

MICROWAVE LOW NOISE AMPLIFIER
NPN SILICON EPITAXIAL TRANSISTOR
SUPER MINI MOLD

DESCRIPTION

The 2SC4225 is an NPN silicon epitaxial transistor designed for low noise amplifier at VHF through UHF band.

It has large dynamic range and good current characteristics.

FEATURES

- Low Noise and High Gain

NF = 1.5 dB TYP. at $V_{CE} = 10\text{ V}$, $I_c = 5\text{ mA}$, $f = 1\text{ GHz}$

$|S_{21e}|^2 = 10\text{ dB TYP.}$ at $V_{CE} = 10\text{ V}$, $I_c = 20\text{ mA}$, $f = 1\text{ GHz}$
(reference value)

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

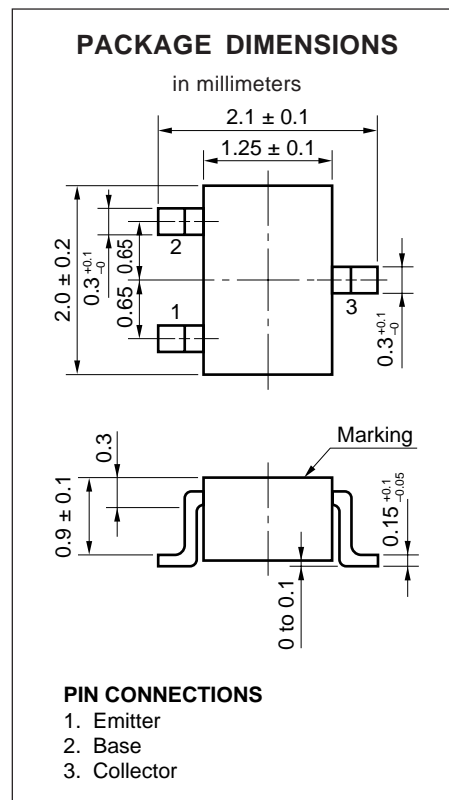
| | | | |
|------------------------------|-----------|-------------|------------------|
| Collector to Base Voltage | V_{CB0} | 25 | V |
| Collector to Emitter Voltage | V_{CE0} | 12 | V |
| Emitter to Base Voltage | V_{EB0} | 3.0 | V |
| Collector Current | I_c | 70 | mA |
| Total Power Dissipation | P_T | 160 | mW |
| Junction Temperature | T_j | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -65 to +150 | $^\circ\text{C}$ |

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

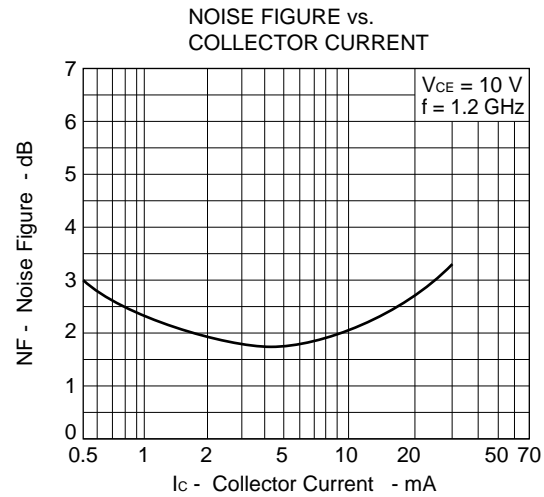
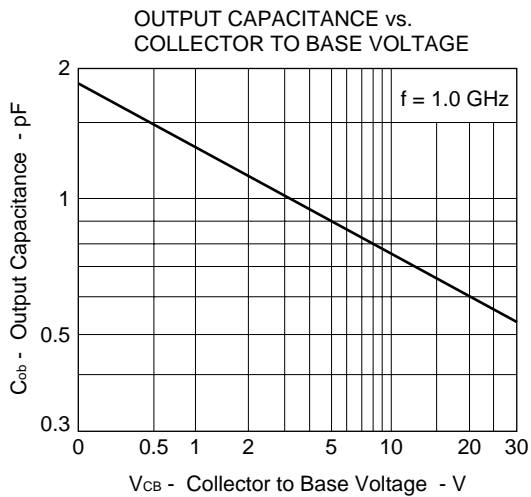
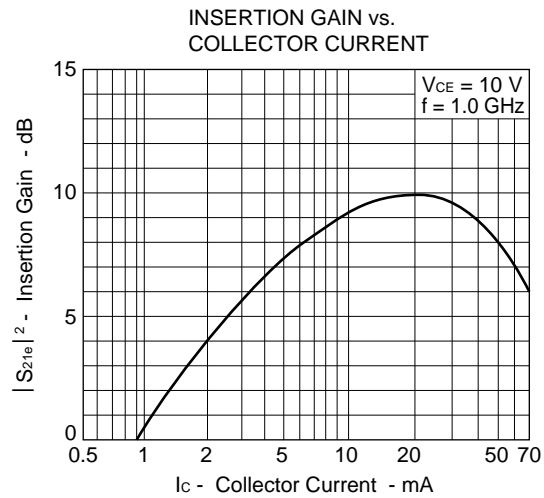
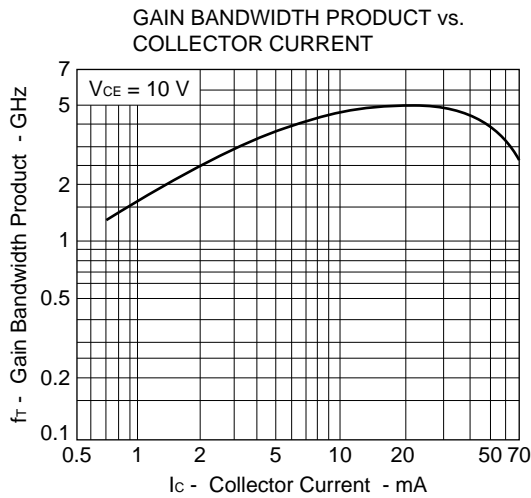
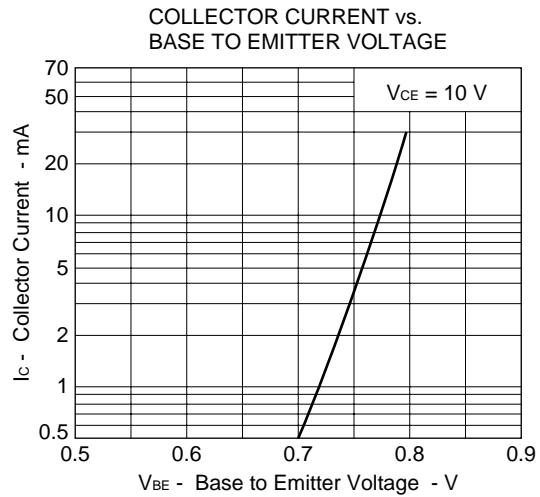
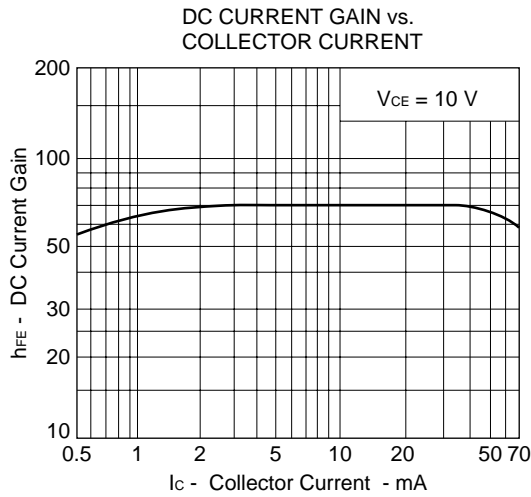
| Characteristics | Symbol | MIN. | TYP. | MAX. | Unit | Test Conditions |
|--------------------------|---------------|------|------|------|---------------|---|
| Collector Cutoff Current | I_{CB0} | | | 1.0 | μA | $V_{CB} = 10\text{ V}$, $I_E = 0$ |
| Emitter Cutoff Current | I_{EB0} | | | 1.0 | μA | $V_{EB} = 2\text{ V}$, $I_c = 0$ |
| DC Current Gain | h_{FE} | 40 | 80 | 200 | | $V_{CE} = 3\text{ V}$, $I_c = 20\text{ mA}$, pulsed |
| Gain Bandwidth Product | f_T | | 4 | | GHz | $V_{CE} = 3\text{ V}$, $I_c = 20\text{ mA}$, $f = 1\text{ GHz}$ |
| Output Capacitance | C_{ob} | | 1.2 | 1.8 | pF | $V_{CB} = 3\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$ |
| Insertion Power Gain | $ S_{21e} ^2$ | 7.5 | 9.0 | | dB | $V_{CE} = 3\text{ V}$, $I_c = 20\text{ mA}$, $f = 1\text{ GHz}$ |
| Noise Figure | NF | | 1.5 | 3.0 | dB | $V_{CE} = 3\text{ V}$, $I_c = 5\text{ mA}$, $f = 1\text{ GHz}$ |

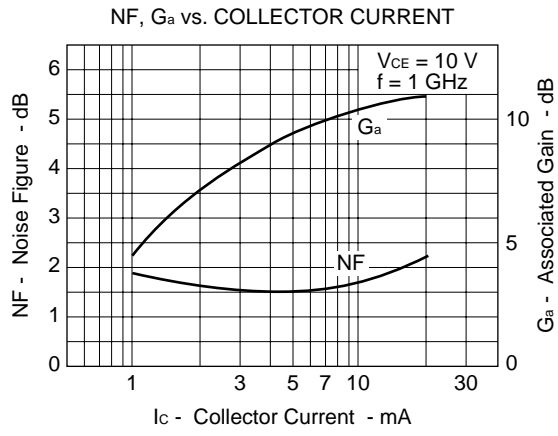
h_{FE} Classifications

| | | |
|----------|-----------|------------|
| Rank | R2 | R3 |
| Marking | R2 | R3 |
| h_{FE} | 40 to 120 | 100 to 200 |



TYPICAL CHARACTERISTICS (T_A = 25 °C)





S-PARAMETER

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

| Frequency MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|-------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.843 | -40.1 | 8.958 | 150.1 | 0.058 | 71.5 | 0.917 | -22.9 |
| 200.00 | 0.718 | -70.6 | 7.260 | 129.1 | 0.091 | 56.8 | 0.752 | -37.6 |
| 300.00 | 0.594 | -94.7 | 5.738 | 113.1 | 0.113 | 47.2 | 0.600 | -48.3 |
| 400.00 | 0.525 | -112.6 | 4.674 | 103.7 | 0.124 | 45.2 | 0.495 | -52.9 |
| 500.00 | 0.484 | -127.3 | 3.900 | 95.2 | 0.131 | 42.4 | 0.413 | -55.8 |
| 600.00 | 0.462 | -140.8 | 3.448 | 90.4 | 0.142 | 43.3 | 0.365 | -57.6 |
| 700.00 | 0.442 | -152.7 | 3.124 | 82.8 | 0.149 | 42.6 | 0.325 | -58.8 |
| 800.00 | 0.432 | -161.9 | 2.834 | 78.4 | 0.160 | 42.9 | 0.301 | -61.0 |
| 900.00 | 0.427 | -169.2 | 2.501 | 72.7 | 0.165 | 45.0 | 0.278 | -63.3 |
| 1000.00 | 0.440 | -176.6 | 2.307 | 68.2 | 0.174 | 44.8 | 0.257 | -66.7 |
| 1100.00 | 0.452 | 175.9 | 2.115 | 64.9 | 0.184 | 47.4 | 0.239 | -70.2 |
| 1200.00 | 0.453 | 167.6 | 1.987 | 60.0 | 0.198 | 46.8 | 0.220 | -73.4 |
| 1300.00 | 0.449 | 162.2 | 1.895 | 56.1 | 0.213 | 46.9 | 0.207 | -77.4 |
| 1400.00 | 0.446 | 158.3 | 1.726 | 52.3 | 0.216 | 46.2 | 0.192 | -81.7 |
| 1500.00 | 0.465 | 154.7 | 1.627 | 47.4 | 0.226 | 45.3 | 0.185 | -86.6 |
| 1600.00 | 0.483 | 151.1 | 1.527 | 46.8 | 0.234 | 47.9 | 0.179 | -92.9 |
| 1700.00 | 0.498 | 145.6 | 1.437 | 44.1 | 0.244 | 47.4 | 0.173 | -99.7 |
| 1800.00 | 0.512 | 141.5 | 1.431 | 41.9 | 0.262 | 49.2 | 0.167 | -109.1 |
| 1900.00 | 0.516 | 138.1 | 1.381 | 38.8 | 0.279 | 47.9 | 0.163 | -116.6 |
| 2000.00 | 0.528 | 135.1 | 1.363 | 33.5 | 0.296 | 46.2 | 0.162 | -123.7 |

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

| Frequency MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.583 | -73.8 | 18.505 | 129.9 | 0.042 | 64.4 | 0.710 | -44.7 |
| 200.00 | 0.453 | -112.7 | 11.723 | 108.7 | 0.059 | 57.2 | 0.451 | -61.0 |
| 300.00 | 0.388 | -136.1 | 8.269 | 96.9 | 0.077 | 56.3 | 0.315 | -69.6 |
| 400.00 | 0.367 | -151.2 | 6.297 | 90.6 | 0.090 | 59.0 | 0.240 | -73.6 |
| 500.00 | 0.363 | -162.6 | 5.086 | 85.0 | 0.103 | 59.3 | 0.191 | -76.3 |
| 600.00 | 0.363 | -172.6 | 4.407 | 82.2 | 0.120 | 61.9 | 0.161 | -78.8 |
| 700.00 | 0.360 | 178.7 | 3.802 | 76.4 | 0.136 | 61.0 | 0.138 | -82.2 |
| 800.00 | 0.360 | 173.2 | 3.468 | 73.4 | 0.155 | 60.6 | 0.121 | -87.2 |
| 900.00 | 0.364 | 168.8 | 3.104 | 69.3 | 0.167 | 61.2 | 0.107 | -93.1 |
| 1000.00 | 0.384 | 164.4 | 2.846 | 65.9 | 0.184 | 59.4 | 0.095 | -101.3 |
| 1100.00 | 0.401 | 159.4 | 2.595 | 63.5 | 0.199 | 60.3 | 0.085 | -109.7 |
| 1200.00 | 0.407 | 152.9 | 2.426 | 59.5 | 0.217 | 58.1 | 0.080 | -120.3 |
| 1300.00 | 0.408 | 148.8 | 2.311 | 56.0 | 0.237 | 56.9 | 0.078 | -130.6 |
| 1400.00 | 0.408 | 146.0 | 2.093 | 52.9 | 0.244 | 55.1 | 0.089 | -142.6 |
| 1500.00 | 0.426 | 143.6 | 1.962 | 48.5 | 0.259 | 52.8 | 0.084 | -151.9 |
| 1600.00 | 0.442 | 141.2 | 1.840 | 48.4 | 0.268 | 54.0 | 0.091 | -160.6 |
| 1700.00 | 0.458 | 137.3 | 1.732 | 46.3 | 0.282 | 52.3 | 0.103 | -169.0 |
| 1800.00 | 0.473 | 134.2 | 1.714 | 44.3 | 0.301 | 52.9 | 0.117 | -177.8 |
| 1900.00 | 0.480 | 131.5 | 1.651 | 41.5 | 0.320 | 50.5 | 0.128 | 176.1 |
| 2000.00 | 0.493 | 129.0 | 1.626 | 36.4 | 0.338 | 47.9 | 0.139 | 172.1 |

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

| Frequency MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|-------|-------|-------|------|-------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.852 | -36.9 | 9.015 | 151.8 | 0.051 | 73.0 | 0.928 | -19.9 |
| 200.00 | 0.730 | -65.3 | 7.451 | 131.5 | 0.081 | 58.9 | 0.781 | -32.7 |
| 300.00 | 0.601 | -88.5 | 5.983 | 115.8 | 0.103 | 49.3 | 0.638 | -42.4 |
| 400.00 | 0.526 | -105.8 | 4.912 | 106.4 | 0.113 | 47.5 | 0.539 | -45.9 |
| 500.00 | 0.479 | -120.3 | 4.118 | 97.6 | 0.120 | 44.9 | 0.456 | -47.9 |
| 600.00 | 0.452 | -134.2 | 3.658 | 93.0 | 0.131 | 45.6 | 0.413 | -48.9 |
| 700.00 | 0.427 | -146.5 | 3.204 | 84.8 | 0.138 | 44.8 | 0.374 | -49.4 |
| 800.00 | 0.414 | -156.2 | 3.018 | 80.8 | 0.149 | 45.0 | 0.352 | -50.9 |
| 900.00 | 0.408 | -164.2 | 2.666 | 75.0 | 0.153 | 47.5 | 0.330 | -52.6 |
| 1000.00 | 0.417 | -172.1 | 2.456 | 70.5 | 0.162 | 47.4 | 0.309 | -55.4 |
| 1100.00 | 0.426 | 180.0 | 2.252 | 67.1 | 0.172 | 49.7 | 0.292 | -57.9 |
| 1200.00 | 0.426 | 171.3 | 2.115 | 62.4 | 0.184 | 49.4 | 0.270 | -60.5 |
| 1300.00 | 0.422 | 165.7 | 2.018 | 58.4 | 0.198 | 49.6 | 0.254 | -63.1 |
| 1400.00 | 0.420 | 161.6 | 1.834 | 54.7 | 0.202 | 49.4 | 0.239 | -66.0 |
| 1500.00 | 0.439 | 157.6 | 1.730 | 49.9 | 0.213 | 48.6 | 0.230 | -69.3 |
| 1600.00 | 0.455 | 153.8 | 1.625 | 49.2 | 0.220 | 51.3 | 0.222 | -73.7 |
| 1700.00 | 0.471 | 148.2 | 1.532 | 46.4 | 0.231 | 51.0 | 0.211 | -78.8 |
| 1800.00 | 0.485 | 143.8 | 1.523 | 44.2 | 0.249 | 52.8 | 0.199 | -85.9 |
| 1900.00 | 0.490 | 140.4 | 1.471 | 41.1 | 0.265 | 51.6 | 0.191 | -91.7 |
| 2000.00 | 0.501 | 137.2 | 1.450 | 35.8 | 0.283 | 50.0 | 0.184 | -97.9 |

V_{CE} = 5 V, I_c = 10 mA

| Frequency MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.596 | -66.5 | 19.076 | 132.3 | 0.039 | 66.0 | 0.741 | -38.6 |
| 200.00 | 0.446 | -103.7 | 12.382 | 110.9 | 0.056 | 58.8 | 0.493 | -52.0 |
| 300.00 | 0.370 | -127.5 | 8.801 | 98.8 | 0.070 | 57.5 | 0.355 | -57.7 |
| 400.00 | 0.337 | -143.6 | 6.728 | 92.4 | 0.083 | 60.3 | 0.280 | -58.6 |
| 500.00 | 0.327 | -155.8 | 5.466 | 86.7 | 0.096 | 60.7 | 0.229 | -58.4 |
| 600.00 | 0.323 | -166.6 | 4.732 | 84.0 | 0.112 | 63.3 | 0.202 | -58.1 |
| 700.00 | 0.320 | -176.1 | 4.073 | 78.2 | 0.126 | 62.3 | 0.178 | -58.2 |
| 800.00 | 0.321 | 177.6 | 3.720 | 75.0 | 0.145 | 62.3 | 0.161 | -59.6 |
| 900.00 | 0.323 | 172.7 | 3.202 | 70.8 | 0.157 | 63.1 | 0.147 | -61.9 |
| 1000.00 | 0.342 | 167.9 | 3.057 | 67.7 | 0.172 | 61.5 | 0.133 | -65.2 |
| 1100.00 | 0.358 | 162.4 | 2.792 | 65.2 | 0.187 | 62.1 | 0.118 | -68.9 |
| 1200.00 | 0.364 | 155.7 | 2.607 | 61.4 | 0.204 | 60.1 | 0.105 | -73.6 |
| 1300.00 | 0.366 | 151.4 | 2.479 | 57.8 | 0.222 | 59.2 | 0.095 | -79.7 |
| 1400.00 | 0.367 | 148.6 | 2.247 | 55.0 | 0.230 | 57.5 | 0.082 | -87.2 |
| 1500.00 | 0.385 | 145.9 | 2.110 | 50.7 | 0.244 | 55.3 | 0.077 | -95.8 |
| 1600.00 | 0.401 | 143.5 | 1.978 | 50.5 | 0.254 | 56.7 | 0.074 | -107.1 |
| 1700.00 | 0.417 | 139.5 | 1.862 | 48.3 | 0.267 | 55.1 | 0.072 | -120.6 |
| 1800.00 | 0.433 | 136.3 | 1.841 | 46.3 | 0.287 | 55.7 | 0.074 | -137.5 |
| 1900.00 | 0.441 | 133.6 | 1.779 | 43.5 | 0.305 | 53.3 | 0.079 | -149.6 |
| 2000.00 | 0.454 | 131.0 | 1.748 | 38.5 | 0.324 | 50.7 | 0.084 | -158.3 |

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

| Frequency MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|-------|-------|-------|------|-------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.875 | -33.4 | 9.048 | 153.5 | 0.043 | 73.6 | 0.939 | -16.6 |
| 200.00 | 0.754 | -59.7 | 7.600 | 134.2 | 0.070 | 60.9 | 0.812 | -27.2 |
| 300.00 | 0.618 | -81.5 | 6.193 | 118.5 | 0.090 | 51.8 | 0.683 | -35.4 |
| 400.00 | 0.537 | -97.9 | 5.145 | 109.1 | 0.100 | 49.8 | 0.592 | -37.9 |
| 500.00 | 0.480 | -112.0 | 4.332 | 100.3 | 0.107 | 47.1 | 0.513 | -39.2 |
| 600.00 | 0.446 | -126.0 | 3.866 | 95.6 | 0.117 | 47.9 | 0.475 | -39.6 |
| 700.00 | 0.415 | -138.4 | 3.396 | 87.4 | 0.123 | 47.4 | 0.440 | -39.5 |
| 800.00 | 0.395 | -148.8 | 3.208 | 83.4 | 0.133 | 47.8 | 0.422 | -40.8 |
| 900.00 | 0.386 | -157.5 | 2.834 | 77.4 | 0.138 | 50.4 | 0.404 | -41.7 |
| 1000.00 | 0.389 | -165.9 | 2.612 | 73.0 | 0.146 | 50.2 | 0.383 | -44.2 |
| 1100.00 | 0.395 | -174.5 | 2.395 | 69.7 | 0.155 | 53.0 | 0.367 | -46.3 |
| 1200.00 | 0.393 | 176.5 | 2.247 | 64.9 | 0.166 | 52.9 | 0.345 | -48.3 |
| 1300.00 | 0.390 | 170.4 | 2.141 | 61.1 | 0.179 | 53.3 | 0.328 | -49.9 |
| 1400.00 | 0.387 | 165.9 | 1.953 | 57.4 | 0.183 | 53.2 | 0.312 | -51.6 |
| 1500.00 | 0.405 | 161.7 | 1.837 | 52.7 | 0.194 | 52.7 | 0.302 | -53.7 |
| 1600.00 | 0.422 | 157.4 | 1.731 | 51.9 | 0.201 | 55.9 | 0.294 | -56.6 |
| 1700.00 | 0.436 | 151.6 | 1.633 | 49.2 | 0.212 | 55.4 | 0.283 | -60.1 |
| 1800.00 | 0.449 | 146.9 | 1.622 | 47.0 | 0.230 | 57.3 | 0.269 | -64.8 |
| 1900.00 | 0.455 | 143.2 | 1.567 | 43.7 | 0.246 | 56.4 | 0.258 | -68.7 |
| 2000.00 | 0.466 | 140.0 | 1.547 | 38.4 | 0.262 | 54.4 | 0.247 | -73.2 |

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

| Frequency MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-------|--------|--------|-------|-------|------|-------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 0.636 | -58.6 | 19.263 | 135.2 | 0.034 | 68.1 | 0.778 | -31.8 |
| 200.00 | 0.461 | -92.8 | 12.924 | 113.7 | 0.050 | 61.0 | 0.547 | -41.7 |
| 300.00 | 0.360 | -115.8 | 9.312 | 101.0 | 0.064 | 58.7 | 0.416 | -45.1 |
| 400.00 | 0.314 | -132.4 | 7.156 | 94.5 | 0.076 | 61.3 | 0.346 | -43.7 |
| 500.00 | 0.294 | -145.2 | 5.814 | 88.7 | 0.087 | 62.1 | 0.299 | -42.2 |
| 600.00 | 0.286 | -157.4 | 5.056 | 86.1 | 0.101 | 64.8 | 0.275 | -40.6 |
| 700.00 | 0.278 | -167.8 | 4.365 | 80.1 | 0.114 | 64.1 | 0.256 | -39.5 |
| 800.00 | 0.277 | -175.4 | 3.962 | 77.0 | 0.130 | 64.0 | 0.243 | -39.8 |
| 900.00 | 0.280 | 178.6 | 3.421 | 72.6 | 0.142 | 65.2 | 0.231 | -40.8 |
| 1000.00 | 0.293 | 173.1 | 3.271 | 69.6 | 0.157 | 63.4 | 0.216 | -42.5 |
| 1100.00 | 0.309 | 166.9 | 2.988 | 67.2 | 0.170 | 64.6 | 0.204 | -44.5 |
| 1200.00 | 0.314 | 159.8 | 2.788 | 63.4 | 0.184 | 62.7 | 0.188 | -46.7 |
| 1300.00 | 0.317 | 155.2 | 2.649 | 60.0 | 0.202 | 62.0 | 0.174 | -48.4 |
| 1400.00 | 0.319 | 152.1 | 2.406 | 57.1 | 0.209 | 60.5 | 0.159 | -50.4 |
| 1500.00 | 0.337 | 149.4 | 2.256 | 52.9 | 0.224 | 58.5 | 0.150 | -52.9 |
| 1600.00 | 0.353 | 146.6 | 2.121 | 52.6 | 0.233 | 60.1 | 0.140 | -56.5 |
| 1700.00 | 0.369 | 142.5 | 2.000 | 50.5 | 0.246 | 58.8 | 0.130 | -61.1 |
| 1800.00 | 0.385 | 139.2 | 1.978 | 48.6 | 0.265 | 59.3 | 0.115 | -68.5 |
| 1900.00 | 0.394 | 136.3 | 1.912 | 45.6 | 0.283 | 57.1 | 0.104 | -75.1 |
| 2000.00 | 0.408 | 133.8 | 1.880 | 40.6 | 0.300 | 54.5 | 0.096 | -83.3 |

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