

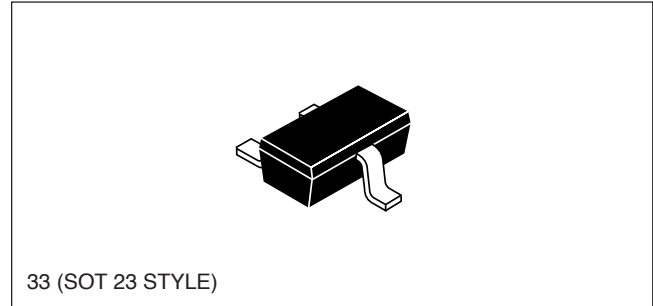


PNP SILICON HIGH FREQUENCY TRANSISTOR

NE97833

FEATURES

- **HIGH GAIN BANDWIDTH PRODUCT:**
 $f_T = 5.5 \text{ GHz TYP}$
- **HIGH SPEED SWITCHING CHARACTERISTICS**
- **NPN COMPLIMENT AVAILABLE:** NE02133
- **HIGH INSERTION POWER GAIN:**
 $IS_{21E}^2 = 10 \text{ dB at } 1 \text{ GHz}$



DESCRIPTION

NEC's NE97833 PNP silicon transistor is designed for ultrahigh speed current mode switching applications and microwave amplifiers up to 3.5 GHz. The NE97833 offers excellent performance and reliability at low cost.

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

| PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE | | | NE97833 2SA1978 33 | | |
|---|---|---------------|--------------------------|------|------|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX |
| f_T | Gain Bandwidth Product at $V_{CE} = -10 \text{ V}$, $I_C = -15 \text{ mA}$ | GHz | 4.0 | 5.5 | |
| NF | Noise Figure at $V_{CE} = -10 \text{ V}$, $I_C = -3 \text{ mA}$ | dB | | 2.0 | 3.0 |
| IS_{21E}^2 | Insertion Power Gain at $V_{CE} = -10 \text{ V}$, $I_C = -15 \text{ mA}$, $f = 1 \text{ GHz}$ | dB | 8.0 | 10.0 | |
| h_{FE} | Forward Current Gain Ratio at $V_{CE} = -10 \text{ V}$, $I_C = -15 \text{ mA}$ | | 20 | 40 | 100 |
| I_{CBO} | Collector Cutoff Current at $V_{CB} = -10 \text{ V}$, $I_E = 0$ | μA | | | -0.1 |
| I_{EBO} | Emitter Cutoff Current at $V_{BE} = -2 \text{ V}$, $I_C = 0$ | μA | | | -0.1 |
| C_{RE}^2 | Feedback Capacitance at $V_{CB} = -10 \text{ V}$, $I_E = 0 \text{ mA}$, $f = 1 \text{ MHz}$ | pF | | 0.5 | 1.0 |
| P_T | Total Power Dissipation | mW | | | 200 |

Notes:

1. Electronic Industrial Association of Japan.
2. Capacitance is measured with emitter and case connected to the guard terminal at the bridge.

ABSOLUTE MAXIMUM RATINGS¹ ($T_A = 25^\circ\text{C}$)

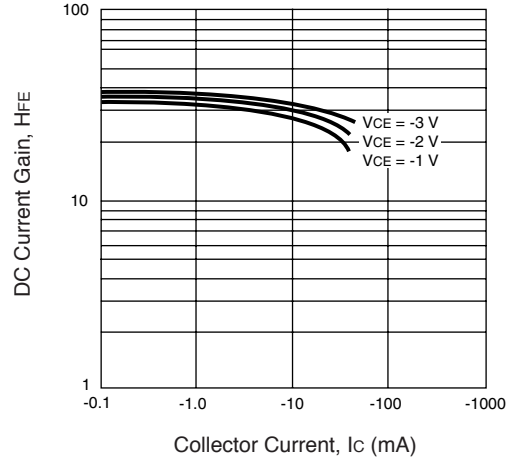
| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|------------------------------|-------|-------------|
| V _{CBO} | Collector to Base Voltage | V | -20 |
| V _{CEO} | Collector to Emitter Voltage | V | -12 |
| V _{EBO} | Emitter to Base Voltage | V | -3 |
| I _C | Collector Current | mA | -50 |
| T _J | Junction Temperature | °C | 150 |
| T _{STG} | Storage Temperature | °C | -65 to +200 |

Note:

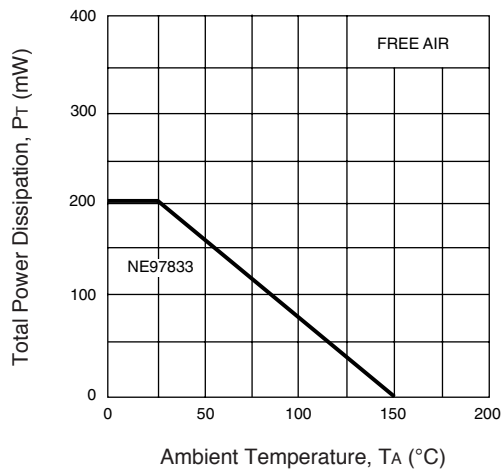
1. Operation in excess of any one of these parameters may result in permanent damage.

TYPICAL PERFORMANCE CURVES ($T_A = 25^\circ\text{C}$)

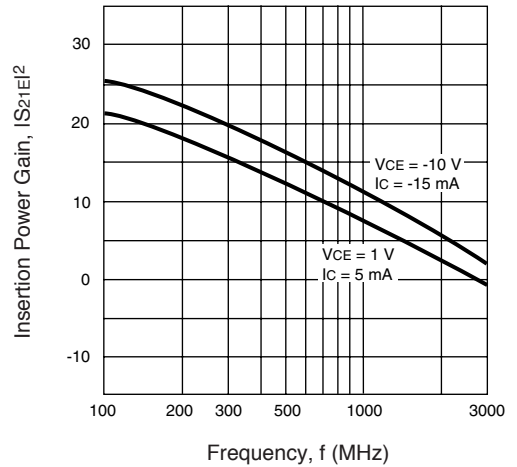
DC CURRENT GAINS vs. COLLECTOR CURRENT



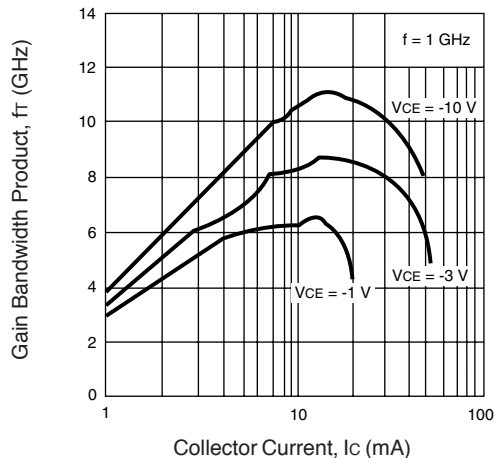
DC POWER DERATING CURVES



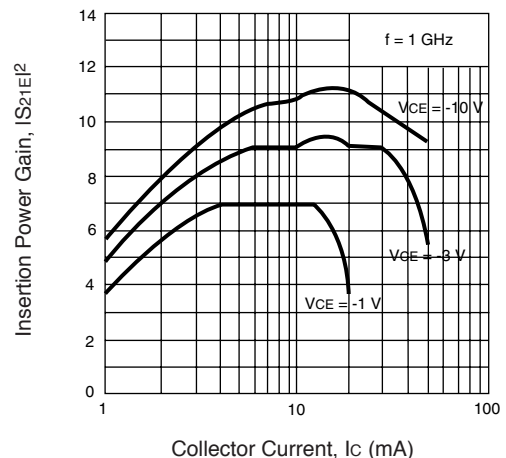
INSERTION GAIN vs. FREQUENCY



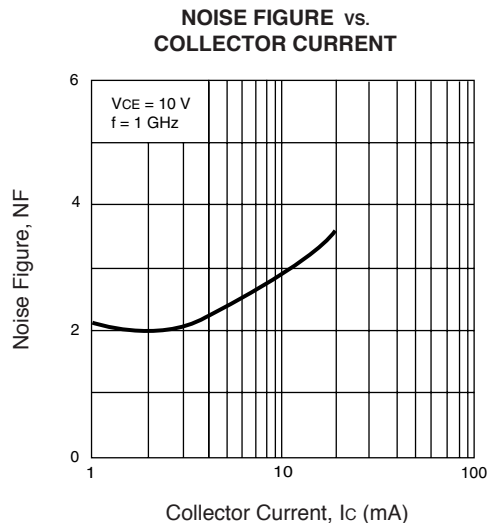
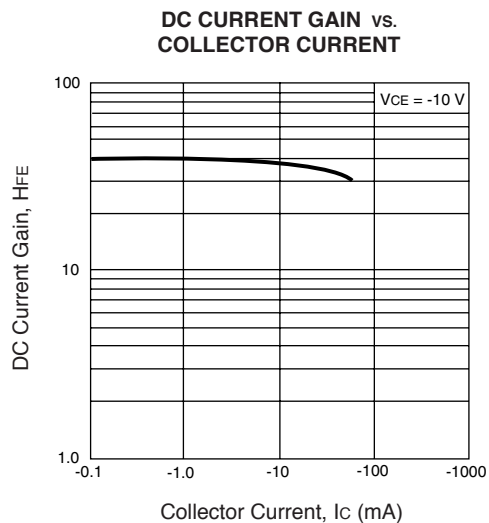
GAIN BANDWIDTH vs. COLLECTOR CURRENT



INSERTION GAIN vs. COLLECTOR CURRENT



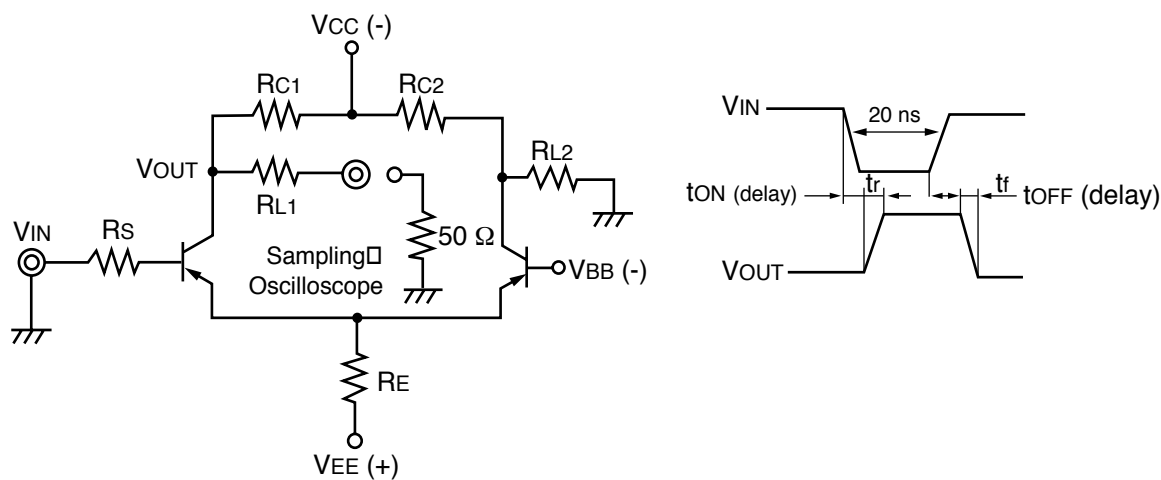
TYPICAL PERFORMANCE CURVES ($T_A = 25^\circ\text{C}$)



SWITCHING CHARACTERISTICS

| UNITS | PARAMETERS | UNITS | $V_{IN} = 1\text{ V}$ |
|-------------------|---------------------|-------|-----------------------|
| | | | TYP |
| t_{ON} (delay) | Turn-on Delay Time | ns | 1.10 |
| t_r | Rise Time | ns | 0.77 |
| t_{OFF} (delay) | Turn-off Delay Time | ns | 0.40 |
| t_f | Fall Time | ns | 0.79 |

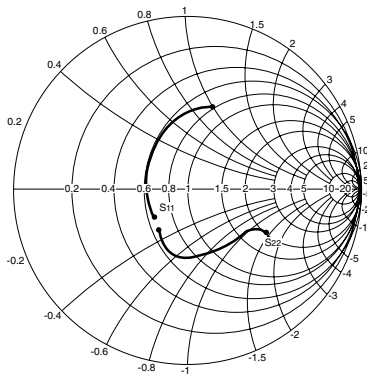
SWITCHING TIME MEASUREMENT CIRCUIT



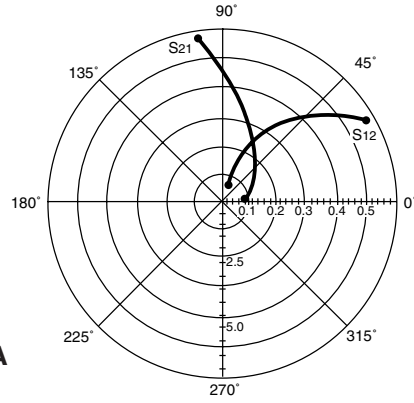
$V_{IN} = 1\text{ v}, V_{BB} = -0.5\text{ V}, R_{C1} = R_{C2}$

| R_s (Ω) | R_c (Ω) | R_{L1} (Ω) | R_{L2} (Ω) | R_E (Ω) | V_{EE} (V) | V_{CC} (V) |
|-----------------------|-----------------------|--------------------------|--------------------------|-----------------------|-----------------|-----------------|
| 160 | 1 K | 200 | 250 | 2.7 K | 27 | 26.3 |

TYPICAL SCATTERING PARAMETERS (TA = 25°C)



NE97833
VCE = -8 V, IC = -10 mA



VCE = -5 V, IC = -10 mA

| FREQUENCY (GHz) | S11 | | S21 | | S12 | | S22 | | K | MAG ¹ (dB) |
|--------------------|-------|--------|-------|------|-------|------|-------|--------|------|--------------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 0.50 | 0.274 | -149.2 | 6.102 | 96.9 | 0.063 | 68.1 | 0.493 | -30.9 | 0.97 | 19.9 |
| 0.80 | 0.273 | -177.0 | 4.037 | 82.0 | 0.093 | 70.1 | 0.432 | -32.2 | 1.07 | 14.7 |
| 1.00 | 0.278 | 169.8 | 3.303 | 74.5 | 0.114 | 70.3 | 0.412 | -34.5 | 1.09 | 12.8 |
| 1.50 | 0.308 | 144.6 | 2.311 | 58.7 | 0.170 | 68.1 | 0.381 | -44.8 | 1.08 | 9.6 |
| 2.00 | 0.352 | 125.0 | 1.808 | 45.3 | 0.229 | 63.9 | 0.362 | -59.4 | 1.03 | 7.8 |
| 2.50 | 0.402 | 109.1 | 1.496 | 33.5 | 0.288 | 58.3 | 0.359 | -75.9 | 0.99 | 7.2 |
| 3.00 | 0.449 | 96.4 | 1.281 | 23.6 | 0.345 | 52.4 | 0.364 | -91.0 | 0.95 | 5.7 |
| 4.00 | 0.506 | 79.7 | 1.023 | 9.1 | 0.458 | 40.7 | 0.350 | -113.5 | 0.91 | 3.5 |
| 5.00 | 0.527 | 71.1 | 0.908 | -1.8 | 0.574 | 27.4 | 0.246 | -138.8 | 0.92 | 2.0 |

VCE = -8 V, IC = -10 mA

| | | | | | | | | | | |
|------|-------|--------|-------|------|-------|------|-------|--------|------|------|
| 0.50 | 0.252 | -140.2 | 6.426 | 98.5 | 0.060 | 68.7 | 0.523 | -29.0 | 0.95 | 20.3 |
| 0.80 | 0.240 | -171.6 | 4.270 | 83.5 | 0.089 | 70.6 | 0.463 | -30.1 | 1.05 | 15.4 |
| 1.00 | 0.243 | 173.7 | 3.496 | 76.0 | 0.109 | 70.9 | 0.443 | -32.3 | 1.08 | 13.4 |
| 1.50 | 0.272 | 145.9 | 2.445 | 60.5 | 0.162 | 60.5 | 0.515 | -43.9 | 1.11 | 9.8 |
| 2.00 | 0.316 | 125.3 | 1.911 | 47.2 | 0.219 | 65.0 | 0.393 | -55.2 | 1.02 | 8.4 |
| 2.50 | 0.369 | 109.0 | 1.582 | 35.6 | 0.276 | 59.8 | 0.388 | -70.6 | 0.98 | 7.6 |
| 3.00 | 0.418 | 96.4 | 1.353 | 25.5 | 0.333 | 54.2 | 0.392 | -85.0 | 0.94 | 6.1 |
| 4.00 | 0.479 | 79.9 | 1.076 | 10.7 | 0.445 | 42.9 | 0.379 | -106.3 | 0.90 | 3.8 |
| 5.00 | 0.503 | 71.7 | 0.950 | -0.4 | 0.563 | 30.2 | 0.278 | -127.3 | 0.90 | 2.3 |

VCE = -10 V, IC = -15 mA

| | | | | | | | | | | |
|------|-------|--------|-------|-------|-------|------|-------|--------|------|------|
| 0.50 | 0.555 | -80.8 | 4.097 | 116.8 | 0.076 | 55.1 | 0.697 | -28.4 | 0.65 | 17.3 |
| 0.80 | 0.399 | -121.8 | 3.325 | 94.8 | 0.094 | 53.5 | 0.600 | -32.6 | 0.89 | 15.5 |
| 1.00 | 0.348 | -143.5 | 2.864 | 84.2 | 0.106 | 55.4 | 0.564 | -35.2 | 1.00 | 14.3 |
| 1.50 | 0.314 | 173.5 | 2.107 | 64.5 | 0.140 | 69.0 | 0.411 | -39.4 | 1.07 | 10.2 |
| 2.00 | 0.342 | 142.8 | 1.669 | 49.0 | 0.186 | 62.8 | 0.494 | -56.1 | 1.08 | 7.8 |
| 2.50 | 0.393 | 120.2 | 1.382 | 36.0 | 0.241 | 61.5 | 0.490 | -70.2 | 1.00 | 7.4 |
| 3.00 | 0.446 | 103.4 | 1.179 | 25.6 | 0.302 | 57.9 | 0.496 | -83.7 | 0.93 | 5.9 |
| 4.00 | 0.515 | 81.7 | 0.934 | 11.9 | 0.433 | 47.8 | 0.484 | -105.8 | 0.87 | 3.3 |
| 5.00 | 0.529 | 69.6 | 0.844 | 3.0 | 0.575 | 34.3 | 0.382 | -128.7 | 0.90 | 1.7 |

VCE = -10 V, IC = -3 mA

| | | | | | | | | | | |
|------|-------|--------|-------|------|-------|------|-------|--------|------|------|
| 0.50 | 0.214 | -153.1 | 6.846 | 96.2 | 0.058 | 73.2 | 0.506 | -27.0 | 0.99 | 20.7 |
| 0.80 | 0.215 | 179.7 | 4.489 | 82.4 | 0.087 | 74.0 | 0.456 | -27.9 | 1.06 | 15.6 |
| 1.00 | 0.221 | 166.8 | 3.664 | 75.4 | 0.108 | 73.7 | 0.439 | -30.1 | 1.07 | 13.7 |
| 1.50 | 0.254 | 141.5 | 2.554 | 60.6 | 0.163 | 70.6 | 0.441 | -41.8 | 1.05 | 10.6 |
| 2.00 | 0.300 | 122.3 | 1.992 | 47.7 | 0.220 | 66.0 | 0.393 | -52.7 | 1.01 | 8.9 |
| 2.50 | 0.352 | 107.1 | 1.648 | 36.2 | 0.276 | 60.4 | 0.387 | -68.0 | 0.97 | 7.8 |
| 3.00 | 0.402 | 95.0 | 1.410 | 26.3 | 0.331 | 54.6 | 0.389 | -82.1 | 0.94 | 6.3 |
| 4.00 | 0.463 | 79.5 | 1.121 | 11.3 | 0.440 | 43.4 | 0.377 | -102.6 | 0.89 | 4.1 |
| 5.00 | 0.489 | 72.1 | 0.984 | -0.2 | 0.555 | 31.0 | 0.277 | -121.3 | 0.89 | 2.5 |

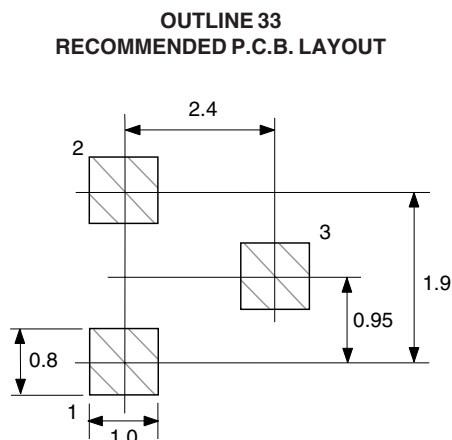
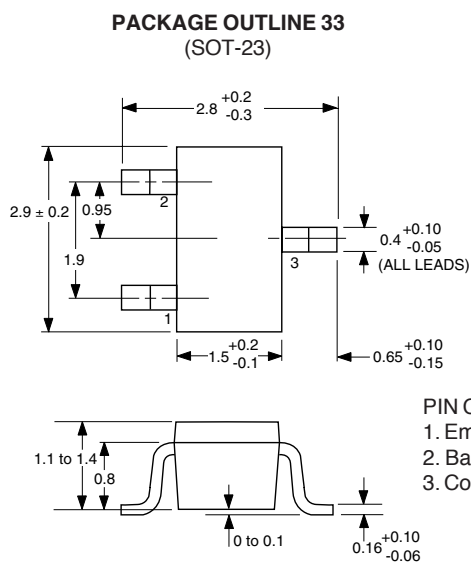
Note:

1. Gain Calculation:

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

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

OUTLINE DIMENSIONS (Units in mm)



ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKAGING |
|---------------|----------|-------------|
| NE97833-T1B-A | 3000 | Tape & Reel |

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|-------------------------------|---|--|-----|
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| Cadmium | < 100 PPM | Not Detected | |
| Hexavalent Chromium | < 1000 PPM | Not Detected | |
| PBB | < 1000 PPM | Not Detected | |
| PBDE | < 1000 PPM | Not Detected | |

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