# THE DATASHEET OF

# NE94433-T1B

# 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:** $C_C \bullet r_{b'b}$ = 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.

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

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

Note:
1. Electronic Industrial Association of Japan.

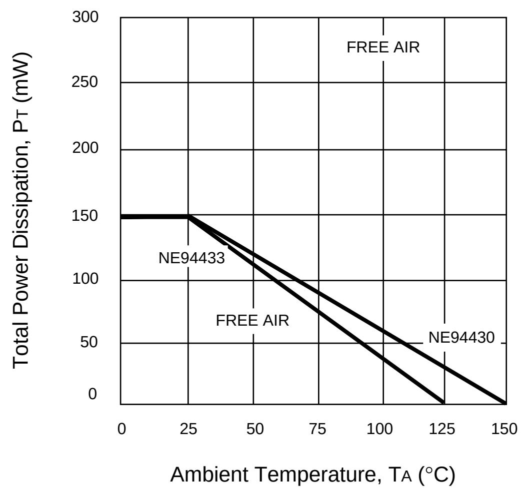
## ABSOLUTE MAXIMUM RATINGS[1] ($T_A$ = 25°C)

| 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 |

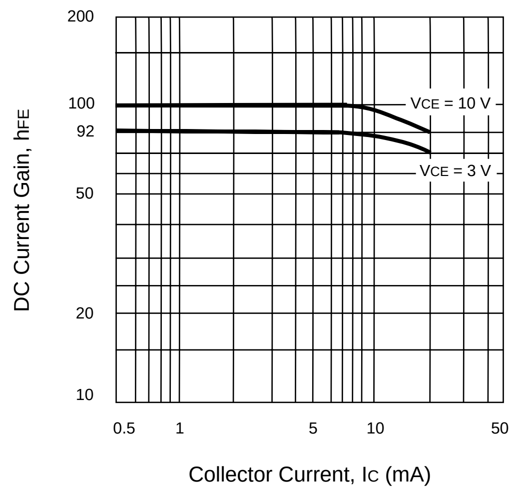
Note:
1. Operation in excess of any one of these parameters may result in permanent damage.

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

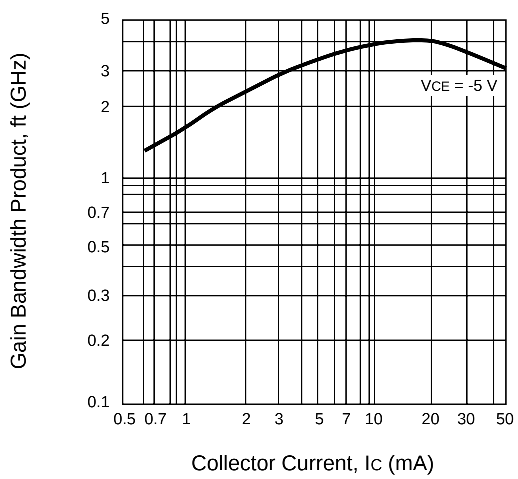
**TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE**



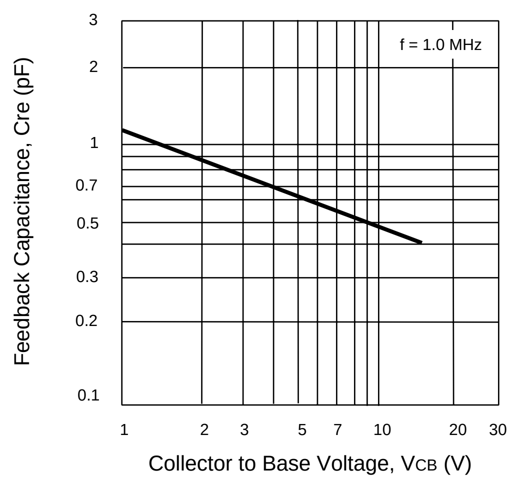

**DC CURRENT GAIN vs. COLLECTOR CURRENT**




**GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT**




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



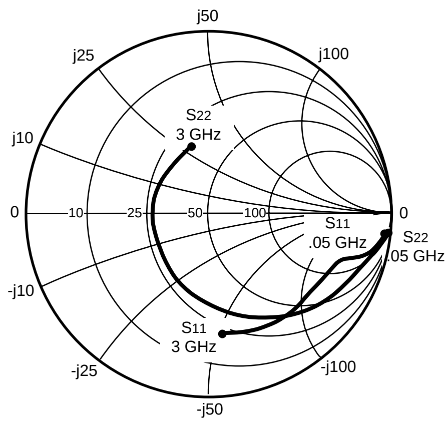
## NE94430
## TYPICAL NOISE PARAMETERS ($T_A$ = 25°C)

| FREQ. (MHz) | $NF_{OPT}$ (dB) | $G_A$ (dB) | $\Gamma_{OPT}$ MAG | $\Gamma_{OPT}$ ANG | Rn/50 |
|---|---|---|---|---|---|
| **$V_{CE}$ = 2.5 V, $I_C$ = 2.5 mA** | | | | | |
| 500 | 3.2 | 11.34 | 0.33 | 63 | 0.75 |
| 1000 | 5.4 | 7.22 | 0.29 | 142 | 0.45 |
| 1500 | 6.7 | 4.44 | 0.32 | 165 | 0.64 |
| **$V_{CE}$ = 3 V, $I_C$ = 5 mA** | | | | | |
| 500 | 3.8 | 12.67 | 0.27 | 79 | 0.70 |
| 1000 | 6.3 | 8.28 | 0.28 | 168 | 0.48 |
| 1500 | 8.3 | 5.58 | 0.38 | -175 | 0.55 |
| **$V_{CE}$ = 10 V, $I_C$ = 5 mA** | | | | | |
| 500 | 3.8 | 13.88 | 0.27 | 69 | 0.75 |
| 1000 | 6.3 | 9.53 | 0.27 | 160 | 0.58 |
| 1500 | 8.3 | 6.63 | 0.32 | 174 | 0.68 |

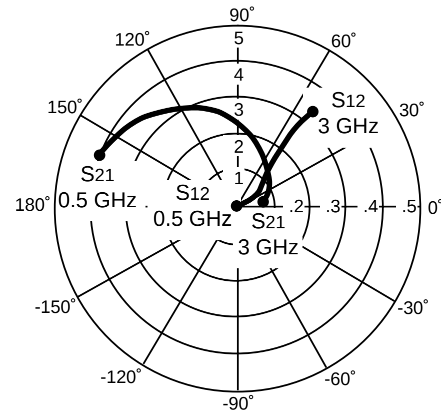
## NE94433
## TYPICAL NOISE PARAMETERS ($T_A$ = 25°C)

| FREQ. (MHz) | $NF_{OPT}$ (dB) | $G_A$ (dB) | $\Gamma_{OPT}$ MAG | $\Gamma_{OPT}$ ANG | Rn/50 | $V_{CE}$ (V) | $I_C$ (mA) |
|---|---|---|---|---|---|---|---|
| **$V_{CE}$ = 8 V, $I_C$ = 5 mA** | | | | | | | |
| 500 | 3.6 | 13.00 | .43 | 51 | 1.0 | 8 | 5 |
| 1000 | 5.8 | 9.34 | .29 | 113 | 0.7 | 8 | 5 |
| **$V_{CE}$ = 10 V, $I_C$ = 5 mA** | | | | | | | |
| 500 | 3.6 | 12.90 | .44 | .51 | 1.04 | 10 | 5 |
| 1000 | 6.0 | 8.90 | .32 | 117 | .70 | 10 | 5 |

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




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




### NE94430

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

| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG[1] (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

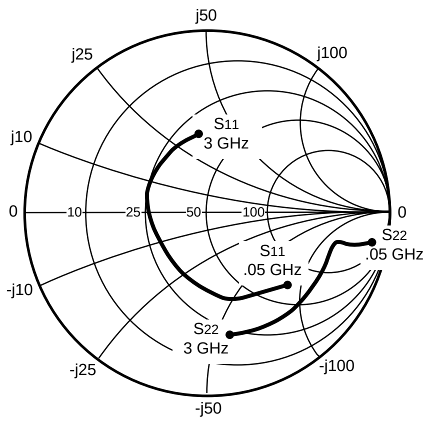
| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG[1] (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | .819 | -19.8 | 7.561 | 154.4 | .014 | 88.3 | .946 | -8.5 | 0.20 | 17.6 | 27.3 |
| 100 | .740 | -38.0 | 6.980 | 138.9 | .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:

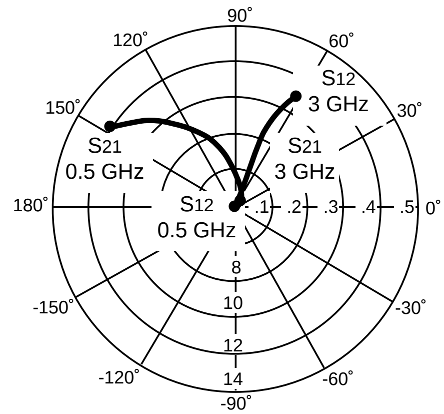
$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

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




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




### NE94430

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

| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG (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

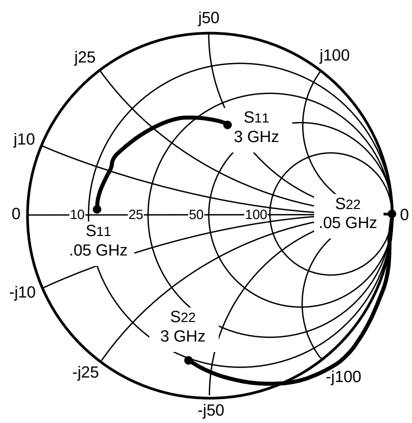
| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | .860 | -17.7 | 7.577 | 156.2 | .012 | 79.9 | .960 | -6.1 | 0.30 | 17.6 | 28.0 |
| 100 | .788 | -35.1 | 6.982 | 141.8 | .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:

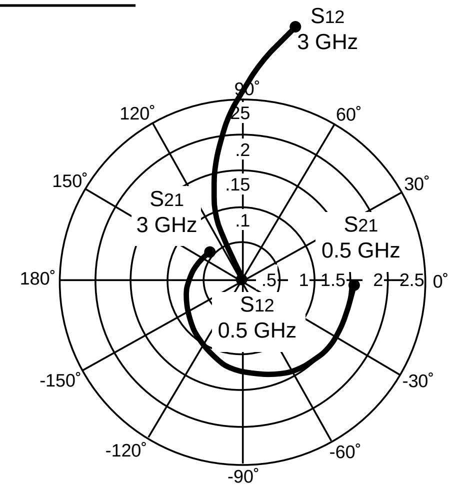
$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

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




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




### NE94430

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

| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG[1] (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | .622 | 178.7 | 1.602 | -2.4 | .001 | 60.6 | 0.996 | -0.6 | -0.104 | 4.1 | 27.2 |
| 100 | .623 | 176.6 | 1.599 | -5.5 | .004 | 101.3 | 0.999 | -1.6 | -0.114 | 4.1 | 25.8 |
| 200 | .622 | 172.6 | 1.601 | -11.7 | .009 | 101.2 | 1.004 | -4.1 | -0.280 | 4.1 | 22.5 |
| 400 | .615 | 164.8 | 1.567 | -25.0 | .019 | 106.4 | 1.015 | -9.4 | -0.470 | 3.9 | 19.2 |
| 600 | .604 | 157.0 | 1.525 | -38.5 | .033 | 111.8 | 1.038 | -15.1 | -0.610 | 3.7 | 16.6 |
| 800 | .598 | 149.4 | 1.467 | -52.0 | .051 | 112.8 | 1.047 | -21.2 | -0.620 | 3.3 | 14.6 |
| 1000 | .592 | 141.9 | 1.395 | -66.1 | .070 | 113.7 | 1.061 | -27.6 | -0.620 | 2.9 | 13.0 |
| 1500 | .570 | 124.2 | 1.166 | -102.4 | .140 | 106.9 | 1.076 | -45.6 | -0.410 | 1.3 | 9.2 |
| 2000 | .543 | 107.4 | 0.923 | -142.3 | .215 | 97.1 | 1.024 | -64.7 | -0.010 | -0.7 | 6.3 |

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

| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG[1] (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | .777 | 178.6 | 1.751 | -2.2 | .002 | 45.9 | 1.000 | -0.5 | -0.154 | 4.9 | 29.4 |
| 100 | .771 | 176.4 | 1.752 | -5.1 | .002 | 102.8 | 1.002 | -1.6 | -0.400 | 4.9 | 29.4 |
| 200 | .774 | 172.6 | 1.747 | -11.2 | .006 | 97.8 | 1.003 | -4.1 | -0.220 | 4.8 | 24.6 |
| 400 | .767 | 164.6 | 1.727 | -24.0 | .017 | 114.2 | 1.015 | -9.0 | -0.520 | 4.7 | 20.1 |
| 600 | .753 | 156.7 | 1.704 | -36.9 | .031 | 121.1 | 1.035 | -14.2 | -0.680 | 4.6 | 17.4 |
| 800 | .741 | 149.1 | 1.657 | -50.2 | .049 | 122.1 | 1.052 | -20.2 | -0.680 | 4.4 | 15.3 |
| 1000 | .735 | 141.5 | 1.595 | -64.5 | .073 | 120.6 | 1.069 | -26.5 | -0.630 | 4.1 | 13.4 |
| 1500 | .710 | 122.8 | 1.368 | -101.3 | .144 | 111.4 | 1.090 | -44.9 | -0.430 | 2.7 | 9.8 |
| 2000 | .670 | 104.8 | 1.094 | -141.3 | .226 | 99.5 | 1.034 | -64.1 | -0.040 | 0.8 | 6.8 |

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

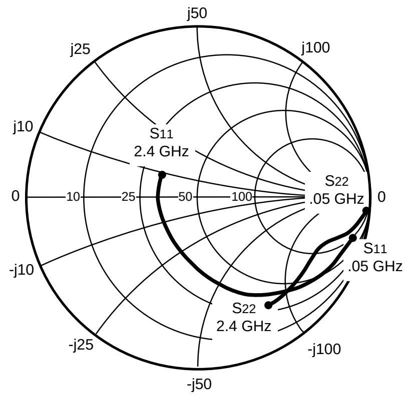
| FREQUENCY (MHz) | S11 MAG | S11 ANG | S21 MAG | S21 ANG | S12 MAG | S12 ANG | S22 MAG | S22 ANG | K | S21 (dB) | MAG[1] (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | .866 | 178.6 | 1.834 | -2.2 | .001 | 16.5 | 0.999 | -0.4 | -0.097 | 5.3 | 32.6 |
| 100 | .861 | 176.6 | 1.840 | -5.3 | .003 | 92.7 | 1.000 | 1.6 | -0.030 | 5.3 | 27.9 |
| 200 | .859 | 172.5 | 1.833 | -11.5 | .006 | 107.3 | 1.003 | - 4.1 | -0.320 | 5.3 | 24.9 |
| 400 | .846 | 164.4 | 1.818 | -24.6 | .017 | 122.3 | 1.017 | -9.1 | -0.600 | 5.2 | 20.3 |
| 600 | .836 | 156.6 | 1.799 | -37.9 | .030 | 123.9 | 1.037 | -14.5 | -0.670 | 5.1 | 17.8 |
| 800 | .826 | 149.1 | 1.749 | -51.7 | .051 | 123.8 | 1.057 | -20.4 | -0.650 | 4.9 | 15.4 |
| 1000 | .819 | 141.5 | 1.687 | -66.6 | .073 | 123.2 | 1.074 | -27.0 | -0.610 | 4.5 | 13.6 |
| 1500 | .793 | 122.1 | 1.443 | -105.4 | .149 | 112.3 | 1.090 | -45.9 | -0.360 | 3.2 | 9.9 |
| 2000 | .738 | 103.2 | 1.132 | -146.8 | .235 | 99.3 | 1.018 | -65.7 | 0.040 | 1.1 | 6.8 |

Note:
1. Gain Calculations:

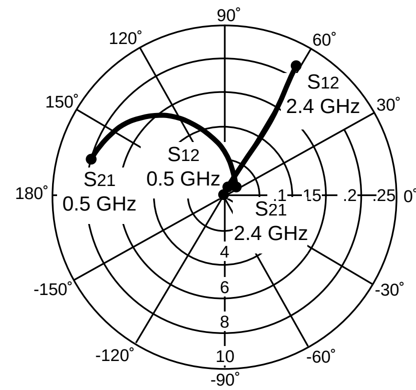
$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right).$$ When $K \leq 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

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




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




### NE94433

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

| FREQUENCY (MHz) | $S_{11}$ MAG | $S_{11}$ ANG | $S_{21}$ MAG | $S_{21}$ ANG | $S_{12}$ MAG | $S_{12}$ ANG | $S_{22}$ MAG | $S_{22}$ ANG | K | MAG[1] (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 |

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

| FREQUENCY (MHz) | $S_{11}$ MAG | $S_{11}$ ANG | $S_{21}$ MAG | $S_{21}$ ANG | $S_{12}$ MAG | $S_{12}$ ANG | $S_{22}$ MAG | $S_{22}$ ANG | K | MAG[1] (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 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

| FREQUENCY (MHz) | $S_{11}$ MAG | $S_{11}$ ANG | $S_{21}$ MAG | $S_{21}$ ANG | $S_{12}$ MAG | $S_{12}$ ANG | $S_{22}$ MAG | $S_{22}$ ANG | K | MAG[1] (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 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:

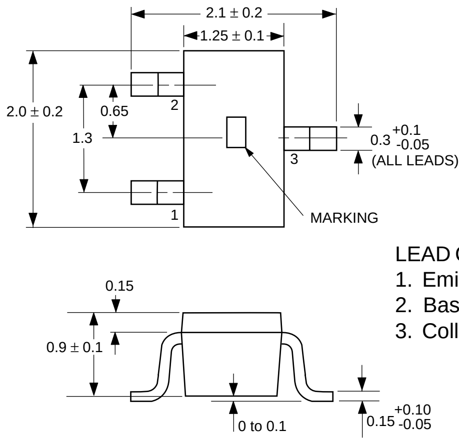
$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12} S_{21}|}$, $\Delta = S_{11} S_{22} - S_{21} S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

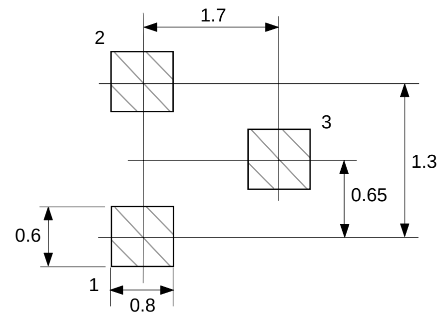
## OUTLINE DIMENSIONS (Units in mm)

### PACKAGE OUTLINE 30

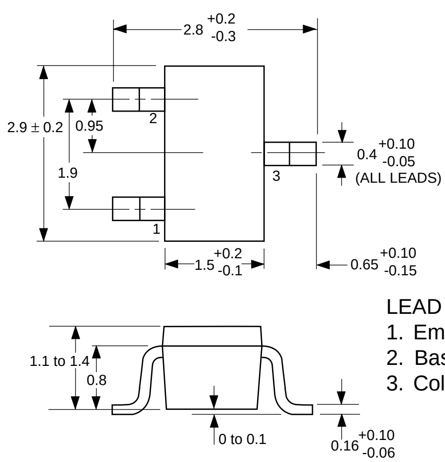



LEAD CONNECTIONS
1. Emitter
2. Base
3. Collector

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

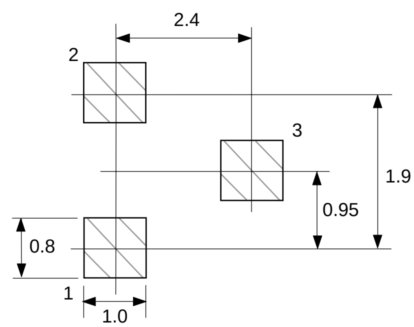



### PACKAGE OUTLINE 33




LEAD CONNECTIONS
1. Emitter
2. Base
3. Collector

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




## ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKAGING |
|---|---|---|
| NE94430-T2 | 3000 | Tape & Reel |
| NE94433-T1B | 3000 | Tape & Reel |