

MICROWAVE LOW NOISE AMPLIFIER
NPN SILICON EPITAXIAL TRANSISTOR
4 PINS 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
- 4-Pin Mini Mold Package
EIAJ: SC-61

ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKING STYLE |
|-------------|-------------|--|
| 2SC5192-T1 | 3 Kpcs/Reel | Embossed tape 8 mm wide. Pin 3 (Base), Pin 4 (Emitter) face to perforation side of the tape. |
| 2SC5192-T2 | 3 Kpcs/Reel | Embossed tape 8 mm wide. Pin 1 (Collector), Pin 2 (Emitter) face to perforation side of the tape. |

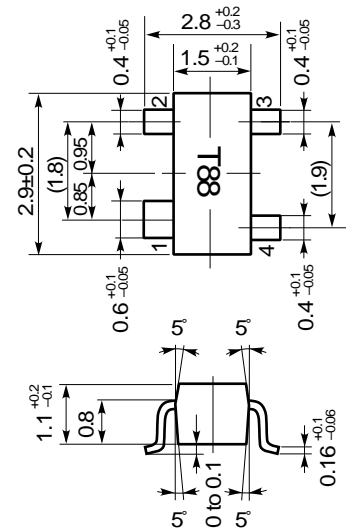
Remark If you require an evaluation sample, please contact an NEC Sales Representative. (Unit sample quantity is 50 pcs.)

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

| PARAMETER | SYMBOL | RATING | UNIT |
|------------------------------|------------------|-------------|------|
| Collector to Base Voltage | V _{CB0} | 9 | V |
| Collector to Emitter Voltage | V _{CEO} | 6 | V |
| Emitter to Base Voltage | V _{EB0} | 2 | V |
| Collector Current | I _c | 100 | mA |
| Total Power Dissipation | P _T | 200 | mW |
| Junction Temperature | T _j | 150 | °C |
| Storage Temperature | T _{stg} | -65 to +150 | °C |

PACKAGE DRAWINGS

(Unit: mm)



PIN CONNECTIONS

1. Collector
2. Emitter
3. Base
4. Emitter

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

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------------------|---------------------------------|--|------|------|------|------|
| Collector Cutoff Current | I _{CEO} | V _{CB} = 5 V, I _E = 0 | | | 100 | nA |
| Emitter Cutoff Current | I _{EB0} | V _{EB} = 1 V, I _C = 0 | | | 100 | nA |
| DC Current Gain | h _{FE} | V _{CE} = 1 V, I _C = 3 mA ^{Note 1} | 80 | | 160 | |
| Insertion Power Gain (1) | S _{21e} ² | V _{CE} = 1 V, I _C = 3 mA, f = 2.0 GHz | 3 | 4.0 | | dB |
| Insertion Power Gain (2) | S _{21e} ² | V _{CE} = 3 V, I _C = 20 mA, f = 2.0 GHz | | 8 | | dB |
| Noise Figure (1) | NF | V _{CE} = 1 V, I _C = 3 mA, f = 2.0 GHz | | 1.7 | 2.5 | dB |
| Noise Figure (2) | NF | V _{CE} = 3 V, I _C = 7 mA, f = 2.0 GHz | | 1.5 | | dB |
| Gain Bandwidth Product (1) | f _T | V _{CE} = 1 V, I _C = 3 mA, f = 2.0 GHz | 4 | 4.5 | | GHz |
| Gain Bandwidth Product (2) | f _T | V _{CE} = 3 V, I _C = 20 mA, f = 2.0 GHz | | 9 | | GHz |
| Collector Capacitance | C _e | V _{CB} = 1 V, I _E = 0, f = 1.0 MHz ^{Note 2} | | 0.65 | 0.8 | pF |

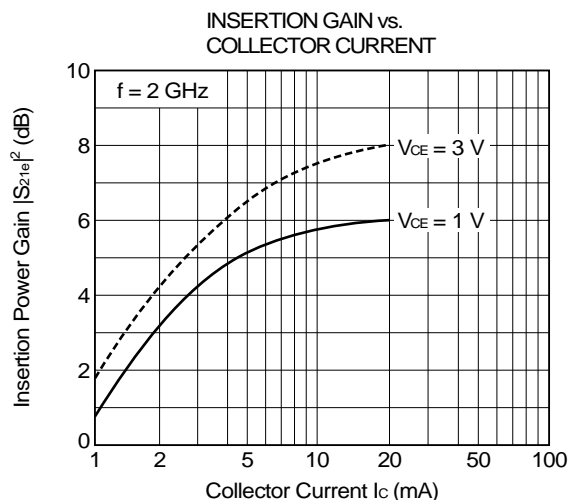
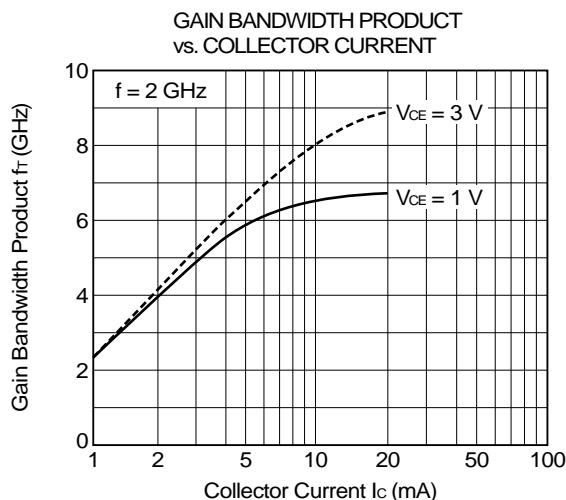
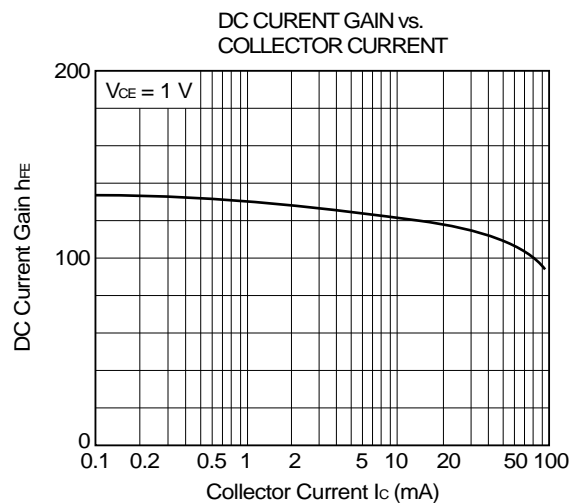
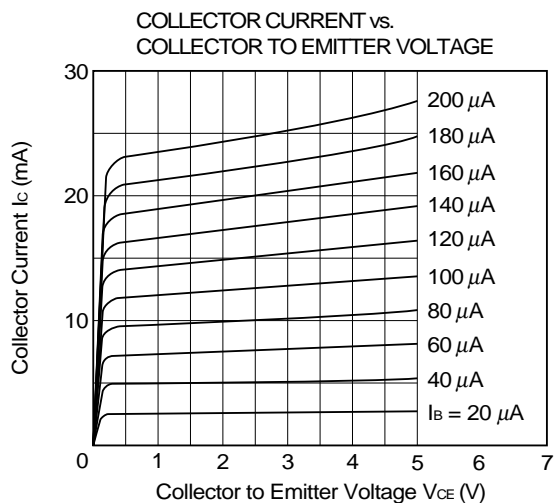
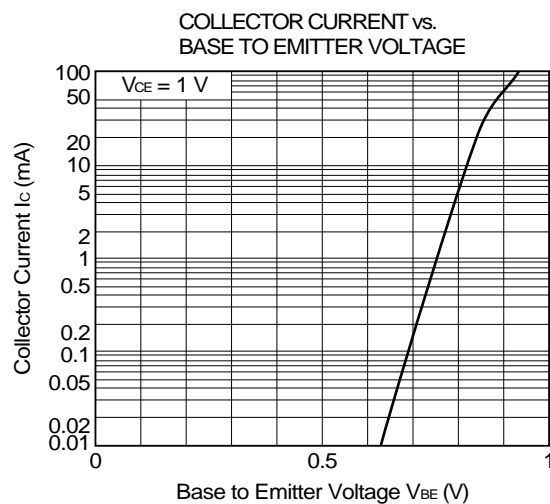
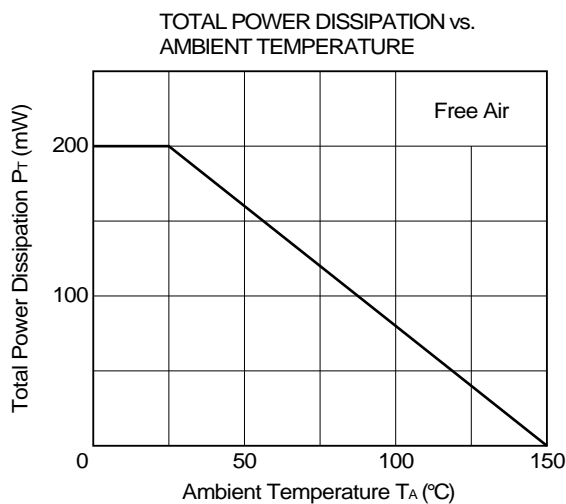
Notes 1. Pulse Measurement: PW ≤ 350 μs, Duty cycle ≤ 2 %, Pulsed

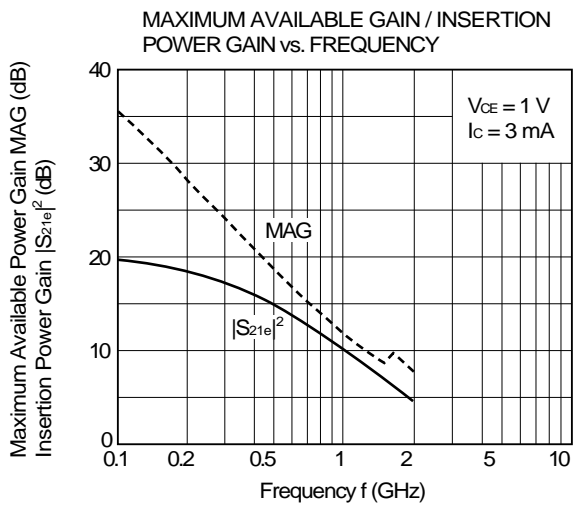
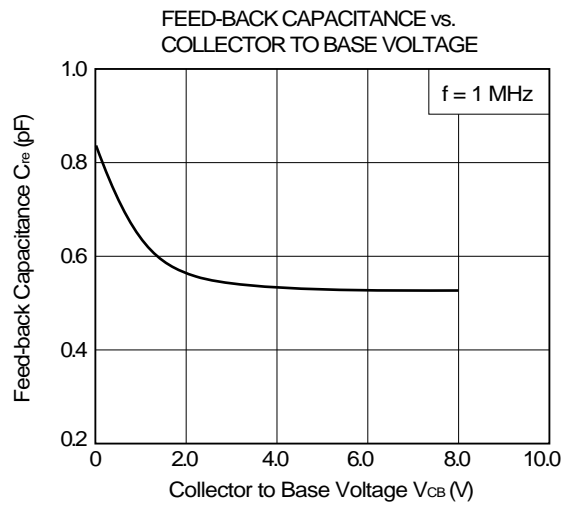
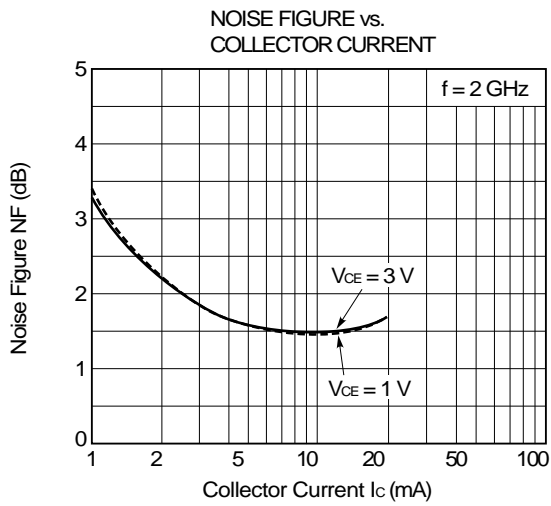
2. Measured with 3-pin bridge, emitter and case should be connected to guard pin of bridge.

h_{FE} Classification

| | |
|-----------------|-----------|
| Rank | FB |
| Marking | T88 |
| h _{FE} | 80 to 160 |

TYPICAL CHARACTERISTICS (T_A = 25 °C)





S-PARAMETERS

$V_{CE} = 1\text{ V}$, $I_c = 1\text{ mA}$, $Z_o = 50\ \Omega$

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.963 | -17.1 | 3.502 | 166.5 | 0.048 | 79.4 | 0.983 | -8.7 |
| 200.00 | 0.934 | -34.1 | 3.413 | 154.0 | 0.087 | 69.6 | 0.957 | -17.1 |
| 300.00 | 0.890 | -49.7 | 3.238 | 142.6 | 0.130 | 60.0 | 0.906 | -25.2 |
| 400.00 | 0.850 | -65.3 | 3.026 | 131.1 | 0.156 | 50.7 | 0.851 | -31.8 |
| 500.00 | 0.806 | -79.9 | 2.825 | 120.8 | 0.178 | 41.8 | 0.801 | -38.3 |
| 600.00 | 0.760 | -92.6 | 2.598 | 111.3 | 0.198 | 37.0 | 0.744 | -43.5 |
| 700.00 | 0.722 | -104.8 | 2.419 | 103.0 | 0.209 | 31.0 | 0.702 | -47.8 |
| 800.00 | 0.695 | -116.4 | 2.238 | 95.5 | 0.221 | 25.2 | 0.646 | -51.5 |
| 900.00 | 0.670 | -127.6 | 2.102 | 87.9 | 0.223 | 20.9 | 0.615 | -55.8 |
| 1000.00 | 0.643 | -137.1 | 1.932 | 81.4 | 0.224 | 18.6 | 0.575 | -58.7 |
| 1100.00 | 0.631 | -147.2 | 1.820 | 75.3 | 0.230 | 14.2 | 0.544 | -62.1 |
| 1200.00 | 0.626 | -155.6 | 1.695 | 69.8 | 0.222 | 10.8 | 0.520 | -66.3 |
| 1300.00 | 0.627 | -164.2 | 1.611 | 64.4 | 0.222 | 8.4 | 0.497 | -69.0 |
| 1400.00 | 0.623 | -172.5 | 1.518 | 58.6 | 0.217 | 7.0 | 0.482 | -72.9 |
| 1500.00 | 0.628 | -179.3 | 1.432 | 54.0 | 0.217 | 2.9 | 0.468 | -75.9 |
| 1600.00 | 0.630 | 175.7 | 1.364 | 49.7 | 0.212 | 2.0 | 0.450 | -80.1 |
| 1700.00 | 0.625 | 168.3 | 1.280 | 45.0 | 0.202 | 1.0 | 0.442 | -82.8 |
| 1800.00 | 0.629 | 162.8 | 1.223 | 41.3 | 0.201 | 0.0 | 0.433 | -88.1 |
| 1900.00 | 0.629 | 157.5 | 1.168 | 37.2 | 0.190 | -1.6 | 0.417 | -89.2 |
| 2000.00 | 0.634 | 152.4 | 1.112 | 33.4 | 0.189 | -0.7 | 0.419 | -94.2 |

$V_{CE} = 1\text{ V}$, $I_c = 3\text{ mA}$, $Z_o = 50\ \Omega$

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.886 | -28.0 | 9.515 | 159.3 | 0.044 | 74.9 | 0.943 | -17.6 |
| 200.00 | 0.809 | -54.2 | 8.567 | 141.9 | 0.078 | 64.0 | 0.847 | -32.1 |
| 300.00 | 0.734 | -75.4 | 7.425 | 128.1 | 0.103 | 52.3 | 0.734 | -44.8 |
| 400.00 | 0.661 | -94.8 | 6.367 | 116.2 | 0.122 | 44.4 | 0.630 | -53.5 |
| 500.00 | 0.608 | -110.6 | 5.529 | 106.7 | 0.130 | 39.1 | 0.547 | -61.0 |
| 600.00 | 0.568 | -124.2 | 4.813 | 98.7 | 0.136 | 35.6 | 0.484 | -66.5 |
| 700.00 | 0.544 | -136.4 | 4.278 | 92.0 | 0.144 | 33.4 | 0.434 | -70.6 |
| 800.00 | 0.531 | -147.4 | 3.841 | 86.0 | 0.145 | 30.7 | 0.381 | -76.2 |
| 900.00 | 0.520 | -157.3 | 3.473 | 80.1 | 0.152 | 30.1 | 0.350 | -78.8 |
| 1000.00 | 0.517 | -165.2 | 3.151 | 75.3 | 0.160 | 29.5 | 0.316 | -83.6 |
| 1100.00 | 0.506 | 174.0 | 2.905 | 70.6 | 0.163 | 27.3 | 0.293 | -89.0 |
| 1200.00 | 0.511 | 179.5 | 2.670 | 66.4 | 0.166 | 26.0 | 0.270 | -92.9 |
| 1300.00 | 0.520 | 172.5 | 2.506 | 61.9 | 0.168 | 26.8 | 0.253 | -98.5 |
| 1400.00 | 0.526 | 166.5 | 2.330 | 57.6 | 0.170 | 26.3 | 0.250 | -101.9 |
| 1500.00 | 0.533 | 161.0 | 2.181 | 53.8 | 0.173 | 25.8 | 0.233 | -106.6 |
| 1600.00 | 0.532 | 157.2 | 2.054 | 50.6 | 0.177 | 26.1 | 0.228 | -112.2 |
| 1700.00 | 0.543 | 151.0 | 1.921 | 47.0 | 0.181 | 23.7 | 0.219 | -117.6 |
| 1800.00 | 0.553 | 146.8 | 1.834 | 43.6 | 0.187 | 22.5 | 0.223 | -124.8 |
| 1900.00 | 0.563 | 143.0 | 1.734 | 40.4 | 0.191 | 24.6 | 0.201 | -127.3 |
| 2000.00 | 0.566 | 138.0 | 1.661 | 37.2 | 0.192 | 24.9 | 0.208 | -133.2 |

V_{CE} = 1 V, I_c = 5 mA, Z_o = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.823 | -37.1 | 13.981 | 153.6 | 0.044 | 70.4 | 0.904 | -25.0 |
| 200.00 | 0.715 | -68.3 | 11.672 | 133.5 | 0.073 | 56.9 | 0.762 | -43.3 |
| 300.00 | 0.633 | -92.2 | 9.511 | 119.4 | 0.086 | 48.9 | 0.612 | -58.0 |
| 400.00 | 0.566 | -112.0 | 7.794 | 108.2 | 0.103 | 43.7 | 0.508 | -66.4 |
| 500.00 | 0.525 | -127.9 | 6.574 | 99.7 | 0.106 | 41.1 | 0.427 | -74.9 |
| 600.00 | 0.504 | -141.1 | 5.620 | 92.7 | 0.114 | 39.9 | 0.367 | -81.4 |
| 700.00 | 0.487 | -152.3 | 4.927 | 86.7 | 0.121 | 39.5 | 0.331 | -86.5 |
| 800.00 | 0.483 | -161.7 | 4.373 | 81.5 | 0.132 | 37.8 | 0.286 | -93.8 |
| 900.00 | 0.477 | -171.1 | 3.928 | 76.6 | 0.132 | 36.2 | 0.261 | -99.0 |
| 1000.00 | 0.482 | -177.9 | 3.550 | 72.3 | 0.141 | 37.9 | 0.240 | -101.7 |
| 1100.00 | 0.483 | 174.7 | 3.252 | 68.1 | 0.144 | 36.4 | 0.222 | -110.7 |
| 1200.00 | 0.487 | 169.3 | 2.984 | 64.5 | 0.153 | 36.8 | 0.210 | -115.2 |
| 1300.00 | 0.496 | 163.0 | 2.794 | 60.3 | 0.161 | 36.4 | 0.190 | -121.5 |
| 1400.00 | 0.504 | 157.9 | 2.590 | 56.4 | 0.169 | 35.1 | 0.199 | -127.7 |
| 1500.00 | 0.521 | 152.8 | 2.420 | 52.8 | 0.175 | 35.4 | 0.188 | -132.5 |
| 1600.00 | 0.524 | 150.2 | 2.282 | 49.9 | 0.181 | 33.1 | 0.184 | -139.9 |
| 1700.00 | 0.529 | 144.0 | 2.127 | 46.6 | 0.191 | 32.0 | 0.174 | -146.3 |
| 1800.00 | 0.540 | 141.0 | 2.031 | 43.5 | 0.201 | 30.6 | 0.199 | -152.2 |
| 1900.00 | 0.547 | 137.1 | 1.913 | 40.5 | 0.204 | 30.3 | 0.180 | -161.7 |
| 2000.00 | 0.551 | 133.2 | 1.829 | 37.7 | 0.202 | 31.4 | 0.184 | -163.4 |

V_{CE} = 1 V, I_c = 7 mA, Z_o = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.741 | -46.4 | 17.962 | 148.1 | 0.038 | 63.9 | 0.844 | -31.3 |
| 200.00 | 0.630 | -81.9 | 13.958 | 126.6 | 0.064 | 55.5 | 0.671 | -53.0 |
| 300.00 | 0.554 | -106.4 | 10.862 | 112.9 | 0.077 | 47.6 | 0.524 | -68.1 |
| 400.00 | 0.506 | -126.3 | 8.635 | 102.7 | 0.087 | 44.3 | 0.416 | -77.7 |
| 500.00 | 0.475 | -141.7 | 7.161 | 95.2 | 0.096 | 43.7 | 0.352 | -86.7 |
| 600.00 | 0.465 | -153.6 | 6.072 | 88.9 | 0.105 | 43.5 | 0.303 | -95.3 |
| 700.00 | 0.462 | -163.4 | 5.283 | 83.6 | 0.111 | 43.4 | 0.267 | -100.2 |
| 800.00 | 0.458 | -172.3 | 4.672 | 78.9 | 0.121 | 43.2 | 0.233 | -108.2 |
| 900.00 | 0.462 | -179.7 | 4.168 | 74.3 | 0.127 | 42.7 | 0.214 | -113.6 |
| 1000.00 | 0.465 | 173.6 | 3.769 | 70.5 | 0.135 | 44.4 | 0.199 | -120.9 |
| 1100.00 | 0.466 | 167.5 | 3.443 | 66.6 | 0.139 | 41.7 | 0.190 | -129.1 |
| 1200.00 | 0.477 | 162.8 | 3.161 | 63.2 | 0.156 | 42.0 | 0.195 | -136.0 |
| 1300.00 | 0.490 | 156.6 | 2.954 | 59.3 | 0.161 | 42.1 | 0.181 | -142.3 |
| 1400.00 | 0.501 | 152.0 | 2.728 | 55.6 | 0.171 | 40.3 | 0.181 | -147.5 |
| 1500.00 | 0.509 | 147.8 | 2.551 | 52.4 | 0.184 | 38.7 | 0.190 | -153.3 |
| 1600.00 | 0.516 | 145.1 | 2.398 | 49.4 | 0.183 | 39.4 | 0.188 | -162.7 |
| 1700.00 | 0.520 | 140.0 | 2.235 | 46.3 | 0.198 | 36.7 | 0.188 | -165.2 |
| 1800.00 | 0.530 | 137.3 | 2.133 | 43.4 | 0.202 | 36.3 | 0.205 | -173.6 |
| 1900.00 | 0.547 | 133.1 | 2.014 | 40.4 | 0.208 | 34.6 | 0.196 | -178.2 |
| 2000.00 | 0.546 | 129.5 | 1.912 | 37.6 | 0.212 | 34.8 | 0.199 | -179.5 |

V_{CE} = 1 V, I_c = 10 mA, Z_o = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.676 | -56.3 | 21.704 | 142.6 | 0.038 | 66.7 | 0.798 | -38.5 |
| 200.00 | 0.561 | -95.4 | 15.685 | 120.5 | 0.058 | 54.2 | 0.593 | -62.6 |
| 300.00 | 0.498 | -120.2 | 11.740 | 107.7 | 0.069 | 50.1 | 0.443 | -78.3 |
| 400.00 | 0.467 | -138.8 | 9.163 | 98.5 | 0.077 | 46.5 | 0.350 | -88.7 |
| 500.00 | 0.453 | -152.8 | 7.523 | 91.7 | 0.085 | 48.5 | 0.304 | -99.0 |
| 600.00 | 0.452 | -163.7 | 6.335 | 86.0 | 0.094 | 48.3 | 0.260 | -107.8 |
| 700.00 | 0.449 | -172.6 | 5.494 | 81.2 | 0.106 | 49.4 | 0.231 | -114.9 |
| 800.00 | 0.452 | 179.8 | 4.847 | 76.8 | 0.119 | 47.6 | 0.213 | -123.1 |
| 900.00 | 0.451 | 172.9 | 4.318 | 72.6 | 0.123 | 47.7 | 0.194 | -131.3 |
| 1000.00 | 0.458 | 167.1 | 3.891 | 69.1 | 0.136 | 47.0 | 0.188 | -135.6 |
| 1100.00 | 0.467 | 161.4 | 3.550 | 65.3 | 0.146 | 46.9 | 0.189 | -145.9 |
| 1200.00 | 0.476 | 157.5 | 3.251 | 62.2 | 0.155 | 45.1 | 0.187 | -152.3 |
| 1300.00 | 0.482 | 152.5 | 3.045 | 58.5 | 0.164 | 45.0 | 0.185 | -158.8 |
| 1400.00 | 0.502 | 148.6 | 2.809 | 54.8 | 0.173 | 44.0 | 0.198 | -161.4 |
| 1500.00 | 0.507 | 144.6 | 2.638 | 51.8 | 0.181 | 43.0 | 0.194 | -170.2 |
| 1600.00 | 0.512 | 142.1 | 2.471 | 49.0 | 0.191 | 41.3 | 0.205 | -174.3 |
| 1700.00 | 0.527 | 137.6 | 2.310 | 45.9 | 0.197 | 39.2 | 0.212 | -178.3 |
| 1800.00 | 0.527 | 133.8 | 2.196 | 43.6 | 0.209 | 38.1 | 0.228 | 177.2 |
| 1900.00 | 0.543 | 130.8 | 2.065 | 40.6 | 0.217 | 37.3 | 0.224 | 169.1 |
| 2000.00 | 0.545 | 126.7 | 1.974 | 38.1 | 0.223 | 35.5 | 0.234 | 168.6 |

V_{CE} = 3 V, I_c = 1 mA, Z_o = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.965 | -14.8 | 3.499 | 168.1 | 0.034 | 82.6 | 0.987 | -6.7 |
| 200.00 | 0.944 | -29.7 | 3.439 | 157.3 | 0.066 | 72.1 | 0.969 | -13.1 |
| 300.00 | 0.916 | -43.8 | 3.305 | 147.1 | 0.093 | 64.7 | 0.940 | -19.3 |
| 400.00 | 0.868 | -57.8 | 3.130 | 136.5 | 0.116 | 55.3 | 0.898 | -24.8 |
| 500.00 | 0.831 | -71.2 | 2.978 | 126.8 | 0.136 | 48.8 | 0.855 | -29.8 |
| 600.00 | 0.785 | -83.5 | 2.769 | 117.8 | 0.150 | 41.7 | 0.816 | -34.8 |
| 700.00 | 0.742 | -95.4 | 2.610 | 109.8 | 0.167 | 37.0 | 0.778 | -37.8 |
| 800.00 | 0.712 | -106.8 | 2.435 | 102.4 | 0.172 | 32.5 | 0.728 | -41.7 |
| 900.00 | 0.685 | -117.6 | 2.307 | 95.0 | 0.180 | 26.4 | 0.703 | -44.6 |
| 1000.00 | 0.656 | -127.8 | 2.133 | 88.3 | 0.183 | 22.1 | 0.667 | -47.4 |
| 1100.00 | 0.641 | -137.8 | 2.029 | 82.3 | 0.182 | 19.2 | 0.637 | -50.3 |
| 1200.00 | 0.631 | -146.7 | 1.881 | 76.7 | 0.180 | 16.9 | 0.609 | -53.6 |
| 1300.00 | 0.625 | -155.8 | 1.801 | 71.4 | 0.179 | 13.1 | 0.592 | -56.1 |
| 1400.00 | 0.622 | -164.7 | 1.703 | 65.7 | 0.176 | 9.9 | 0.577 | -59.2 |
| 1500.00 | 0.627 | -172.0 | 1.605 | 61.0 | 0.176 | 9.6 | 0.561 | -61.7 |
| 1600.00 | 0.622 | -177.2 | 1.520 | 56.3 | 0.170 | 9.2 | 0.543 | -64.7 |
| 1700.00 | 0.623 | 174.5 | 1.434 | 51.9 | 0.167 | 6.5 | 0.531 | -67.1 |
| 1800.00 | 0.615 | 168.2 | 1.369 | 48.1 | 0.166 | 7.6 | 0.516 | -71.0 |
| 1900.00 | 0.621 | 162.9 | 1.310 | 44.2 | 0.159 | 6.4 | 0.505 | -73.2 |
| 2000.00 | 0.618 | 157.0 | 1.257 | 39.8 | 0.157 | 6.8 | 0.505 | -74.4 |

V_{CE} = 3 V, I_c = 3 mA, Z_O = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.898 | -23.3 | 9.607 | 162.0 | 0.033 | 75.5 | 0.956 | -13.1 |
| 200.00 | 0.834 | -45.3 | 8.890 | 146.4 | 0.059 | 65.2 | 0.892 | -24.3 |
| 300.00 | 0.758 | -64.2 | 7.932 | 133.5 | 0.081 | 54.5 | 0.801 | -33.8 |
| 400.00 | 0.682 | -82.0 | 6.964 | 121.9 | 0.095 | 49.4 | 0.711 | -40.6 |
| 500.00 | 0.623 | -97.2 | 6.174 | 112.4 | 0.105 | 44.9 | 0.636 | -46.5 |
| 600.00 | 0.570 | -110.9 | 5.436 | 104.2 | 0.110 | 41.7 | 0.573 | -50.9 |
| 700.00 | 0.533 | -122.3 | 4.874 | 97.3 | 0.120 | 37.4 | 0.522 | -54.1 |
| 800.00 | 0.511 | -134.8 | 4.398 | 91.2 | 0.122 | 35.7 | 0.474 | -56.7 |
| 900.00 | 0.493 | -145.1 | 4.012 | 85.4 | 0.127 | 33.8 | 0.443 | -59.2 |
| 1000.00 | 0.477 | -153.9 | 3.648 | 80.2 | 0.132 | 31.9 | 0.407 | -61.6 |
| 1100.00 | 0.477 | -163.5 | 3.380 | 75.5 | 0.136 | 33.6 | 0.383 | -64.3 |
| 1200.00 | 0.471 | -170.6 | 3.099 | 71.2 | 0.137 | 31.5 | 0.357 | -66.9 |
| 1300.00 | 0.479 | -178.8 | 2.915 | 66.9 | 0.141 | 32.2 | 0.337 | -69.8 |
| 1400.00 | 0.486 | 174.1 | 2.724 | 62.7 | 0.149 | 30.1 | 0.325 | -72.3 |
| 1500.00 | 0.492 | 167.4 | 2.554 | 58.6 | 0.149 | 30.6 | 0.311 | -75.4 |
| 1600.00 | 0.493 | 164.1 | 2.399 | 55.3 | 0.152 | 29.4 | 0.298 | -79.1 |
| 1700.00 | 0.498 | 156.6 | 2.247 | 51.7 | 0.164 | 31.3 | 0.290 | -80.7 |
| 1800.00 | 0.503 | 152.4 | 2.144 | 48.2 | 0.165 | 29.4 | 0.274 | -89.1 |
| 1900.00 | 0.513 | 148.8 | 2.032 | 44.9 | 0.169 | 30.0 | 0.253 | -88.2 |
| 2000.00 | 0.519 | 143.3 | 1.944 | 41.8 | 0.170 | 29.8 | 0.250 | -91.9 |

V_{CE} = 3 V, I_c = 5 mA, Z_O = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.839 | -29.8 | 14.278 | 157.2 | 0.031 | 77.2 | 0.935 | -17.7 |
| 200.00 | 0.736 | -56.5 | 12.457 | 138.9 | 0.053 | 65.0 | 0.819 | -31.9 |
| 300.00 | 0.651 | -77.6 | 10.528 | 125.1 | 0.071 | 56.2 | 0.694 | -42.5 |
| 400.00 | 0.568 | -96.3 | 8.837 | 113.9 | 0.081 | 48.5 | 0.594 | -48.9 |
| 500.00 | 0.515 | -111.8 | 7.559 | 105.1 | 0.091 | 46.6 | 0.515 | -54.8 |
| 600.00 | 0.471 | -125.7 | 6.524 | 97.8 | 0.094 | 44.8 | 0.452 | -58.9 |
| 700.00 | 0.445 | -137.6 | 5.768 | 91.7 | 0.101 | 41.4 | 0.408 | -61.3 |
| 800.00 | 0.436 | -148.3 | 5.134 | 86.4 | 0.107 | 41.0 | 0.363 | -64.6 |
| 900.00 | 0.422 | -158.6 | 4.637 | 81.3 | 0.112 | 40.5 | 0.335 | -66.8 |
| 1000.00 | 0.421 | -166.4 | 4.199 | 76.8 | 0.120 | 40.8 | 0.308 | -69.0 |
| 1100.00 | 0.416 | 175.0 | 3.864 | 72.8 | 0.123 | 40.9 | 0.281 | -71.7 |
| 1200.00 | 0.422 | 178.6 | 3.540 | 68.9 | 0.136 | 41.3 | 0.263 | -75.9 |
| 1300.00 | 0.430 | 171.7 | 3.320 | 64.9 | 0.142 | 40.1 | 0.245 | -80.3 |
| 1400.00 | 0.439 | 165.9 | 3.085 | 61.1 | 0.145 | 40.3 | 0.241 | -81.6 |
| 1500.00 | 0.451 | 159.6 | 2.888 | 57.6 | 0.154 | 40.3 | 0.227 | -86.3 |
| 1600.00 | 0.457 | 156.3 | 2.718 | 54.6 | 0.157 | 38.4 | 0.211 | -90.4 |
| 1700.00 | 0.464 | 149.7 | 2.539 | 51.2 | 0.164 | 37.3 | 0.202 | -92.0 |
| 1800.00 | 0.467 | 145.7 | 2.410 | 48.2 | 0.170 | 36.8 | 0.194 | -102.8 |
| 1900.00 | 0.483 | 141.5 | 2.286 | 45.1 | 0.173 | 36.1 | 0.172 | -102.5 |
| 2000.00 | 0.485 | 137.6 | 2.183 | 42.0 | 0.181 | 35.6 | 0.173 | -107.3 |

V_{CE} = 3 V, I_c = 7 mA, Z_O = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.769 | -35.8 | 18.610 | 152.6 | 0.026 | 73.9 | 0.890 | -22.5 |
| 200.00 | 0.658 | -66.3 | 15.310 | 132.5 | 0.051 | 59.8 | 0.743 | -38.5 |
| 300.00 | 0.561 | -88.8 | 12.331 | 118.8 | 0.061 | 53.2 | 0.604 | -49.4 |
| 400.00 | 0.485 | -107.9 | 10.032 | 108.3 | 0.071 | 51.0 | 0.504 | -55.6 |
| 500.00 | 0.444 | -124.0 | 8.438 | 100.3 | 0.076 | 48.0 | 0.423 | -60.5 |
| 600.00 | 0.411 | -137.7 | 7.186 | 93.6 | 0.084 | 49.0 | 0.371 | -64.1 |
| 700.00 | 0.397 | -148.5 | 6.299 | 88.2 | 0.093 | 46.8 | 0.327 | -66.8 |
| 800.00 | 0.395 | -158.2 | 5.583 | 83.4 | 0.101 | 47.6 | 0.290 | -70.2 |
| 900.00 | 0.386 | -167.9 | 5.020 | 78.8 | 0.106 | 48.0 | 0.268 | -73.3 |
| 1000.00 | 0.389 | -175.7 | 4.526 | 74.7 | 0.118 | 44.9 | 0.245 | -75.7 |
| 1100.00 | 0.392 | 176.0 | 4.151 | 70.8 | 0.126 | 44.6 | 0.226 | -79.4 |
| 1200.00 | 0.396 | 170.9 | 3.801 | 67.5 | 0.131 | 45.8 | 0.203 | -83.8 |
| 1300.00 | 0.404 | 164.8 | 3.555 | 63.7 | 0.140 | 44.1 | 0.195 | -87.1 |
| 1400.00 | 0.417 | 158.7 | 3.304 | 60.1 | 0.150 | 45.1 | 0.189 | -92.1 |
| 1500.00 | 0.426 | 153.6 | 3.091 | 56.6 | 0.157 | 45.6 | 0.177 | -96.9 |
| 1600.00 | 0.432 | 151.9 | 2.906 | 53.9 | 0.162 | 42.7 | 0.168 | -103.4 |
| 1700.00 | 0.443 | 145.2 | 2.712 | 50.6 | 0.173 | 41.8 | 0.160 | -106.6 |
| 1800.00 | 0.446 | 141.4 | 2.588 | 48.1 | 0.179 | 41.6 | 0.157 | -115.7 |
| 1900.00 | 0.466 | 137.6 | 2.435 | 45.2 | 0.182 | 41.7 | 0.141 | -120.9 |
| 2000.00 | 0.470 | 133.4 | 2.339 | 42.2 | 0.192 | 37.3 | 0.146 | -125.3 |

V_{CE} = 3 V, I_c = 10 mA, Z_O = 50 Ω

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.698 | -42.9 | 22.901 | 147.9 | 0.025 | 67.3 | 0.849 | -26.9 |
| 200.00 | 0.570 | -77.2 | 17.709 | 126.7 | 0.042 | 60.5 | 0.666 | -44.8 |
| 300.00 | 0.482 | -100.1 | 13.726 | 113.5 | 0.055 | 53.5 | 0.527 | -55.1 |
| 400.00 | 0.424 | -119.5 | 10.922 | 103.8 | 0.066 | 52.4 | 0.424 | -60.8 |
| 500.00 | 0.391 | -134.8 | 9.033 | 96.5 | 0.073 | 52.7 | 0.359 | -66.2 |
| 600.00 | 0.370 | -147.6 | 7.653 | 90.6 | 0.083 | 52.2 | 0.307 | -69.7 |
| 700.00 | 0.364 | -158.4 | 6.669 | 85.5 | 0.090 | 53.4 | 0.276 | -72.5 |
| 800.00 | 0.361 | -167.4 | 5.894 | 81.1 | 0.097 | 52.7 | 0.243 | -75.0 |
| 900.00 | 0.363 | -176.0 | 5.278 | 76.9 | 0.107 | 51.5 | 0.223 | -79.0 |
| 1000.00 | 0.366 | 177.1 | 4.764 | 73.1 | 0.113 | 50.6 | 0.201 | -79.3 |
| 1100.00 | 0.368 | 170.5 | 4.356 | 69.6 | 0.123 | 50.9 | 0.182 | -85.7 |
| 1200.00 | 0.378 | 165.3 | 3.992 | 66.4 | 0.129 | 50.8 | 0.174 | -94.5 |
| 1300.00 | 0.391 | 159.7 | 3.733 | 62.8 | 0.138 | 49.8 | 0.156 | -96.1 |
| 1400.00 | 0.402 | 154.4 | 3.461 | 59.4 | 0.151 | 47.6 | 0.158 | -101.5 |
| 1500.00 | 0.417 | 150.4 | 3.221 | 56.2 | 0.162 | 47.2 | 0.149 | -107.4 |
| 1600.00 | 0.420 | 147.3 | 3.035 | 53.6 | 0.164 | 46.2 | 0.138 | -117.4 |
| 1700.00 | 0.431 | 142.1 | 2.831 | 50.6 | 0.172 | 44.9 | 0.135 | -120.2 |
| 1800.00 | 0.434 | 138.4 | 2.703 | 47.7 | 0.179 | 44.2 | 0.142 | -130.9 |
| 1900.00 | 0.454 | 135.4 | 2.547 | 45.0 | 0.189 | 43.0 | 0.126 | -137.6 |
| 2000.00 | 0.461 | 130.8 | 2.434 | 42.1 | 0.196 | 40.8 | 0.127 | -143.0 |

[MEMO]

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