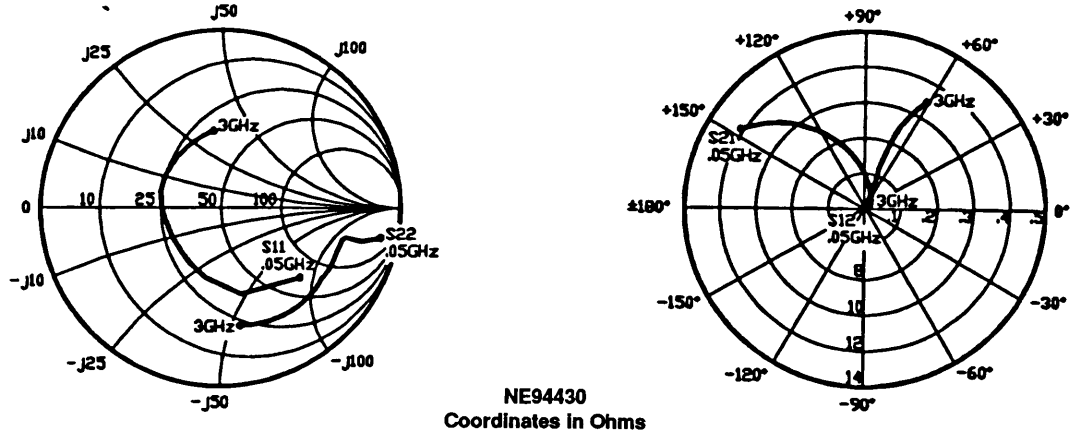
| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .819 | -19.8 | 7.561 | 154.4 | .014 | 88.3 | .946 | -8.5 | 0.20 | 17.6 | 27.3 |
| 100 | .740 | -38.0 | 6.980 | 138.9 | .025 | 63.8 | .874 | -13.2 | 0.57 | 16.9 | 24.5 |
| 200 | .511 | -76.6 | 5.906 | 117.4 | .037 | 59.4 | .771 | -15.6 | 0.77 | 15.4 | 22.0 |
| 300 | .414 | -106.3 | 4.762 | 101.6 | .046 | 58.2 | .732 | -16.4 | 0.92 | 13.6 | 20.2 |
| 400 | .354 | -125.6 | 3.819 | 91.5 | .052 | 59.9 | .713 | -17.5 | 1.07 | 11.6 | 17.0 |
| 500 | .326 | -138.4 | 3.152 | 84.3 | .064 | 60.3 | .705 | -19.2 | 1.09 | 10.0 | 15.1 |
| 600 | .313 | -147.8 | 2.671 | 78.4 | .072 | 61.7 | .701 | -21.1 | 1.15 | 8.5 | 13.3 |
| 700 | .306 | -155.6 | 2.318 | 73.3 | .081 | 62.4 | .699 | -23.2 | 1.18 | 7.3 | 12.0 |
| 800 | .303 | -162.1 | 2.050 | 68.7 | .089 | 62.7 | .697 | -25.4 | 1.21 | 6.2 | 10.8 |
| 900 | .302 | -167.8 | 1.839 | 64.4 | .098 | 63.2 | .696 | -27.7 | 1.22 | 5.3 | 9.9 |
| 1000 | .303 | -173.3 | 1.669 | 60.4 | .106 | 63.5 | .695 | -30.1 | 1.24 | 4.4 | 9.0 |
| 1500 | .316 | 163.0 | 1.169 | 43.8 | .151 | 64.6 | .696 | -41.4 | 1.19 | 1.4 | 6.3 |
| 2000 | .333 | 141.1 | 0.914 | 30.2 | .198 | 64.3 | .699 | -53.8 | 1.12 | -0.8 | 4.6 |
| 2500 | .361 | 119.9 | 0.751 | 20.2 | .259 | 62.8 | .691 | -66.3 | 1.05 | -2.5 | 3.3 |
| 3000 | .401 | 100.9 | 0.642 | 13.9 | .332 | 58.7 | .672 | -79.9 | 1.02 | -3.8 | 2.0 |

Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

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




**NE94430**
**Coordinates in Ohms**
**Frequency in GHz**
**($V_{CE}$ = 3 V, $I_C$ = 10 mA)**

**$V_{CE}$ = 3 V, $I_C$ = 10 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .585 | -42.0 | 12.113 | 141.5 | .010 | 70.5 | .896 | -11.0 | 0.64 | 21.7 | 30.8 |
| 100 | .496 | -76.7 | 10.005 | 124.0 | .015 | 60.1 | .799 | -13.5 | 0.95 | 20.0 | 28.2 |
| 200 | .354 | -119.1 | 6.964 | 102.0 | .028 | 63.7 | .721 | -13.4 | 1.05 | 16.9 | 22.5 |
| 300 | .320 | -138.2 | 5.042 | 91.6 | .039 | 65.1 | .702 | -14.0 | 1.12 | 14.0 | 19.1 |
| 400 | .313 | -150.2 | 3.910 | 84.5 | .049 | 66.7 | .693 | -15.4 | 1.16 | 11.8 | 16.6 |
| 500 | .310 | -158.3 | 3.184 | 78.7 | .058 | 66.7 | .690 | -17.3 | 1.21 | 10.1 | 14.6 |
| 600 | .313 | -164.8 | 2.680 | 73.6 | .067 | 67.6 | .689 | -19.5 | 1.23 | 8.6 | 13.1 |
| 700 | .317 | -170.5 | 2.316 | 69.1 | .076 | 68.2 | .689 | -21.8 | 1.24 | 7.3 | 11.9 |
| 800 | .322 | -175.4 | 2.040 | 64.8 | .084 | 68.2 | .689 | -24.2 | 1.26 | 6.2 | 10.8 |
| 900 | .326 | -179.9 | 1.824 | 60.8 | .093 | 68.6 | .690 | -26.6 | 1.26 | 5.2 | 9.9 |
| 1000 | .330 | 175.5 | 1.652 | 57.1 | .101 | 68.7 | .690 | -29.1 | 1.27 | 4.4 | 9.0 |
| 1500 | .354 | 154.6 | 1.145 | 41.2 | .148 | 70.1 | .694 | -41.0 | 1.18 | 1.2 | 6.3 |
| 2000 | .374 | 134.2 | 0.887 | 28.1 | .202 | 69.0 | .697 | -53.8 | 1.07 | -1.0 | 4.8 |
| 2500 | .402 | 114.4 | 0.722 | 18.6 | .269 | 66.2 | .689 | -66.7 | 1.01 | -2.8 | 3.7 |
| 3000 | .438 | 96.2 | 0.613 | 13.2 | .347 | 60.7 | .668 | -80.6 | 1.01 | -4.3 | 2.1 |

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

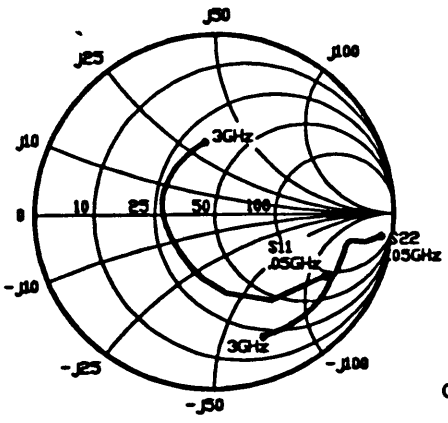
| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .860 | -17.7 | 7.577 | 156.2 | .012 | 79.9 | .960 | -6.1 | 0.30 | 17.6 | 28.0 |
| 100 | .788 | -35.1 | 6.982 | 141.8 | .021 | 60.9 | .909 | -10.2 | 0.57 | 16.9 | 25.2 |
| 200 | .574 | -68.0 | 6.049 | 120.3 | .033 | 60.0 | .826 | -12.6 | 0.71 | 15.6 | 22.6 |
| 300 | .428 | -95.6 | 4.966 | 104.4 | .039 | 59.9 | .792 | -13.6 | 0.86 | 13.9 | 21.0 |
| 400 | .349 | -114.9 | 4.020 | 93.9 | .045 | 61.9 | .776 | -14.7 | 0.98 | 12.1 | 19.5 |
| 500 | .312 | -127.9 | 3.329 | 86.6 | .053 | 62.5 | .768 | -16.3 | 1.04 | 10.4 | 16.7 |
| 600 | .293 | -138.0 | 2.823 | 80.7 | .060 | 63.9 | .765 | -18.1 | 1.09 | 9.0 | 14.9 |
| 700 | .282 | -146.3 | 2.450 | 75.6 | .067 | 64.5 | .763 | -19.9 | 1.13 | 7.8 | 13.5 |
| 800 | .277 | -153.6 | 2.165 | 70.9 | .074 | 65.0 | .762 | -22.0 | 1.15 | 6.7 | 12.3 |
| 900 | .274 | -159.8 | 1.941 | 66.7 | .082 | 66.0 | .761 | -24.0 | 1.15 | 5.8 | 11.4 |
| 1000 | .273 | -165.8 | 1.759 | 62.8 | .088 | 66.3 | .760 | -26.1 | 1.18 | 4.9 | 10.4 |
| 1500 | .283 | 168.0 | 1.223 | 46.3 | .126 | 68.6 | .763 | -36.0 | 1.12 | 1.7 | 7.8 |
| 2000 | .301 | 144.3 | 0.949 | 32.5 | .167 | 69.7 | .768 | -46.8 | 1.03 | -0.5 | 6.6 |
| 2500 | .334 | 121.7 | 0.772 | 22.0 | .221 | 69.6 | .766 | -57.6 | 0.93 | -2.2 | 5.4 |
| 3000 | .380 | 101.5 | 0.649 | 15.0 | .290 | 66.7 | .755 | -69.3 | 0.87 | -3.8 | 3.5 |

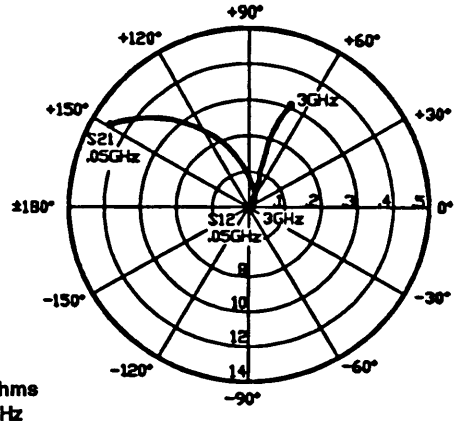
Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

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




**NE94430**
**Coordinates in Ohms**
**Frequency in GHz**
**($V_{CE}$ = 10 V, $I_C$ = 10 mA)**

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

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .707 | -30.1 | 13.371 | 148.5 | .010 | 66.4 | .929 | -8.1 | 0.51 | 22.5 | 31.3 |
| 100 | .584 | -57.5 | 11.507 | 130.2 | .016 | 66.5 | .851 | -10.9 | 0.63 | 21.2 | 28.6 |
| 200 | .374 | -99.7 | 8.064 | 106.4 | .021 | 66.8 | .781 | -11.4 | 1.00 | 18.1 | 25.5 |
| 300 | .305 | -121.8 | 5.739 | 94.7 | .031 | 67.0 | .760 | -12.1 | 1.06 | 15.2 | 21.1 |
| 400 | .282 | -136.1 | 4.411 | 87.1 | .041 | 67.4 | .752 | -13.3 | 1.08 | 12.9 | 18.6 |
| 500 | .273 | -146.0 | 3.576 | 81.3 | .049 | 68.3 | .749 | -14.9 | 1.11 | 11.1 | 16.6 |
| 600 | .272 | -153.8 | 3.003 | 76.2 | .057 | 68.6 | .749 | -16.8 | 1.13 | 9.6 | 15.0 |
| 700 | .273 | -160.4 | 2.588 | 71.7 | .064 | 69.3 | .749 | -18.8 | 1.15 | 8.3 | 13.7 |
| 800 | .276 | -166.2 | 2.276 | 67.5 | .071 | 69.4 | .749 | -20.9 | 1.17 | 7.1 | 12.6 |
| 900 | .280 | -171.5 | 2.033 | 63.6 | .079 | 70.2 | .749 | -23.0 | 1.16 | 6.2 | 11.7 |
| 1000 | .284 | -176.7 | 1.837 | 60.0 | .085 | 70.2 | .750 | -25.2 | 1.18 | 5.3 | 10.8 |
| 1500 | .307 | 159.8 | 1.264 | 44.2 | .125 | 72.6 | .755 | -35.2 | 1.08 | 2.0 | 8.3 |
| 2000 | .328 | 137.8 | 0.973 | 30.9 | .170 | 73.3 | .762 | -46.2 | 0.97 | -0.2 | 7.6 |
| 2500 | .362 | 116.8 | 0.786 | 20.5 | .228 | 71.9 | .760 | -57.2 | 0.88 | -2.1 | 5.4 |
| 3000 | .405 | 97.9 | 0.657 | 13.6 | .300 | 68.0 | .749 | -68.9 | 0.84 | -3.6 | 3.4 |

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

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .453 | -63.0 | 16.590 | 133.6 | .009 | 68.4 | .883 | -8.5 | 0.64 | 24.4 | 32.7 |
| 100 | .348 | -99.9 | 11.826 | 113.7 | .015 | 63.1 | .816 | -9.1 | 0.84 | 21.5 | 29.0 |
| 200 | .285 | -130.6 | 6.999 | 97.9 | .022 | 70.0 | .780 | -9.3 | 1.11 | 16.9 | 23.0 |
| 300 | .278 | -144.8 | 4.907 | 89.7 | .030 | 69.9 | .769 | -10.6 | 1.20 | 13.8 | 19.4 |
| 400 | .284 | -154.4 | 3.777 | 83.6 | .038 | 71.8 | .765 | -12.4 | 1.23 | 11.5 | 17.1 |
| 500 | .291 | -161.5 | 3.075 | 78.5 | .046 | 72.4 | .763 | -14.4 | 1.25 | 9.6 | 15.3 |
| 600 | .299 | -167.6 | 2.592 | 73.8 | .053 | 72.1 | .762 | -16.6 | 1.26 | 8.3 | 13.8 |
| 700 | .306 | -173.0 | 2.242 | 69.5 | .060 | 73.2 | .761 | -18.8 | 1.28 | 7.0 | 12.6 |
| 800 | .314 | -178.0 | 1.978 | 65.4 | .067 | 73.8 | .761 | -21.0 | 1.28 | 5.9 | 11.5 |
| 900 | .320 | 177.4 | 1.771 | 61.5 | .075 | 74.6 | .761 | -23.3 | 1.26 | 5.0 | 10.7 |
| 1000 | .325 | 172.7 | 1.604 | 57.8 | .082 | 75.2 | .761 | -25.5 | 1.26 | 4.1 | 9.9 |
| 1500 | .351 | 151.5 | 1.110 | 41.8 | .125 | 77.6 | .764 | -36.1 | 1.12 | 0.9 | 7.4 |
| 2000 | .372 | 130.9 | 0.851 | 28.4 | .175 | 77.0 | .770 | -47.5 | 0.99 | -1.4 | 6.9 |
| 2500 | .405 | 111.1 | 0.680 | 18.6 | .239 | 74.3 | .764 | -58.8 | 0.92 | -3.4 | 4.5 |
| 3000 | .445 | 93.1 | 0.562 | 13.3 | .316 | 68.9 | .748 | -71.0 | 0.92 | -5.0 | 2.5 |

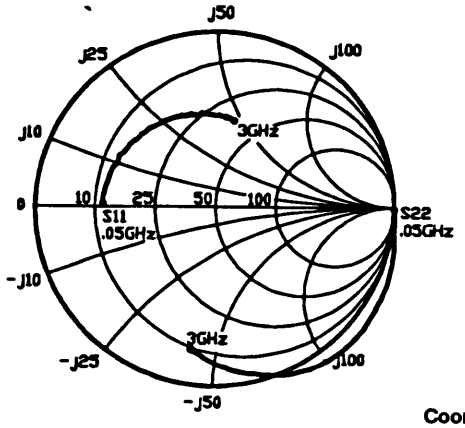
Note:

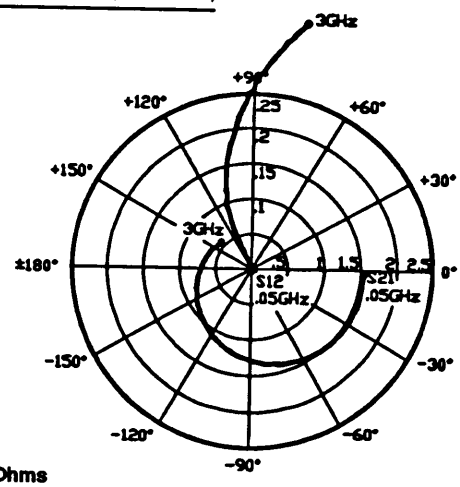
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

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




NE94430
Coordinates in Ohms
Frequency in GHz
($V_{CB}$ = 2.5 V, $I_C$ = 2.5 mA)

**$V_{CB}$ = 2.5 V, $I_C$ = 2.5 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .622 | 178.7 | 1.602 | -2.4 | .001 | 60.6 | 0.996 | -0.6 | 1.51 | 4.1 | 27.2 |
| 100 | .623 | 176.6 | 1.599 | -5.5 | .004 | 101.3 | 0.999 | -1.6 | -0.02 | 4.1 | 25.8 |
| 200 | .622 | 172.6 | 1.601 | -11.7 | .009 | 101.2 | 1.004 | -4.1 | -0.28 | 4.1 | 22.5 |
| 300 | .618 | 168.5 | 1.588 | -18.7 | .014 | 105.2 | 1.008 | -6.8 | -0.37 | 4.0 | 20.5 |
| 400 | .615 | 164.8 | 1.567 | -25.0 | .019 | 106.4 | 1.015 | -9.4 | -0.47 | 3.9 | 19.2 |
| 500 | .613 | 160.8 | 1.550 | -31.5 | .026 | 110.5 | 1.024 | -12.1 | -0.57 | 3.8 | 17.8 |
| 600 | .604 | 157.0 | 1.525 | -38.5 | .033 | 111.8 | 1.038 | -15.1 | -0.61 | 3.7 | 16.6 |
| 700 | .601 | 153.2 | 1.497 | -45.1 | .041 | 113.2 | 1.041 | -18.0 | -0.65 | 3.5 | 15.6 |
| 800 | .598 | 149.4 | 1.467 | -52.0 | .051 | 112.8 | 1.047 | -21.2 | -0.62 | 3.3 | 14.6 |
| 900 | .592 | 145.5 | 1.427 | -59.3 | .062 | 113.0 | 1.057 | -24.5 | -0.63 | 3.1 | 13.6 |
| 10000 | .592 | 141.9 | 1.395 | -66.1 | .070 | 113.7 | 1.061 | -27.6 | -0.62 | 2.9 | 13.0 |
| 1500 | .570 | 124.2 | 1.166 | -102.4 | .140 | 106.9 | 1.076 | -45.6 | -0.41 | 1.3 | 9.2 |
| 2000 | .543 | 107.4 | 0.923 | -142.3 | .215 | 97.1 | 1.024 | -64.7 | -0.01 | -0.7 | 6.3 |
| 2500 | .527 | 92.2 | 0.744 | 177.3 | .296 | 87.0 | 0.919 | -82.3 | 0.50 | -2.6 | 4.0 |
| 3000 | .501 | 79.4 | 0.658 | 140.7 | .372 | 76.7 | 0.807 | -98.3 | 0.88 | -3.6 | 2.5 |

**$V_{CB}$ = 3 V, $I_C$ = 5 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | $S_{21}$ | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .777 | 178.6 | 1.751 | -2.2 | .002 | 45.9 | 1.000 | -0.5 | 0.55 | 4.9 | 29.4 |
| 100 | .771 | 176.4 | 1.752 | -5.1 | .002 | 102.8 | 1.002 | -1.6 | -0.40 | 4.9 | 29.4 |
| 200 | .774 | 172.6 | 1.747 | -11.2 | .006 | 97.8 | 1.003 | -4.1 | -0.22 | 4.8 | 24.6 |
| 300 | .764 | 168.2 | 1.742 | -17.4 | .012 | 109.3 | 1.010 | -6.4 | -0.46 | 4.8 | 21.6 |
| 400 | .767 | 164.6 | 1.727 | -24.0 | .017 | 114.2 | 1.015 | -9.0 | -0.52 | 4.7 | 20.1 |
| 500 | .760 | 160.5 | 1.713 | -30.5 | .023 | 118.4 | 1.026 | -11.5 | -0.64 | 4.7 | 18.7 |
| 600 | .753 | 156.7 | 1.704 | -36.9 | .031 | 121.1 | 1.035 | -14.2 | -0.68 | 4.6 | 17.4 |
| 700 | .748 | 152.8 | 1.677 | -43.5 | .040 | 121.2 | 1.045 | -17.2 | -0.68 | 4.5 | 16.2 |
| 800 | .741 | 149.1 | 1.657 | -50.2 | .049 | 122.1 | 1.052 | -20.2 | -0.68 | 4.4 | 15.3 |
| 900 | .744 | 145.2 | 1.618 | -57.2 | .059 | 120.8 | 1.063 | -23.4 | -0.67 | 4.2 | 14.4 |
| 1000 | .735 | 141.5 | 1.595 | -64.5 | .073 | 120.6 | 1.069 | -26.5 | -0.63 | 4.1 | 13.4 |
| 1500 | .710 | 122.8 | 1.368 | -101.3 | .144 | 111.4 | 1.090 | -44.9 | -0.43 | 2.7 | 9.8 |
| 2000 | .670 | 104.8 | 1.094 | -141.3 | .226 | 99.5 | 1.034 | -64.1 | -0.04 | 0.8 | 6.8 |
| 2500 | .623 | 88.7 | 0.868 | 179.0 | .308 | 87.8 | 0.916 | -81.9 | 0.42 | -1.2 | 4.5 |
| 3000 | .577 | 74.6 | 0.747 | 142.7 | .382 | 76.6 | 0.798 | -97.7 | 0.78 | -2.5 | 2.9 |

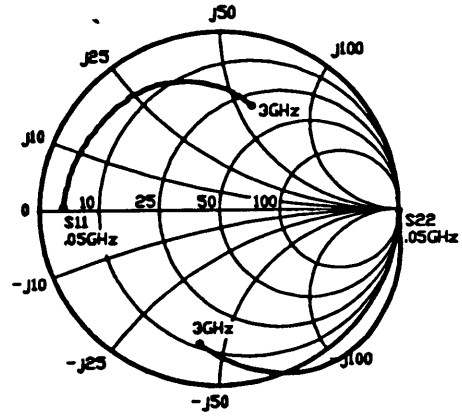
Note:
1. Gain Calculations:

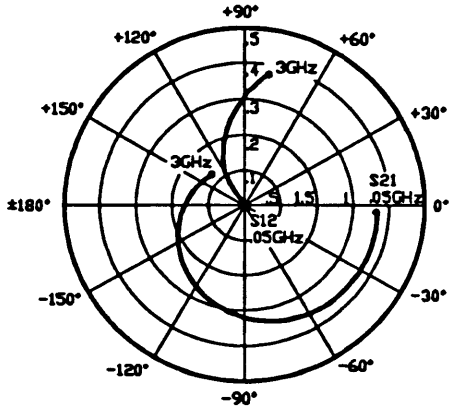
$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

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




**NE94430**
**Coordinates in Ohms**
**Frequency in GHz**
**($V_{CE}$ = 3 V, $I_C$ = 10mA)**

**$V_{CE}$ = 3 V, $I_C$ = 10mA**

| FREQUENCY | S11 | | S21 | | S12 | | S22 | | K | S21 | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .866 | 178.6 | 1.834 | -2.2 | .001 | 16.5 | 0.999 | -0.4 | 0.97 | 5.33 | 2.6 |
| 100 | .861 | 176.6 | 1.840 | -5.3 | .003 | 92.7 | 1.000 | 1.6 | -0.03 | 5.3 | 27.9 |
| 200 | .859 | 172.5 | 1.833 | -11.5 | .006 | 107.3 | 1.003 | - 4.1 | -0.32 | 5.3 | 24.9 |
| 300 | .852 | 168.4 | 1.830 | -17.9 | .010 | 119.8 | 1.010 | -6.5 | -0.57 | 5.2 | 22.6 |
| 400 | .846 | 164.4 | 1.818 | -24.6 | .017 | 122.3 | 1.017 | -9.1 | -0.60 | 5.2 | 20.3 |
| 500 | .840 | 160.4 | 1.804 | -30.9 | .024 | 122.3 | 1.027 | -11.5 | -0.63 | 5.1 | 18.8 |
| 600 | .836 | 156.6 | 1.799 | -37.9 | .030 | 123.9 | 1.037 | -14.5 | -0.67 | 5.1 | 17.8 |
| 700 | .828 | 153.1 | 1.775 | -44.7 | .039 | 123.6 | 1.049 | -17.4 | -0.67 | 5.0 | 16.6 |
| 800 | .826 | 149.1 | 1.749 | -51.7 | .051 | 123.8 | 1.057 | -20.4 | -0.65 | 4.9 | 15.4 |
| 900 | .823 | 145.6 | 1.723 | -59.4 | .062 | 123.2 | 1.068 | -23.9 | -0.63 | 4.7 | 14.4 |
| 1000 | .819 | 141.5 | 1.687 | -66.6 | .073 | 123.2 | 1.074 | -27.0 | -0.61 | 4.5 | 13.6 |
| 1500 | .793 | 122.1 | 1.443 | -105.4 | .149 | 112.3 | 1.090 | -45.9 | -0.36 | 3.2 | 9.9 |
| 2000 | .738 | 103.2 | 1.132 | -146.8 | .235 | 99.3 | 1.018 | -65.7 | 0.04 | 1.1 | 6.8 |
| 2500 | .679 | 86.4 | 0.892 | 173.1 | .315 | 86.6 | 0.890 | -83.0 | 0.44 | -1.0 | 4.5 |
| 3000 | .607 | 73.5 | 0.756 | 137.7 | .389 | 75.4 | 0.771 | -98.1 | 0.83 | -2.4 | 2.9 |

**$V_{CB}$= 10 V, $I_C$= 5 mA**

| FREQUENCY | S11 | | S21 | | S12 | | S22 | | K | S21 | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | (dB) | (dB) | |
| 50 | .772 | 178.4 | 1.741 | -2.1 | .002 | 79.8 | 0.991 | 0.1 | 1.19 | 4.8 | 26.8 |
| 100 | .767 | 176.6 | 1.747 | -4.7 | .002 | 111.0 | 1.000 | -0.9 | -0.27 | 4.8 | 29.4 |
| 200 | .765 | 172.4 | 1.745 | -10.7 | .005 | 101.4 | 1.004 | -3.0 | -0.34 | 4.8 | 25.4 |
| 300 | .759 | 168.3 | 1.742 | -16.6 | .010 | 110.1 | 1.010 | -5.0 | -0.50 | 4.8 | 22.4 |
| 400 | .755 | 164.4 | 1.728 | -22.7 | .014 | 119.9 | 1.016 | -7.1 | -0.66 | 4.8 | 20.9 |
| 500 | .751 | 160.2 | 1.718 | -28.7 | .019 | 121.7 | 1.027 | -9.3 | -0.76 | 4.7 | 19.6 |
| 600 | .748 | 156.4 | 1.704 | -35.1 | .027 | 125.0 | 1.035 | -11.6 | -0.76 | 4.6 | 18.0 |
| 700 | .742 | 152.6 | 1.687 | -41.1 | .035 | 124.6 | 1.046 | -13.9 | -0.77 | 4.5 | 16.8 |
| 800 | .738 | 148.7 | 1.668 | -47.7 | .043 | 124.3 | 1.054 | -16.4 | -0.76 | 4.4 | 15.9 |
| 900 | .731 | 144.9 | 1.646 | -54.3 | .053 | 123.5 | 1.066 | -19.2 | -0.75 | 4.3 | 14.9 |
| 1000 | .725 | 141.2 | 1.623 | -61.1 | .063 | 123.2 | 1.077 | -21.8 | -0.74 | 4.2 | 14.1 |
| 1500 | .704 | 122.8 | 1.430 | -95.7 | .129 | 115.0 | 1.114 | -37.5 | -0.56 | 3.1 | 10.4 |
| 2000 | .672 | 104.8 | 1.186 | -133.7 | .202 | 103.9 | 1.084 | -54.9 | -0.21 | 1.5 | 7.7 |
| 2500 | .636 | 88.6 | 0.955 | -172.1 | .282 | 92.9 | 0.984 | -71.0 | 0.25 | -0.4 | 5.3 |
| 3000 | .595 | 74.8 | 0.807 | 153.0 | .353 | 82.3 | 0.873 | -85.6 | 0.62 | -1.9 | 3.6 |

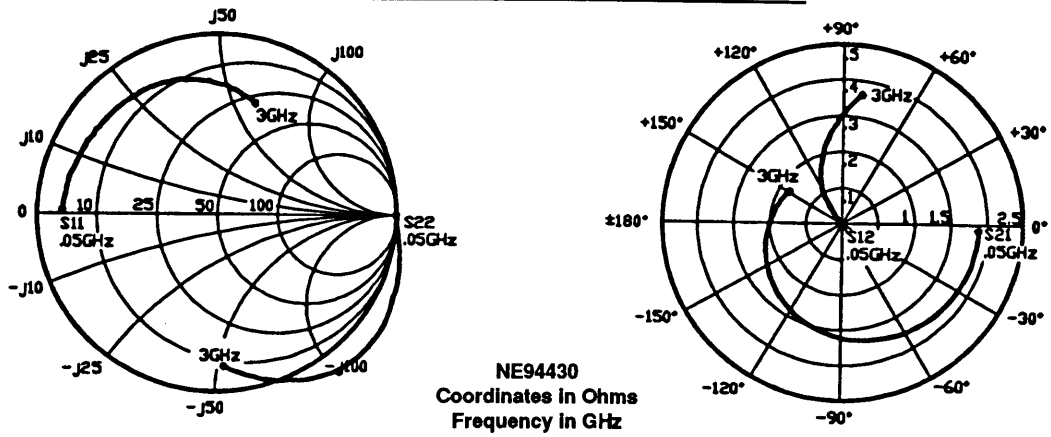
Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

## TYPICAL COMMON BASE SCATTERING PARAMETERS ($T_A$ = 25°C)




NE94430
Coordinates in Ohms
Frequency in GHz
($V_{CB}$ = 10 V, Ic = 10 mA)

**$V_{CB}$ = 10 V, Ic = 10 mA**

| FREQUENCY | S11 | | S21 | | S12 | | S22 | | K | S21 | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .856 | 178.6 | 1.820 | -2.0 | .002 | 151.9 | 0.994 | 0.0 | -0.30 | 5.2 | 29.6 |
| 100 | .853 | 176.7 | 1.834 | -4.6 | .003 | 108.2 | 1.001 | -1.1 | -0.31 | 5.3 | 27.9 |
| 200 | .846 | 172.4 | 1.831 | -10.3 | .005 | 109.0 | 1.003 | -3.0 | -0.37 | 5.3 | 25.6 |
| 300 | .845 | 168.4 | 1.827 | -16.3 | .007 | 124.5 | 1.010 | -5.1 | -0.71 | 5.2 | 24.2 |
| 400 | .840 | 164.4 | 1.823 | -22.3 | .014 | 119.8 | 1.016 | -7.0 | -0.60 | 5.2 | 21.1 |
| 500 | .830 | 160.6 | 1.814 | -28.3 | .019 | 127.9 | 1.028 | -9.1 | -0.77 | 5.2 | 19.8 |
| 600 | .826 | 156.7 | 1.805 | -34.6 | .026 | 129.0 | 1.038 | -11.5 | -0.78 | 5.1 | 18.4 |
| 700 | .823 | 153.3 | 1.791 | -41. | .034 | 126.6 | 1.049 | -13.9 | -0.75 | 5.1 | 17.2 |
| 800 | .819 | 149.1 | 1.778 | -47. | .042 | 128.8 | 1.059 | -16.5 | -0.77 | 5.0 | 16.2 |
| 900 | .820 | 145.4 | 1.761 | -54.3 | .053 | 128.0 | 1.069 | -19.3 | -0.74 | 4.9 | 15.2 |
| 1000 | .814 | 142.0 | 1.739 | -60.8 | .063 | 127.3 | 1.081 | -22.0 | -0.73 | 4.8 | 14.4 |
| 1500 | .800 | 122.8 | 1.556 | -96.9 | .134 | 118.5 | 1.123 | -38.0 | -0.53 | 3.8 | 10.6 |
| 2000 | .758 | 103.8 | 1.288 | -135.9 | .213 | 105.3 | 1.085 | -56.1 | -0.17 | 2.2 | 7.8 |
| 2500 | .708 | 85.9 | 1.019 | -174.3 | .293 | 92.7 | 0.973 | -72.5 | 0.25 | 0.2 | 5.4 |
| 3000 | .644 | 71.7 | 0.855 | 150.5 | .363 | 81.1 | 0.857 | -86.7 | 0.63 | -1.4 | 3.7 |

**$V_{CB}$ = 10 V, Ic = 20 mA**

| FREQUENCY | S11 | | S21 | | S12 | | S22 | | K | S21 | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) | (dB) |
| 50 | .896 | 178.2 | 1.854 | -2.5 | .002 | 71.1 | 0.993 | -0.1 | 0.62 | 5.4 | 28.7 |
| 100 | .891 | 175.6 | 1.867 | -5.8 | .003 | 108.5 | 1.001 | -1.0 | -0.30 | 5.4 | 27.3 |
| 200 | .880 | 171.1 | 1.852 | -12.7 | .005 | 103.2 | 1.001 | -3.2 | -0.22 | 5.4 | 25.3 |
| 300 | .867 | 166.4 | 1.835 | -19.7 | .010 | 112.5 | 1.010 | -5.4 | -0.45 | 5.3 | 22.7 |
| 400 | .855 | 162.5 | 1.810 | -26.4 | .015 | 118.1 | 1.016 | -7.6 | -0.53 | 5.2 | 20.8 |
| 500 | .841 | 158.8 | 1.790 | -33.0 | .021 | 117.8 | 1.028 | -10.1 | -0.58 | 5.1 | 19.3 |
| 600 | .828 | 154.9 | 1.772 | -40.1 | .029 | 119.5 | 1.035 | -12.5 | -0.58 | 5.0 | 17.9 |
| 700 | .822 | 151.3 | 1.741 | -46.9 | .036 | 121.6 | 1.046 | -15.2 | -0.63 | 4.8 | 16.9 |
| 800 | .815 | 147.8 | 1.716 | -54.2 | .045 | 122.6 | 1.053 | -18.1 | -0.61 | 4.7 | 15.8 |
| 900 | .809 | 144.0 | 1.683 | -61.6 | .054 | 122.7 | 1.060 | -21.0 | -0.59 | 4.5 | 14.9 |
| 1000 | .807 | 140.3 | 1.647 | -69.1 | .065 | 120.6 | 1.069 | -24.1 | -0.54 | 4.3 | 14.0 |
| 1500 | .779 | 121.2 | 1.396 | -107.4 | .134 | 113.0 | 1.079 | -40.6 | -0.30 | 2.9 | 10.2 |
| 2000 | .730 | 102.1 | 1.105 | -148.5 | .210 | 101.0 | 1.015 | -57.9 | 0.11 | 0.9 | 7.2 |
| 2500 | .665 | 85.6 | 0.872 | 172.5 | .285 | 89.1 | 0.897 | -72.8 | 0.56 | -1.2 | 4.9 |
| 3000 | .611 | 73.5 | 0.753 | 138.6 | .353 | 78.8 | 0.793 | -85.9 | 0.88 | -2.5 | 3.3 |

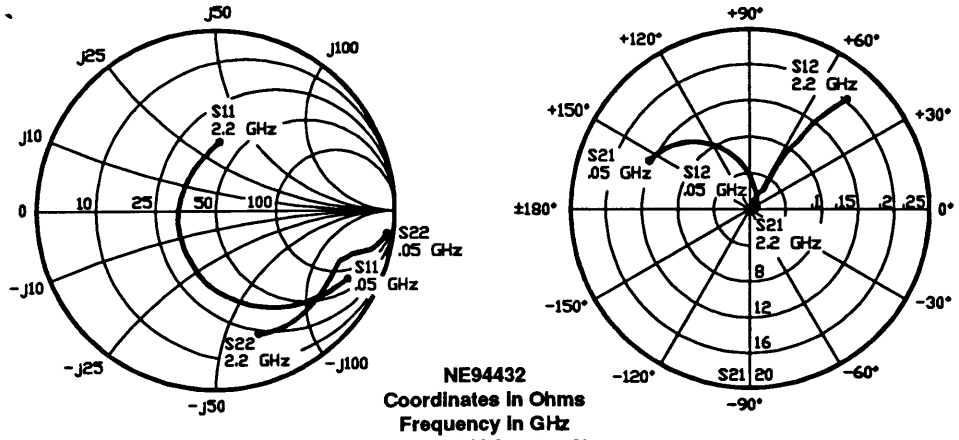
Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

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




NE94432
Coordinates in Ohms
Frequency in GHz
($V_{CE}$ = 10 V, $I_C$ = 5 mA)

3

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

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 50 | 0.825 | -27 | 12.225 | 155 | 0.012 | 64 | 0.961 | -8 | 0.38 | 30.1 |
| 100 | 0.690 | -48 | 10.312 | 136 | 0.025 | 62 | 0.898 | -14 | 0.43 | 26.2 |
| 200 | 0.490 | -79 | 7.169 | 112 | 0.035 | 54 | 0.799 | -17 | 0.72 | 23.1 |
| 400 | 0.315 | -115 | 4.083 | 88 | 0.054 | 57 | 0.743 | -22 | 0.97 | 18.8 |
| 600 | 0.255 | -136 | 2.815 | 73 | 0.074 | 58 | 0.737 | -27 | 1.06 | 14. |
| 800 | 0.227 | -154 | 2.155 | 62 | 0.091 | 57 | 0.737 | -33 | 1.10 | 11.8 |
| 1000 | 0.210 | -172 | 1.759 | 52 | 0.106 | 5 | 0.741 | -39 | 1.13 | 10.0 |
| 1200 | 0.203 | 168 | 1.490 | 42 | 0.122 | 55 | 0.744 | -44 | 1.13 | 8. |
| 1400 | 0.211 | 147 | 1.301 | 34 | 0.138 | 54 | 0.745 | -49 | 1.12 | 7.6 |
| 1600 | 0.235 | 128 | 1.159 | 26 | 0.155 | 53 | 0.747 | -54 | 1.08 | 7 |
| 1800 | 0.275 | 111 | 1.047 | 18 | 0.172 | 52 | 0.744 | -60 | 1.04 | 6. |
| 2000 | 0.321 | 98 | 0.955 | 11 | 0.198 | 50 | 0.735 | -65 | 1.01 | 6. |
| 2200 | 0.379 | 87 | 0.875 | 5 | 0.215 | 48 | 0.724 | -71 | 0.96 | 6. |
| **$V_{CE}$ =10 V, $I_C$ = 10 mA** | | | | | | | | | | |
| 50 | 0.650 | -41 | 18.493 | 145 | 0.016 | 61 | 0.919 | -9 | 0.44 | 30.6 |
| 100 | 0.500 | -69 | 13.742 | 123 | 0.027 | 59 | 0.832 | -14 | 0.53 | 27.1 |
| 200 | 0.345 | -101 | 8.232 | 102 | 0.030 | 58 | 0.749 | -16 | 0.88 | 24.4 |
| 400 | 0.256 | -135 | 4.373 | 82 | 0.050 | 63 | 0.720 | -20 | 1.04 | 18.1 |
| 600 | 0.239 | -155 | 2.964 | 69 | 0.069 | 64 | 0.722 | -25 | 1.00 | 14.6 |
| 800 | 0.233 | -172 | 2.248 | 58 | 0.087 | 62 | 0.726 | -32 | 1.11 | 12.1 |
| 1000 | 0.232 | 171 | 1.821 | 49 | 0.101 | 61 | 0.733 | -37 | 1.13 | 10.4 |
| 1200 | 0.239 | 153 | 1.534 | 40 | 0.117 | 59 | 0.740 | -43 | 1.10 | 9.2 |
| 1400 | 0.254 | 135 | 1.331 | 31 | 0.136 | 59 | 0.742 | -49 | 1.07 | 8.3 |
| 1600 | 0.283 | 119 | 1.178 | 24 | 0.154 | 58 | 0.742 | -54 | 1.03 | 7.8 |
| 1800 | 0.323 | 105 | 1.060 | 16 | 0.174 | 56 | 0.742 | -59 | 0.97 | 7.9 |
| 2000 | 0.368 | 93 | 0.960 | 9 | 0.195 | 54 | 0.734 | -64 | 0.94 | 6.9 |
| 2200 | 0.421 | 83 | 0.878 | 3 | 0.220 | 52 | 0.722 | -70 | 0.89 | 6.0 |

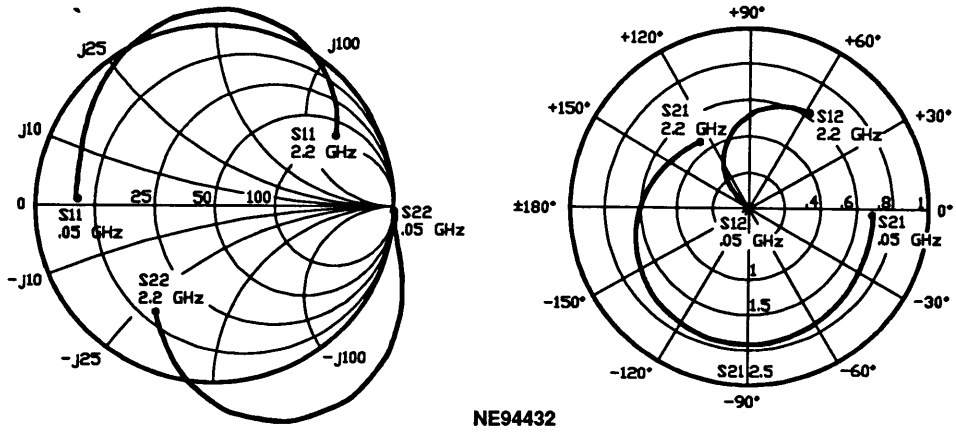
Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

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




**NE94432**
**Coordinates in Ohms**
**Frequency in GHz**
**($V_{CB}$ = 10 V, $I_C$ = 5 mA)**

**$V_{CB}$ = 10 V, $I_C$ = 5 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 50 | 0.765 | 178 | 1.752 | -3 | 0.005 | 125 | 1.004 | -1 | -0.63 | 25.4 |
| 100 | 0.776 | 175 | 1.764 | -7 | 0.007 | 124 | 1.008 | -3 | -0.80 | 25.3 |
| 200 | 0.777 | 170 | 1.763 | -13 | 0.010 | 123 | 1.015 | -6 | -0.80 | 22.4 |
| 400 | 0.799 | 160 | 1.789 | -27 | 0.037 | 135 | 1.055 | -13 | -0.92 | 16.8 |
| 600 | 0.844 | 149 | 1.841 | -43 | 0.082 | 135 | 1.121 | -20 | -0.93 | 13.5 |
| 800 | 0.911 | 136 | 1.897 | -61 | 0.146 | 132 | 1.202 | -29 | -0.88 | 11.1 |
| 1000 | 0.990 | 121 | 1.948 | -82 | 0.233 | 125 | 1.288 | -41 | -0.79 | 9.2 |
| 1200 | 1.067 | 104 | 1.938 | -108 | 0.340 | 114 | 1.335 | -55 | -0.63 | 7.6 |
| 1400 | 1.094 | 85 | 1.834 | -136 | 0.448 | 101 | 1.292 | -71 | -0.43 | 6.1 |
| 1600 | 1.051 | 66 | 1.646 | -165 | 0.531 | 87 | 1.161 | -87 | -0.19 | 4.9 |
| 1800 | 0.961 | 51 | 1.436 | 168 | 0.578 | 75 | 0.980 | -100 | 0.06 | 3.9 |
| 2000 | 0.865 | 38 | 1.263 | 145 | 0.605 | 65 | 0.807 | -110 | 0.30 | 3.2 |
| 2200 | 0.774 | 29 | 1.143 | 125 | 0.620 | 57 | 0.666 | -118 | 0.50 | 2.7 |

**$V_{CB}$ = 10 V, $I_C$ = 10 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 50 | 0.886 | 177 | 1.870 | -3 | 0.005 | 140 | 1.010 | -1 | -0.92 | 25.7 |
| 100 | 0.896 | 175 | 1.877 | -7 | 0.006 | 136 | 1.012 | -3 | -0.87 | 24.9 |
| 200 | 0.889 | 170 | 1.884 | -13 | 0.010 | 137 | 1.016 | -6 | -0.90 | 22.8 |
| 400 | 0.920 | 161 | 1.928 | -28 | 0.035 | 144 | 1.062 | -12 | -0.93 | 17.4 |
| 600 | 0.979 | 150 | 2.008 | -43 | 0.084 | 143 | 1.134 | -20 | -0.90 | 13.8 |
| 800 | 1.077 | 138 | 2.106 | -63 | 0.155 | 139 | 1.227 | -29 | -0.83 | 11.3 |
| 1000 | 1.195 | 122 | 2.194 | -86 | 0.257 | 130 | 1.325 | -42 | -0.70 | 9.3 |
| 1200 | 1.291 | 103 | 2.182 | -114 | 0.381 | 116 | 1.363 | -58 | -0.52 | 7.6 |
| 1400 | 1.291 | 82 | 2.015 | -145 | 0.496 | 100 | 1.281 | -75 | -0.32 | 6.1 |
| 1600 | 1.192 | 63 | 1.743 | -174 | 0.571 | 84 | 1.105 | -91 | -0.08 | 4.8 |
| 1800 | 1.053 | 47 | 1.476 | 160 | 0.604 | 72 | 0.908 | -102 | 0.16 | 3.9 |
| 2000 | 0.924 | 36 | 1.277 | 138 | 0.619 | 63 | 0.739 | -111 | 0.37 | 3.1 |
| 2200 | 0.815 | 27 | 1.150 | 119 | 0.627 | 55 | 0.610 | -118 | 0.55 | 2.6 |

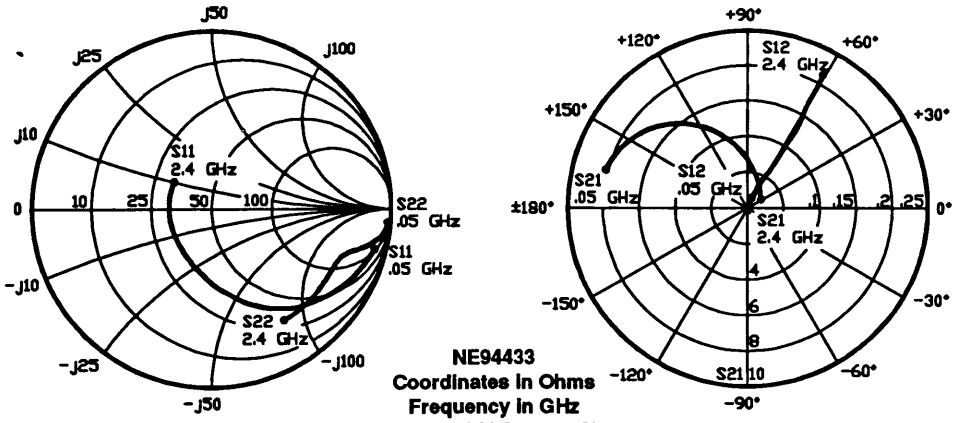
Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

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




NE94433
Coordinates in Ohms
Frequency in GHz
($V_{CE}$ = 10 V, $I_C$ = 5 mA)

**NE94433**
**$V_{CE}$ = 10 V, $I_C$ = 5 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 50 | 0.932 | -14 | 8.225 | 165 | 0.015 | 65 | 0.982 | -4 | 0.42 | 27.4 |
| 100 | 0.857 | -29 | 7.587 | 151 | 0.028 | 64 | 0.961 | -9 | 0.40 | 24.4 |
| 200 | 0.710 | -51 | 6.158 | 130 | 0.039 | 64 | 0.884 | -14 | 0.47 | 22.0 |
| 400 | 0.478 | -79 | 4.030 | 104 | 0.064 | 59 | 0.797 | -18 | 0.74 | 18.0 |
| 600 | 0.366 | -98 | 2.902 | 88 | 0.083 | 58 | 0.765 | -20 | 0.89 | 15.4 |
| 800 | 0.308 | -114 | 2.263 | 77 | 0.100 | 58 | 0.752 | -24 | 0.97 | 13.5 |
| 1000 | 0.274 | -128 | 1.867 | 68 | 0.115 | 58 | 0.748 | -28 | 1.01 | 11.4 |
| 1200 | 0.254 | -141 | 1.595 | 59 | 0.130 | 58 | 0.746 | -31 | 1.04 | 9.7 |
| 1400 | 0.242 | -155 | 1.403 | 52 | 0.145 | 58 | 0.745 | -36 | 1.04 | 8.6 |
| 1600 | 0.236 | -168 | 1.256 | 46 | 0.160 | 59 | 0.745 | -39 | 1.03 | 7.9 |
| 1800 | 0.234 | 179 | 1.142 | 40 | 0.175 | 60 | 0.744 | -44 | 1.01 | 7.4 |
| 2000 | 0.239 | 167 | 1.050 | 34 | 0.193 | 60 | 0.743 | -48 | 0.98 | 7.4 |
| 2200 | 0.247 | 154 | 0.970 | 29 | 0.212 | 60 | 0.742 | -53 | 0.95 | 6.6 |
| 2400 | 0.257 | 143 | 0.903 | 24 | 0.233 | 61 | 0.738 | -58 | 0.93 | 5.9 |
| **$V_{CE}$ = 10 V, $I_C$ = 10 mA** | | | | | | | | | | |
| 50 | 0.890 | -19 | 10.530 | 162 | 0.014 | 62 | 0.967 | -5 | 0.44 | 28.7 |
| 100 | 0.796 | -35 | 9.392 | 145 | 0.025 | 60 | 0.942 | -10 | 0.46 | 25.7 |
| 200 | 0.629 | -60 | 7.081 | 123 | 0.037 | 62 | 0.851 | -14 | 0.55 | 22.8 |
| 400 | 0.417 | -89 | 4.323 | 99 | 0.059 | 60 | 0.772 | -17 | 0.81 | 18.6 |
| 600 | 0.332 | -109 | 3.043 | 85 | 0.079 | 60 | 0.750 | -20 | 0.92 | 15.9 |
| 800 | 0.291 | -126 | 2.349 | 74 | 0.095 | 60 | 0.739 | -23 | 0.99 | 13.9 |
| 1000 | 0.270 | -141 | 1.927 | 65 | 0.109 | 61 | 0.738 | -27 | 1.03 | 11.4 |
| 1200 | 0.258 | -155 | 1.639 | 57 | 0.125 | 61 | 0.736 | -31 | 1.04 | 10.0 |
| 1400 | 0.254 | -169 | 1.438 | 50 | 0.141 | 62 | 0.738 | -35 | 1.02 | 9.3 |
| 1600 | 0.254 | 179 | 1.283 | 44 | 0.156 | 62 | 0.738 | -39 | 1.00 | 8.7 |
| 1800 | 0.257 | 167 | 1.165 | 38 | 0.173 | 63 | 0.738 | -43 | 0.98 | 8.3 |
| 2000 | 0.264 | 156 | 1.070 | 33 | 0.194 | 64 | 0.737 | -48 | 0.94 | 7.4 |
| 2200 | 0.273 | 144 | 0.987 | 28 | 0.214 | 64 | 0.736 | -53 | 0.91 | 6.6 |
| 2400 | 0.286 | 134 | 0.916 | 23 | 0.239 | 63 | 0.732 | -57 | 0.87 | 5.8 |
| **$V_{CE}$ = 10 V, $I_C$ = 20 mA** | | | | | | | | | | |
| 50 | 0.828 | -28 | 10.472 | 156 | 0.014 | 65 | 0.969 | -5 | 0.36 | 28.7 |
| 100 | 0.685 | -48 | 8.553 | 136 | 0.024 | 64 | 0.915 | -10 | 0.45 | 25.6 |
| 200 | 0.445 | -74 | 5.730 | 115 | 0.035 | 59 | 0.840 | -12 | 0.72 | 22.2 |
| 400 | 0.347 | -105 | 3.358 | 95 | 0.055 | 62 | 0.790 | -16 | 0.96 | 17.9 |
| 600 | 0.302 | -128 | 2.394 | 83 | 0.073 | 61 | 0.773 | -19 | 1.06 | 13.7 |
| 800 | 0.285 | -146 | 1.877 | 72 | 0.089 | 63 | 0.763 | -23 | 1.11 | 11.2 |
| 1000 | 0.278 | -161 | 1.558 | 63 | 0.105 | 64 | 0.758 | -27 | 1.13 | 9.5 |
| 1200 | 0.278 | -175 | 1.337 | 55 | 0.121 | 66 | 0.756 | -32 | 1.12 | 8.3 |
| 1400 | 0.281 | 173 | 1.178 | 48 | 0.139 | 66 | 0.754 | -36 | 1.10 | 7.4 |
| 1600 | 0.286 | 162 | 1.055 | 42 | 0.158 | 67 | 0.753 | -41 | 1.07 | 6.6 |
| 1500 | 0.295 | 151 | 0.959 | 36 | 0.178 | 68 | 0.752 | -45 | 1.03 | 6.3 |
| 2000 | 0.304 | 142 | 0.882 | 31 | 0.202 | 68 | 0.748 | -50 | 0.99 | 6.4 |
| 2200 | 0.317 | 132 | 0.813 | 26 | 0.225 | 67 | 0.744 | -55 | 0.96 | 5.6 |
| 2400 | 0.329 | 123 | 0.753 | 22 | 0.254 | 66 | 0.737 | -60 | 0.94 | 4.7 |

Note:
1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$ . When $K \le 1$, MAG = MSG. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$