

**MICROWAVE LOW NOISE AMPLIFIER
NPN SILICON EPITAXIAL TRANSISTOR
(WITH BUILT-IN 2 × 2SC5193) SMALL MINI MOLD**

FEATURES

- Low Voltage Operation, Low Phase Distortion
- Low Noise
NF = 1.5 dB TYP. @V_{CE} = 3 V, I_c = 7 mA, f = 2 GHz
NF = 1.7 dB TYP. @V_{CE} = 1 V, I_c = 3 mA, f = 2 GHz
- Large Absolute Maximum Collector Current
I_c = 100 mA
- A Small Mini Mold Package Adopted
- Built-in 2 Transistors (2 × 2SC5193)

ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKING STYLE |
|-------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| μPA814T | Loose products (50 PCS) | Embossed tape 8 mm wide. Pin 6 (Q1 Base), Pin 5 (Q1 Emitter), Pin 4 (Q2 Emitter) face to perforation side of the tape. |
| μPA814T-T1 | Taping products (3 KPCS/Reel) | |

Remark If you require an evaluation sample, please contact an NEC Sales Representative. (Unit sample quantity is 50 pcs.)

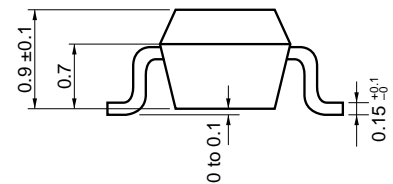
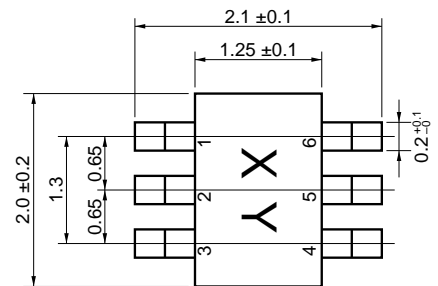
ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

| PARAMETER | SYMBOL | RATING | UNIT |
|------------------------------|------------------|-------------------------------------------------------|------|
| Collector to Base Voltage | V _{CBO} | 9 | V |
| Collector to Emitter Voltage | V _{CEO} | 6 | V |
| Emitter to Base Voltage | V _{EBO} | 2 | V |
| Collector Current | I _c | 100 | mA |
| Total Power Dissipation | P _T | 150 in 1 element 200 in 2 elements ^{Note} | mW |
| Junction Temperature | T _j | 150 | °C |
| Storage Temperature | T _{stg} | -65 to +150 | °C |

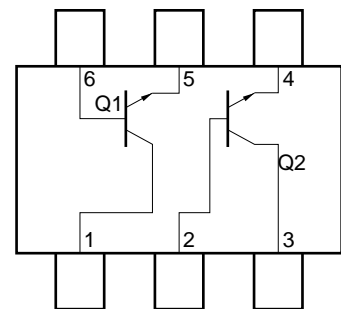
Note 110 mW must not be exceeded in 1 element.

PACKAGE DRAWINGS

(Unit: mm)



PIN CONFIGURATION (Top View)



PIN CONNECTIONS

- | | |
|-------------------|-----------------|
| 1. Collector (Q1) | 4. Emitter (Q2) |
| 2. Base (Q2) | 5. Emitter (Q1) |
| 3. Collector (Q2) | 6. Base (Q1) |

This device uses radio frequency technology. Take due precautions to protect it from excessive input levels such as static electricity.

The information in this document is subject to change without notice.

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Collector Cutoff Current | I _{CB0} | V _{CB} = 5 V, I _E = 0 | | | 0.1 | μA |
| Emitter Cutoff Current | I _{EB0} | V _{EB} = 1 V, I _C = 0 | | | 0.1 | μA |
| DC Current Gain | h _{FE} | V _{CE} = 1 V, I _C = 3 mA ^{Note 1} | 80 | | 160 | |
| Gain Bandwidth Product (1) | f _T (1) | V _{CE} = 1 V, I _C = 3 mA, f = 2 GHz | 4.0 | 4.5 | | GHz |
| Gain Bandwidth Product (2) | f _T (2) | V _{CE} = 3 V, I _C = 20 mA, f = 2 GHz | | 9.0 | | GHz |
| Feed-back Capacitance | C _{re} | V _{CB} = 1 V, I _E = 0, f = 1 MHz ^{Note 2} | | 0.75 | 0.85 | pF |
| Insertion Power Gain (1) | S _{21e} ² (1) | V _{CE} = 1 V, I _C = 3 mA, f = 2 GHz | 2.5 | 3.5 | | dB |
| Insertion Power Gain (2) | S _{21e} ² (2) | V _{CE} = 3 V, I _C = 20 mA, f = 2 GHz | | 6.5 | | dB |
| Noise Figure (1) | NF (1) | V _{CE} = 1 V, I _C = 3 mA, f = 2 GHz | | 1.7 | 2.5 | dB |
| Noise Figure (2) | NF (2) | V _{CE} = 3 V, I _C = 7 mA, f = 2 GHz | | 1.5 | | dB |
| h _{FE} Ratio | h _{FE1} /h _{FE2} | V _{CE} = 1 V, I _C = 3 mA A smaller value among h _{FE} of h _{FE1} = Q1, Q2 A larger value among h _{FE} of h _{FE2} = Q1, Q2 | 0.85 | | | |

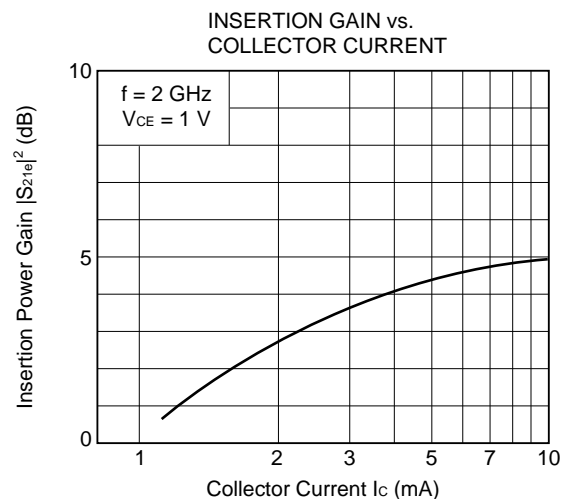
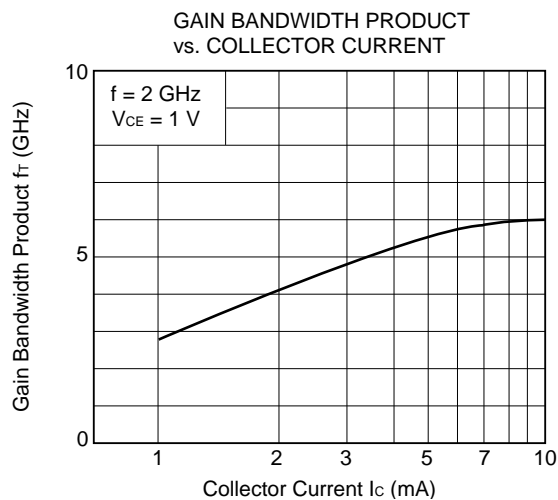
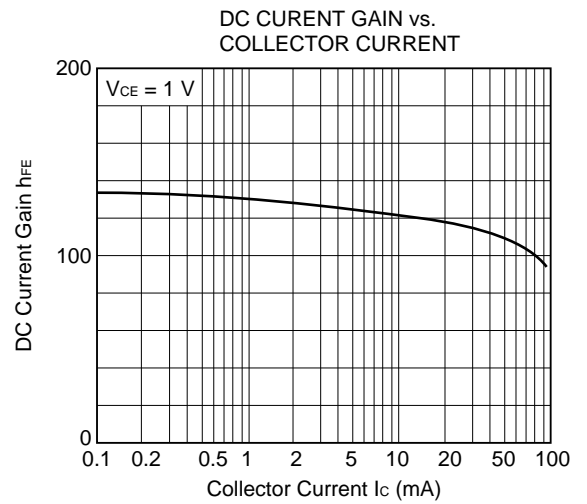
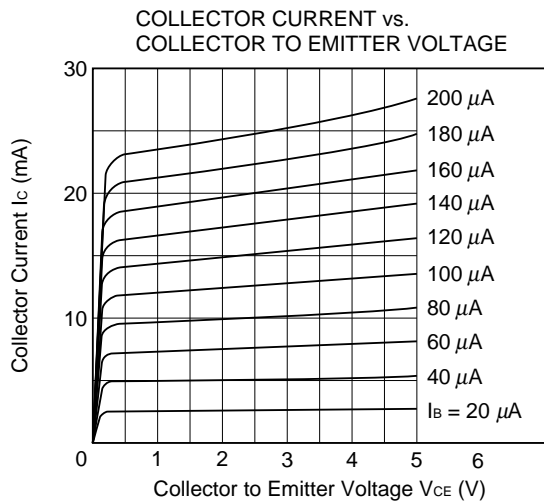
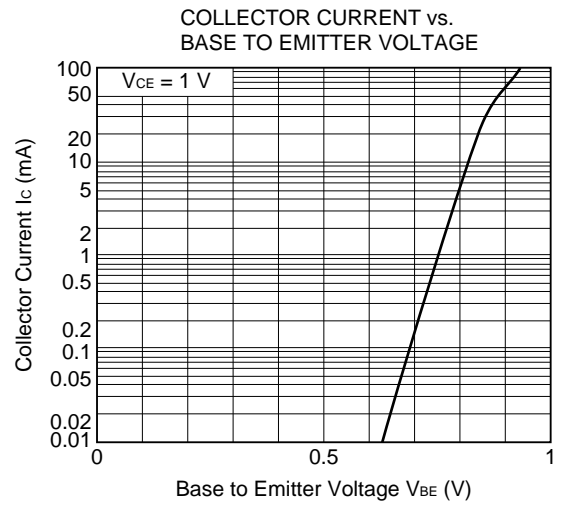
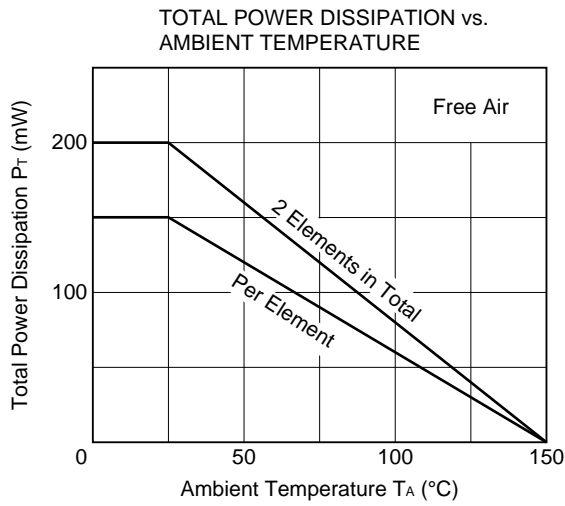
Notes 1. Pulse Measurement: P_w ≤ 350 μs, Duty cycle ≤ 2 %

2. Measured with 3-pin bridge, emitter and case should be connected to guard pin of bridge.

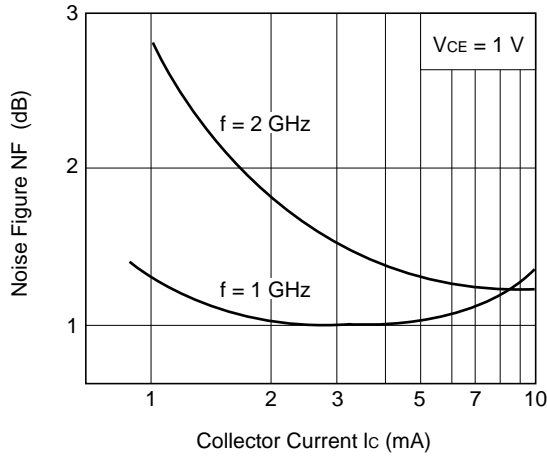
h_{FE} CLASSIFICATION

| | |
|-----------------------|-----------|
| Rank | KB |
| Marking | 88T |
| h _{FE} Value | 80 to 160 |

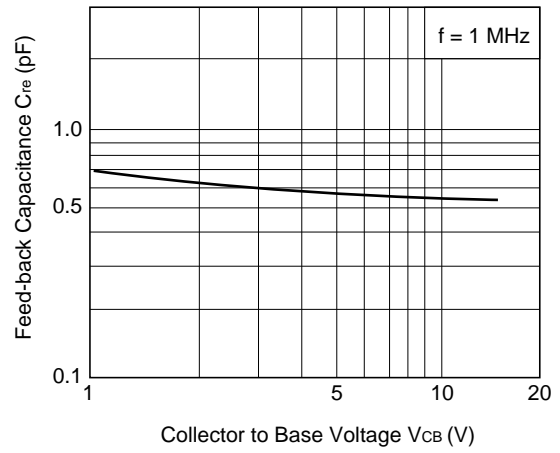
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)



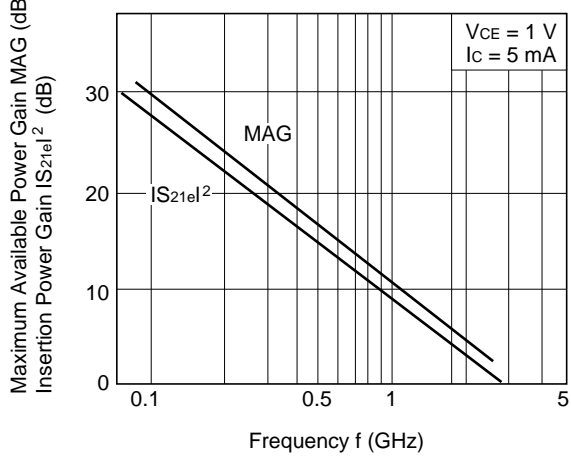
NOISE FIGURE vs. COLLECTOR CURRENT



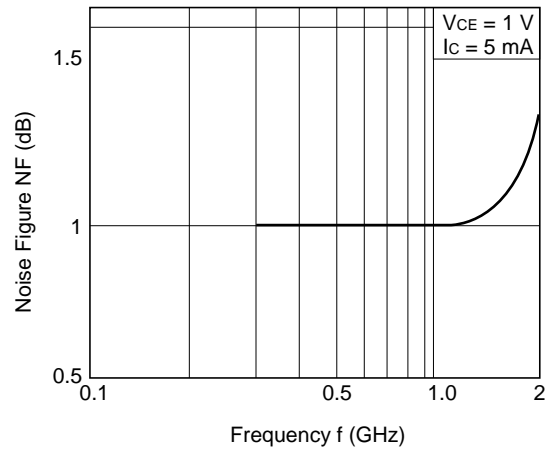
FEED-BACK CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



MAXIMUM AVAILABLE GAIN / INSERTION POWER GAIN vs. FREQUENCY



NOISE FIGURE vs. FREQUENCY



S-PARAMETERS

V_{CE} = 1 V, I_c = 1 mA

| FREQUENCY | | S11 | | S21 | | S12 | | S22 | |
|-----------|-------|--------|-------|-------|-------|------|-------|--------|--|
| MHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | |
| 100.00 | 0.959 | -19.0 | 3.692 | 165.1 | 0.053 | 78.5 | 0.985 | -10.2 | |
| 200.00 | 0.931 | -35.2 | 3.385 | 152.3 | 0.097 | 68.8 | 0.945 | -18.7 | |
| 300.00 | 0.849 | -51.4 | 3.161 | 138.3 | 0.137 | 57.2 | 0.871 | -28.2 | |
| 400.00 | 0.825 | -64.7 | 2.868 | 129.8 | 0.166 | 50.6 | 0.817 | -33.9 | |
| 500.00 | 0.782 | -76.8 | 2.677 | 119.2 | 0.186 | 42.6 | 0.731 | -39.2 | |
| 600.00 | 0.761 | -91.4 | 2.506 | 112.5 | 0.205 | 38.3 | 0.693 | -43.9 | |
| 700.00 | 0.725 | -103.2 | 2.351 | 101.6 | 0.213 | 32.3 | 0.638 | -47.0 | |
| 800.00 | 0.677 | -114.4 | 2.224 | 95.2 | 0.225 | 27.6 | 0.609 | -51.7 | |
| 900.00 | 0.647 | -124.0 | 2.015 | 86.8 | 0.223 | 25.5 | 0.574 | -55.3 | |
| 1000.00 | 0.633 | -133.0 | 1.886 | 80.4 | 0.224 | 21.2 | 0.533 | -60.7 | |
| 1100.00 | 0.619 | -141.6 | 1.749 | 75.3 | 0.228 | 20.7 | 0.502 | -64.6 | |
| 1200.00 | 0.601 | -150.7 | 1.670 | 69.2 | 0.231 | 18.1 | 0.463 | -68.5 | |
| 1300.00 | 0.591 | -156.9 | 1.595 | 65.1 | 0.235 | 15.7 | 0.434 | -71.7 | |
| 1400.00 | 0.580 | -162.3 | 1.482 | 59.4 | 0.224 | 13.9 | 0.408 | -75.0 | |
| 1500.00 | 0.598 | -168.9 | 1.423 | 54.7 | 0.221 | 11.3 | 0.394 | -78.4 | |
| 1600.00 | 0.610 | -175.2 | 1.354 | 51.5 | 0.211 | 14.1 | 0.376 | -82.7 | |
| 1700.00 | 0.606 | 176.5 | 1.293 | 47.5 | 0.209 | 13.7 | 0.363 | -87.5 | |
| 1800.00 | 0.599 | 171.7 | 1.285 | 43.9 | 0.213 | 16.0 | 0.345 | -93.2 | |
| 1900.00 | 0.585 | 167.3 | 1.238 | 39.1 | 0.213 | 16.0 | 0.333 | -98.5 | |
| 2000.00 | 0.603 | 164.1 | 1.216 | 33.1 | 0.217 | 15.4 | 0.320 | -103.8 | |

V_{CE} = 1 V, I_c = 3 mA

| FREQUENCY | | S11 | | S21 | | S12 | | S22 | |
|-----------|-------|--------|-------|-------|-------|------|-------|--------|--|
| MHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | |
| 100.00 | 0.888 | -31.2 | 9.366 | 156.5 | 0.050 | 73.2 | 0.942 | -20.2 | |
| 200.00 | 0.801 | -56.4 | 8.003 | 138.0 | 0.084 | 61.5 | 0.821 | -35.4 | |
| 300.00 | 0.682 | -78.0 | 6.696 | 122.5 | 0.111 | 50.1 | 0.680 | -48.7 | |
| 400.00 | 0.619 | -93.8 | 5.670 | 113.3 | 0.126 | 45.6 | 0.572 | -56.4 | |
| 500.00 | 0.569 | -107.5 | 4.859 | 104.3 | 0.135 | 41.2 | 0.473 | -62.6 | |
| 600.00 | 0.546 | -121.1 | 4.337 | 99.1 | 0.146 | 40.2 | 0.413 | -67.2 | |
| 700.00 | 0.518 | -132.6 | 3.837 | 90.2 | 0.151 | 37.8 | 0.358 | -70.9 | |
| 800.00 | 0.498 | -142.3 | 3.529 | 85.6 | 0.162 | 36.5 | 0.322 | -75.3 | |
| 900.00 | 0.488 | -150.3 | 3.233 | 79.1 | 0.165 | 37.3 | 0.287 | -79.6 | |
| 1000.00 | 0.488 | -158.0 | 2.970 | 74.1 | 0.172 | 35.6 | 0.256 | -85.3 | |
| 1100.00 | 0.485 | -165.7 | 2.704 | 70.4 | 0.180 | 37.1 | 0.227 | -90.3 | |
| 1200.00 | 0.477 | -173.7 | 2.528 | 65.5 | 0.189 | 35.8 | 0.201 | -95.8 | |
| 1300.00 | 0.472 | -178.3 | 2.393 | 62.0 | 0.200 | 35.3 | 0.182 | -101.3 | |
| 1400.00 | 0.467 | 178.0 | 2.190 | 57.9 | 0.201 | 34.6 | 0.164 | -107.8 | |
| 1500.00 | 0.491 | 173.2 | 2.072 | 53.6 | 0.208 | 33.1 | 0.153 | -114.7 | |
| 1600.00 | 0.508 | 168.8 | 1.954 | 51.4 | 0.213 | 35.8 | 0.143 | -123.8 | |
| 1700.00 | 0.512 | 161.9 | 1.858 | 48.3 | 0.223 | 34.5 | 0.136 | -133.6 | |
| 1800.00 | 0.512 | 157.8 | 1.825 | 45.2 | 0.235 | 35.9 | 0.132 | -145.7 | |
| 1900.00 | 0.505 | 154.2 | 1.746 | 40.8 | 0.248 | 33.9 | 0.130 | -155.8 | |
| 2000.00 | 0.520 | 152.1 | 1.704 | 35.5 | 0.260 | 31.8 | 0.131 | -165.3 | |

V_{CE} = 1 V, I_c = 5 mA

| FREQUENCY | | S11 | | S21 | | S12 | | S22 | |
|-----------|-------|--------|--------|-------|-------|------|-------|--------|--|
| MHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | |
| 100.00 | 0.820 | -41.1 | 13.583 | 150.1 | 0.045 | 71.6 | 0.898 | -27.9 | |
| 200.00 | 0.699 | -70.8 | 10.743 | 128.9 | 0.074 | 57.8 | 0.719 | -46.7 | |
| 300.00 | 0.578 | -94.2 | 8.453 | 113.9 | 0.094 | 48.9 | 0.555 | -60.8 | |
| 400.00 | 0.515 | -110.4 | 6.860 | 105.2 | 0.105 | 47.0 | 0.443 | -69.1 | |
| 500.00 | 0.479 | -123.8 | 5.735 | 97.6 | 0.115 | 44.7 | 0.355 | -75.9 | |
| 600.00 | 0.463 | -136.2 | 5.013 | 93.3 | 0.125 | 45.9 | 0.300 | -81.3 | |
| 700.00 | 0.445 | -146.8 | 4.384 | 85.6 | 0.134 | 44.7 | 0.254 | -86.0 | |
| 800.00 | 0.437 | -154.9 | 3.996 | 81.6 | 0.146 | 44.6 | 0.222 | -92.0 | |
| 900.00 | 0.433 | -161.7 | 3.464 | 75.6 | 0.154 | 45.5 | 0.194 | -98.3 | |
| 1000.00 | 0.442 | -168.5 | 3.334 | 71.4 | 0.164 | 43.9 | 0.170 | -106.0 | |
| 1100.00 | 0.444 | -175.3 | 3.026 | 68.2 | 0.174 | 45.3 | 0.149 | -113.9 | |
| 1200.00 | 0.442 | 177.4 | 2.809 | 63.7 | 0.187 | 43.8 | 0.135 | -123.4 | |
| 1300.00 | 0.438 | 173.4 | 2.650 | 60.6 | 0.200 | 43.1 | 0.122 | -132.7 | |
| 1400.00 | 0.435 | 170.3 | 2.422 | 56.8 | 0.205 | 42.1 | 0.115 | -143.3 | |
| 1500.00 | 0.461 | 166.8 | 2.285 | 52.9 | 0.216 | 40.3 | 0.117 | -152.6 | |
| 1600.00 | 0.479 | 163.0 | 2.150 | 51.1 | 0.222 | 42.1 | 0.118 | -164.4 | |
| 1700.00 | 0.486 | 156.7 | 2.041 | 48.2 | 0.235 | 40.3 | 0.126 | -175.2 | |
| 1800.00 | 0.487 | 152.8 | 2.002 | 45.3 | 0.249 | 40.8 | 0.134 | -174.3 | |
| 1900.00 | 0.484 | 149.6 | 1.905 | 41.2 | 0.264 | 38.1 | 0.145 | -165.3 | |
| 2000.00 | 0.498 | 147.8 | 1.857 | 36.0 | 0.279 | 35.8 | 0.152 | -158.7 | |

$V_{CE} = 1\text{ V}$, $I_c = 7\text{ mA}$

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.749 | -49.9 | 17.270 | 143.9 | 0.043 | 68.1 | 0.844 | -34.8 |
| 200.00 | 0.611 | -83.5 | 12.699 | 122.0 | 0.066 | 56.2 | 0.627 | -55.8 |
| 300.00 | 0.502 | -107.3 | 9.561 | 107.8 | 0.082 | 49.9 | 0.460 | -70.5 |
| 400.00 | 0.451 | -123.2 | 7.542 | 100.0 | 0.092 | 49.9 | 0.356 | -79.7 |
| 500.00 | 0.427 | -136.0 | 6.261 | 93.3 | 0.103 | 49.4 | 0.281 | -87.2 |
| 600.00 | 0.418 | -147.2 | 5.396 | 89.7 | 0.115 | 51.5 | 0.235 | -93.7 |
| 700.00 | 0.408 | -156.7 | 4.703 | 82.7 | 0.125 | 50.5 | 0.197 | -100.6 |
| 800.00 | 0.405 | -163.7 | 4.270 | 79.2 | 0.140 | 50.4 | 0.171 | -108.6 |
| 900.00 | 0.405 | -169.3 | 3.681 | 73.7 | 0.150 | 50.8 | 0.150 | -117.7 |
| 1000.00 | 0.417 | -175.3 | 3.356 | 69.5 | 0.164 | 49.6 | 0.135 | -128.1 |
| 1100.00 | 0.424 | 178.6 | 3.205 | 66.9 | 0.174 | 50.1 | 0.122 | -139.4 |
| 1200.00 | 0.424 | 171.8 | 2.974 | 62.7 | 0.188 | 48.3 | 0.117 | -150.6 |
| 1300.00 | 0.421 | 168.1 | 2.806 | 59.6 | 0.203 | 47.3 | 0.114 | -160.9 |
| 1400.00 | 0.420 | 165.7 | 2.554 | 56.3 | 0.210 | 46.0 | 0.118 | -171.3 |
| 1500.00 | 0.445 | 162.5 | 2.404 | 52.4 | 0.222 | 43.9 | 0.125 | -179.2 |
| 1600.00 | 0.464 | 159.3 | 2.259 | 50.8 | 0.230 | 45.3 | 0.135 | 171.4 |
| 1700.00 | 0.472 | 153.5 | 2.143 | 48.2 | 0.243 | 43.1 | 0.149 | 163.6 |
| 1800.00 | 0.476 | 149.8 | 2.099 | 45.3 | 0.258 | 43.3 | 0.162 | 156.6 |
| 1900.00 | 0.473 | 146.9 | 1.997 | 41.3 | 0.274 | 40.3 | 0.177 | 149.7 |
| 2000.00 | 0.487 | 145.2 | 1.945 | 36.3 | 0.289 | 37.7 | 0.185 | 145.0 |

$V_{CE} = 1\text{ V}$, $I_c = 10\text{ mA}$

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.0 | 0.672 | -59.5 | 20.710 | 138.2 | 0.040 | 65.0 | 0.784 | -41.7 |
| 200.0 | 0.532 | -95.5 | 14.189 | 116.1 | 0.058 | 56.9 | 0.542 | -64.5 |
| 300.0 | 0.444 | -119.1 | 10.380 | 102.9 | 0.073 | 53.2 | 0.384 | -79.5 |
| 400.0 | 0.407 | -134.3 | 8.042 | 96.1 | 0.084 | 53.6 | 0.293 | -89.8 |
| 500.0 | 0.394 | -146.0 | 6.581 | 90.1 | 0.096 | 54.0 | 0.229 | -98.7 |
| 600.0 | 0.390 | -156.0 | 5.667 | 87.1 | 0.109 | 56.2 | 0.192 | -106.9 |
| 700.0 | 0.384 | -164.7 | 4.903 | 80.6 | 0.122 | 55.6 | 0.163 | -115.9 |
| 800.0 | 0.384 | -170.5 | 4.444 | 77.4 | 0.138 | 54.9 | 0.144 | -126.4 |
| 900.0 | 0.387 | -175.2 | 3.836 | 72.3 | 0.149 | 55.2 | 0.133 | -137.7 |
| 1000.0 | 0.402 | 179.5 | 3.480 | 68.5 | 0.164 | 53.1 | 0.126 | -149.5 |
| 1100.0 | 0.411 | 174.0 | 3.328 | 65.9 | 0.176 | 53.4 | 0.120 | -161.2 |
| 1200.0 | 0.413 | 167.5 | 3.085 | 62.0 | 0.191 | 51.2 | 0.123 | -171.6 |
| 1300.0 | 0.411 | 164.3 | 2.906 | 59.0 | 0.206 | 50.2 | 0.125 | 179.5 |
| 1400.0 | 0.410 | 162.2 | 2.643 | 55.7 | 0.214 | 48.7 | 0.135 | 171.3 |
| 1500.0 | 0.435 | 159.5 | 2.486 | 52.1 | 0.226 | 46.3 | 0.144 | 165.7 |
| 1600.0 | 0.455 | 156.6 | 2.335 | 50.5 | 0.237 | 47.3 | 0.159 | 159.0 |
| 1700.0 | 0.465 | 151.1 | 2.213 | 48.0 | 0.250 | 44.8 | 0.173 | 152.8 |
| 1800.0 | 0.468 | 147.6 | 2.166 | 45.3 | 0.265 | 44.8 | 0.190 | 147.2 |
| 1900.0 | 0.468 | 144.8 | 2.056 | 41.4 | 0.282 | 41.7 | 0.206 | 142.3 |
| 2000.0 | 0.481 | 143.3 | 2.003 | 36.5 | 0.297 | 38.8 | 0.215 | 138.1 |

$V_{CE} = 3\text{ V}$, $I_c = 1\text{ mA}$

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|-------|-------|-------|------|-------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.967 | -16.3 | 3.686 | 167.1 | 0.038 | 79.8 | 0.988 | -7.7 |
| 200.00 | 0.943 | -30.5 | 3.405 | 156.0 | 0.071 | 71.8 | 0.962 | -14.1 |
| 300.00 | 0.868 | -44.6 | 3.238 | 143.1 | 0.103 | 61.3 | 0.905 | -21.6 |
| 400.00 | 0.851 | -56.7 | 2.983 | 135.8 | 0.126 | 55.5 | 0.868 | -25.8 |
| 500.00 | 0.814 | -67.9 | 2.821 | 125.6 | 0.143 | 48.2 | 0.795 | -29.9 |
| 600.00 | 0.791 | -82.1 | 2.687 | 119.4 | 0.159 | 44.3 | 0.770 | -33.7 |
| 700.00 | 0.754 | -93.6 | 2.541 | 108.7 | 0.168 | 38.1 | 0.725 | -36.1 |
| 800.00 | 0.698 | -104.5 | 2.419 | 102.4 | 0.179 | 34.1 | 0.702 | -40.2 |
| 900.00 | 0.662 | -114.0 | 2.204 | 94.1 | 0.179 | 31.9 | 0.674 | -43.2 |
| 1000.00 | 0.641 | -122.9 | 2.068 | 87.8 | 0.182 | 27.6 | 0.634 | -47.8 |
| 1100.00 | 0.623 | -131.7 | 1.924 | 82.9 | 0.184 | 27.2 | 0.602 | -50.9 |
| 1200.00 | 0.601 | -140.8 | 1.847 | 77.0 | 0.187 | 24.7 | 0.562 | -53.9 |
| 1300.00 | 0.588 | -147.7 | 1.763 | 73.1 | 0.191 | 22.5 | 0.534 | -56.0 |
| 1400.00 | 0.576 | -153.7 | 1.651 | 67.3 | 0.182 | 21.3 | 0.507 | -58.0 |
| 1500.00 | 0.589 | -160.9 | 1.589 | 62.8 | 0.181 | 19.4 | 0.496 | -60.1 |
| 1600.00 | 0.595 | -167.7 | 1.517 | 59.4 | 0.173 | 22.5 | 0.479 | -62.8 |
| 1700.00 | 0.587 | -176.3 | 1.451 | 55.2 | 0.174 | 22.4 | 0.468 | -66.6 |
| 1800.00 | 0.577 | 178.5 | 1.438 | 51.7 | 0.177 | 25.2 | 0.452 | -70.5 |
| 1900.00 | 0.563 | 173.8 | 1.383 | 46.6 | 0.179 | 25.3 | 0.436 | -74.6 |
| 2000.00 | 0.580 | 170.1 | 1.355 | 41.1 | 0.182 | 24.8 | 0.421 | -78.6 |

V_{CE} = 3 V, I_c = 3 mA

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|-------|-------|-------|------|-------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.901 | -25.7 | 9.468 | 159.6 | 0.035 | 76.1 | 0.961 | -14.7 |
| 200.00 | 0.824 | -46.7 | 8.338 | 143.2 | 0.062 | 65.0 | 0.870 | -26.0 |
| 300.00 | 0.706 | -65.5 | 7.180 | 128.3 | 0.086 | 55.4 | 0.751 | -36.3 |
| 400.00 | 0.642 | -79.7 | 6.228 | 119.7 | 0.099 | 51.0 | 0.660 | -41.4 |
| 500.00 | 0.584 | -92.3 | 5.424 | 110.4 | 0.109 | 46.7 | 0.565 | -45.5 |
| 600.00 | 0.550 | -106.1 | 4.896 | 105.2 | 0.119 | 45.8 | 0.514 | -48.1 |
| 700.00 | 0.512 | -117.6 | 4.373 | 96.0 | 0.125 | 43.3 | 0.462 | -49.6 |
| 800.00 | 0.477 | -127.9 | 4.024 | 91.3 | 0.135 | 42.6 | 0.430 | -52.4 |
| 900.00 | 0.457 | -136.7 | 3.538 | 84.4 | 0.138 | 43.0 | 0.399 | -54.4 |
| 1000.00 | 0.449 | -145.0 | 3.247 | 79.5 | 0.144 | 41.4 | 0.364 | -57.8 |
| 1100.00 | 0.438 | -153.1 | 3.124 | 76.0 | 0.151 | 42.9 | 0.336 | -60.2 |
| 1200.00 | 0.427 | -161.4 | 2.924 | 71.3 | 0.159 | 41.8 | 0.306 | -62.8 |
| 1300.00 | 0.419 | -166.8 | 2.764 | 68.0 | 0.168 | 41.4 | 0.280 | -64.2 |
| 1400.00 | 0.415 | -171.3 | 2.549 | 63.7 | 0.171 | 41.3 | 0.257 | -65.9 |
| 1500.00 | 0.434 | -176.7 | 2.418 | 59.9 | 0.178 | 40.1 | 0.243 | -67.8 |
| 1600.00 | 0.448 | 177.9 | 2.283 | 57.5 | 0.182 | 42.8 | 0.226 | -70.5 |
| 1700.00 | 0.449 | 170.5 | 2.176 | 54.2 | 0.193 | 41.6 | 0.211 | -74.3 |
| 1800.00 | 0.447 | 166.0 | 2.129 | 51.2 | 0.204 | 43.0 | 0.193 | -79.0 |
| 1900.00 | 0.441 | 162.1 | 2.035 | 46.7 | 0.215 | 41.3 | 0.177 | -83.7 |
| 2000.00 | 0.456 | 159.7 | 1.984 | 41.8 | 0.226 | 39.4 | 0.163 | -88.2 |

V_{CE} = 3 V, I_c = 5 mA

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.841 | -32.8 | 13.922 | 154.2 | 0.035 | 75.1 | 0.926 | -20.2 |
| 200.00 | 0.726 | -57.8 | 11.499 | 134.7 | 0.058 | 62.5 | 0.786 | -34.0 |
| 300.00 | 0.594 | -78.3 | 9.352 | 119.8 | 0.075 | 54.5 | 0.637 | -44.6 |
| 400.00 | 0.519 | -93.0 | 7.762 | 111.3 | 0.085 | 51.8 | 0.534 | -49.3 |
| 500.00 | 0.467 | -105.8 | 6.561 | 103.1 | 0.093 | 49.8 | 0.444 | -52.5 |
| 600.00 | 0.439 | -118.7 | 5.788 | 98.8 | 0.104 | 50.8 | 0.394 | -54.3 |
| 700.00 | 0.410 | -129.9 | 5.098 | 90.7 | 0.112 | 49.6 | 0.348 | -55.1 |
| 800.00 | 0.390 | -139.3 | 4.656 | 86.6 | 0.123 | 49.7 | 0.318 | -57.2 |
| 900.00 | 0.379 | -147.3 | 4.055 | 80.5 | 0.130 | 50.2 | 0.290 | -58.9 |
| 1000.00 | 0.378 | -155.1 | 3.699 | 76.1 | 0.140 | 49.2 | 0.260 | -61.9 |
| 1100.00 | 0.373 | -162.5 | 3.548 | 73.2 | 0.148 | 50.2 | 0.237 | -64.3 |
| 1200.00 | 0.368 | -170.3 | 3.298 | 68.9 | 0.158 | 49.1 | 0.210 | -66.8 |
| 1300.00 | 0.363 | -175.1 | 3.111 | 65.9 | 0.171 | 48.7 | 0.188 | -68.4 |
| 1400.00 | 0.363 | -178.9 | 2.857 | 62.3 | 0.176 | 47.9 | 0.168 | -70.6 |
| 1500.00 | 0.384 | 176.6 | 2.699 | 58.5 | 0.186 | 46.6 | 0.155 | -72.7 |
| 1600.00 | 0.400 | 172.1 | 2.542 | 56.5 | 0.194 | 48.5 | 0.138 | -76.7 |
| 1700.00 | 0.405 | 165.4 | 2.421 | 53.7 | 0.205 | 46.5 | 0.123 | -81.6 |
| 1800.00 | 0.406 | 161.3 | 2.365 | 50.8 | 0.218 | 47.3 | 0.108 | -89.2 |
| 1900.00 | 0.403 | 157.7 | 2.254 | 46.6 | 0.231 | 44.8 | 0.093 | -97.0 |
| 2000.00 | 0.418 | 155.7 | 2.194 | 41.8 | 0.245 | 42.5 | 0.081 | -105.9 |

V_{CE} = 3 V, I_c = 7 mA

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.775 | -39.4 | 17.958 | 148.6 | 0.032 | 71.8 | 0.887 | -25.1 |
| 200.00 | 0.633 | -67.5 | 13.904 | 127.9 | 0.052 | 61.3 | 0.704 | -40.5 |
| 300.00 | 0.503 | -88.8 | 10.822 | 113.2 | 0.067 | 55.4 | 0.545 | -50.6 |
| 400.00 | 0.433 | -103.6 | 8.710 | 105.4 | 0.076 | 54.8 | 0.441 | -54.7 |
| 500.00 | 0.390 | -116.1 | 7.271 | 98.3 | 0.085 | 53.6 | 0.360 | -57.0 |
| 600.00 | 0.369 | -128.4 | 6.330 | 94.7 | 0.096 | 55.7 | 0.314 | -58.2 |
| 700.00 | 0.350 | -139.1 | 5.532 | 87.3 | 0.107 | 54.9 | 0.274 | -58.7 |
| 800.00 | 0.338 | -147.8 | 5.024 | 93.7 | 0.120 | 55.0 | 0.247 | -60.3 |
| 900.00 | 0.333 | -154.9 | 4.354 | 78.2 | 0.128 | 55.5 | 0.222 | -62.0 |
| 1000.00 | 0.337 | -162.1 | 3.950 | 74.1 | 0.139 | 53.7 | 0.197 | -65.1 |
| 1100.00 | 0.336 | -168.9 | 3.621 | 71.2 | 0.149 | 54.6 | 0.175 | -67.3 |
| 1200.00 | 0.334 | -176.5 | 3.521 | 67.6 | 0.161 | 53.2 | 0.152 | -70.4 |
| 1300.00 | 0.333 | 179.2 | 3.316 | 64.7 | 0.174 | 52.5 | 0.133 | -72.3 |
| 1400.00 | 0.334 | 176.1 | 3.041 | 61.3 | 0.181 | 51.4 | 0.115 | -75.4 |
| 1500.00 | 0.356 | 172.2 | 2.864 | 57.8 | 0.192 | 49.7 | 0.102 | -78.5 |
| 1600.00 | 0.371 | 168.2 | 2.698 | 55.9 | 0.201 | 51.4 | 0.087 | -84.2 |
| 1700.00 | 0.380 | 161.9 | 2.565 | 53.3 | 0.214 | 49.2 | 0.074 | -92.8 |
| 1800.00 | 0.382 | 158.1 | 2.502 | 50.6 | 0.228 | 49.4 | 0.063 | -108.0 |
| 1900.00 | 0.382 | 154.9 | 2.380 | 46.6 | 0.241 | 46.4 | 0.052 | -124.8 |
| 2000.00 | 0.397 | 153.1 | 2.314 | 41.9 | 0.256 | 43.9 | 0.047 | -143.3 |

V_{CE} = 3 V, I_c = 10 mA

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.704 | -46.5 | 21.888 | 143.4 | 0.030 | 70.3 | 0.841 | -30.3 |
| 200.00 | 0.545 | -76.9 | 15.924 | 121.8 | 0.046 | 61.5 | 0.623 | -46.2 |
| 300.00 | 0.426 | -98.4 | 11.954 | 108.0 | 0.061 | 56.6 | 0.463 | -55.4 |
| 400.00 | 0.365 | -113.1 | 9.399 | 100.9 | 0.071 | 57.1 | 0.366 | -58.8 |
| 500.00 | 0.335 | -125.5 | 7.735 | 94.7 | 0.081 | 57.4 | 0.296 | -60.4 |
| 600.00 | 0.320 | -137.0 | 6.694 | 91.6 | 0.093 | 60.1 | 0.254 | -61.2 |
| 700.00 | 0.307 | -147.2 | 5.821 | 84.9 | 0.104 | 59.5 | 0.220 | -61.2 |
| 800.00 | 0.301 | -154.8 | 5.283 | 81.6 | 0.118 | 59.2 | 0.195 | -62.5 |
| 900.00 | 0.300 | -161.4 | 4.566 | 76.6 | 0.128 | 59.1 | 0.173 | -64.7 |
| 1000.00 | 0.308 | -167.7 | 4.143 | 72.7 | 0.141 | 57.3 | 0.151 | -67.7 |
| 1100.00 | 0.310 | -174.3 | 3.703 | 70.0 | 0.151 | 57.6 | 0.131 | -70.2 |
| 1200.00 | 0.312 | 178.7 | 3.537 | 66.3 | 0.163 | 56.0 | 0.109 | -74.2 |
| 1300.00 | 0.311 | 174.8 | 3.459 | 63.8 | 0.178 | 55.1 | 0.094 | -76.7 |
| 1400.00 | 0.314 | 172.0 | 3.168 | 60.6 | 0.185 | 53.9 | 0.077 | -82.0 |
| 1500.00 | 0.335 | 168.8 | 2.981 | 57.3 | 0.198 | 51.8 | 0.066 | -87.7 |
| 1600.00 | 0.353 | 165.2 | 2.806 | 55.6 | 0.207 | 53.0 | 0.053 | -98.3 |
| 1700.00 | 0.362 | 159.2 | 2.666 | 53.1 | 0.221 | 50.6 | 0.044 | -116.1 |
| 1800.00 | 0.365 | 155.7 | 2.599 | 50.4 | 0.235 | 50.6 | 0.040 | -141.9 |
| 1900.00 | 0.367 | 152.6 | 2.473 | 46.5 | 0.249 | 47.5 | 0.041 | -169.7 |
| 2000.00 | 0.382 | 150.9 | 2.402 | 41.9 | 0.263 | 44.9 | 0.050 | 171.7 |

[MEMO]

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